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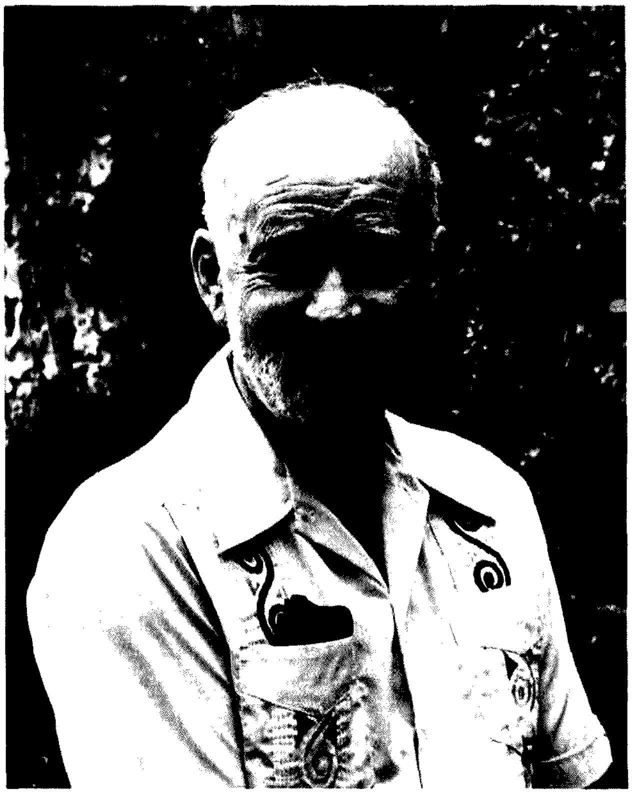
W2NSD/1
NEVER SAY DIE
editorial by Wayne Green

SAM HARRIS W1FZJ

On page 8 of the September issue of *73*, we printed a picture of Sam Harris and his wife Helen. Word arrived from his son, Pat, that Sam died in early November. VHFers will miss him.

For some reason, Sam and I clicked early on . . . I think it was around 1948 or so that we began to get into extended contacts on the low end of 75m. We both shared an interest in 75m DXing . . . in VHF . . . and in learning more about the anomalies of life. When I moved out to Cleveland and became W8NSD in 1951, I visited Sam and Helen at their farm just east of Cleveland. Sam was W8UKS at that time. We talked just about every evening on 75m.

Later, when I became the editor of *CQ* in 1955, Sam signed on as VHF editor and did a splendid job. During those days, I occasionally had a chance to drive or fly (I had a plane then) up to visit him in Medfield, just outside of Boston, and sack out on his living room couch.



Sam Harris W1FZJ.

Sam was one of those who said what he thought of people, pulling few punches. I remember a luncheon with the president of National Radio, where this chap asked Sam what he thought of their new receiver. Sam told him in no uncertain terms what he thought of their overpriced, unstable, easily overloaded bomb.

We get so used to kids wearing beards these days that we tend to forget that it wasn't long ago when a man with a beard was an unusual sight. Sam always had a beard . . . might have been born with one, for all I know. I asked him if the stares on the street ever bothered him, and he said they did sometimes . . . made him wonder if his fly was open.

Sam was not a difficult man to deal with or understand once you grasped that amateur radio came first, second, and perhaps even third in his life. Helen got used to it early on, and brought him his meals and coffee at his operating desk. This preoccupation with hamming manifested itself in a way that was helpful to many of us: He *had* to have the loudest signal in the world on a band before he would get active on it.

The antennas and towers which this conviction brought about have appeared in many magazine articles. I once ran an article by Sam on his "contest 100-Watt amplifier." I still pull out that article when I want to collapse a visiting ham with laughter. The final actually ran about 7,000 Watts, and consisted of separate finals for each of the low bands (which were built into Sam's garage). The article was a spoof of the 100-Watt listings in *QST* contest results, where many hams

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CONTESTS

HUNTING LIONS ON THE AIR CONTEST

Starts: 1200 GMT, January 13
Ends: 1200 GMT, January 14

The contest is sponsored by Lions International and coordinated by the Lions Club of Rio de Janeiro (Arpoador), Brazil. Participation is open to all licensed radio operators except members of the contest committee. The contest will be separated into two sections, phone and CW, with points counting separately and participation allowed in both modes. All bands 80 through 10 meters may be used, with each station being contacted no more than once per band and mode. When contacts are made between Lions and Leos, the name of the Lions Club or Leo Club contacted should be noted in the log. Confirmation of contacts will be made by log comparisons.

SCORING:

QSOs within the same continent count 1 point each; between different continents, 3 points. Bonus points: 1 extra point for a QSO with member of a Lions or Leo Club and 5 extra points for a QSO with a member of the Rio de Janeiro (Arpoador) Lions Club. Contacts between members of the Arpoador Club will not count any bonus points.

ENTRIES AND AWARDS:

Lions International will present first-, second-, and third-place awards in two categories—phone and CW. The first place winner in each category will receive a trophy, the second a medallion, and the third a plaque. The Lions Club of Rio de Janeiro will award additional vermillion award medallions to the fourth- through tenth-place winners. Each participant making more than 20 points will receive a special QSL from the Lions Club of Rio de Janeiro. Logs for each mode showing time and callsign should be sent to the contest committee no later than 30 days after the contest: Lions Club of Rio de Janeiro (Arpoador), Rua Souza Lima n. 310—Apt. 802, Rio de Janeiro 22.081, ZC-37 Brazil.

IAAH AIRLINE CONTEST

Starts: 1500 GMT Saturday, January 27
Ends: 1500 GMT Sunday, January 28

Sponsored by the International Association of Airline Hams (IAAH), this is their first annual contest open to all "airline hams" and non-members. Members of the IAAH may work both members and non-members, and vice versa. Certificates will be given to the top 3 scorers in each of the two categories (members and non-members). Multi-op counts as one station. General call is "CQ Air Contest," etc.

EXCHANGE:

Non-members, five: "non-member," consecutive serial number, signal report, state, province, or country.

Members, five (the same as for non-members), except: "member," IAAH roster number, 3-letter airport identifier (if applicable), flight number or aircraft number if station is "aeronautical mobile."

Please Note: Specific laws apply to hams operating their equipment from on board an aircraft. Please contact the IAAH for rules BEFORE doing this!

SCORING:

Score 4 points for "airport operations" such as W9XYZ/9 at O'Hare Airport; score 5 points for contact with an "aeronautical mobile"; all others score 1 point each. Then add the total number of points, including bonus points. Add the total number of multipliers (states, countries, and Canadian provinces) and multiply the total points by the total multiplier for the final score.

ENTRIES:

Submit all logs, separate logs for each band, to: Frank Sadilek WB9OUE, 3818 N. Newcastle Avenue, Chicago IL 60634. Deadline for submitted logs will be March 1.

SUGGESTED FREQUENCIES:

CW—3550, 7050, 14050, 21050, 28050, 50095.

SSB—3975, 7275, 14280, 21375, 28550, 50105.

Novice/Tech—3725, 7125, 21125, 28125.

FM—146.52 and/or 146.55 simplex; duplex through a repeater is permissible!

WORKED COLUMBIA AND GREENE COUNTIES AWARD

Offered by the Rip Van Winkle Amateur Radio Society of Columbia and Greene Counties, New York, the award is given for having two-way contacts by amateur radio with two stations in each of Columbia and Greene Counties, New York. Contacts may be on any band or mode, except that repeaters may not be used. Send log information and $1.00 to: Rip Van Winkle ARS, PO Box 1028, Hudson NY 12534.

FRENCH CONTEST

CW
Starts: 0000 GMT, January 27
Ends: 2400 GMT, January 28
Phone
Starts: 0000 GMT, February 24
Ends: 2400 GMT, February 25

All contacts must be made on 160 meter CW (or 1,826 MHz for F stations). All entries must be single operator.

EXCHANGE:

RS(T) and QSO number.

SCORING:

Score 3 points for each F or overseas French department or territory contacted in your own continent (10 points if in another continent). Multipliers are each F department (95) and DA1/2 STN/FFA (F forces in DL),

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CALENDAR

Jan 1*	**ARRL Straight Key Night**
Jan 6-7	**ARRL CD Party—Phone**
Jan 13	**Hunting Lions on the Air Contest**
Jan 13-14	**ARRL CD Party—CW**
	ARRL VHF Sweepstakes
Jan 27-28	**ARRL Simulated Emergency Test**
	French Contest—CW
	IAAH Airline Contest
Jan 28-29	**Classic Radio Exchange**
Feb 2-11	**ARRL Novice Roundup**
Feb 4 & 11	**10-10 Net Winter QSO Party**
Feb 10-11	**QCWA QSO Contest—CW**
Feb 17-19	**Two-Land QSO Party**
Feb 17-Mar 4	**University of Cape Town Festival Station**
Feb 24-25	**French Contest—Phone**
Mar 3-4	**ARRL DX Competition—Phone**
Mar 10-11	**QCWA QSO Contest—Phone**
Mar 17-18	**ARRL DX Competition—CW**
Apr 7-8	**ARRL Open CD Party—CW**
Apr 21-22	**ARRL Open CD Party—Phone**
	ARRL EME Contest
May 19-20	**ARRL EME Contest**
June 9-10	**ARRL VHF QSO Party**
June 23-24	**ARRL Field Day**

***described in last issue**

LETTERS

DRAWBACK?

Your latest issue is the best yet, and one of the fattest I've ever seen. You're approaching Japanese *CQ ham radio* girth. The only drawback was your taking on the Chrysler Corp. I don't think ham radio needs any more powerful opponents and I for one wish you'd keep your printed opinions in the ham radio arena. There are certainly enough electronic foibles to aim your barbs at, aren't there? If you're running short, let me suggest DX list operations, blatant business phone patches, the FCC considering overseas religious missions to be business, and the FCC's inability to run a computer rather than be run by it.

David L. Bell W6AQ
Hollywood CA

PERISH THE THOUGHT!

After reading your editorial in the September issue of *73*, I just had to let you know how strongly I agree with what you say about the ITU and WARC and the effect the deliberations of WARC may have on the future of amateur radio as we know it today.

The reason I can so readily agree with you is that I am familiar with the operations of the ITU and its associate agencies. My first participation was while I was a member of a Canadian R & D organization then up to my retirement in 1973 as a consultant with the Canadian Department of Communications (DOC). I think that many amateurs are not fully aware of what the ITU really is and what it does. The ITU, a specialized agency of the United Nations, has, among other activities, two very important consultative committees. One of these is the CCITT, the International Consultative Committee for Telephones and Telegraph. The other is the CCIR, the International Consultative Committee for Radio. It is my feeling that it was in the CCIR that we amateurs should have had most interest and this should have extended back for many years. As you indicated in your editorial, this committee deals in all areas of radio telecommunications. These areas are divided into about a dozen study groups, such as for marine radio, radio astronomy, television, radio satellites, and, of course, radio telecommunications in all frequencies from the lowest to the GHz and up. It is also probably not known to many amateurs that the only recognized participants in these study groups are the official government representatives of the member United Nations countries. Each of these administrations may include in their delegation certain specialists by personally inviting them and also informing Geneva. It is easy to understand that in the aggregate these specialists probably include the world's most knowledgeable people in all areas of telecommunications. Unfortunately, only a very few of these are amateurs, although none was selected for this reason. There is no study group dealing in amateur radio.

In addition to the international study group meetings, most administrations held national meetings paralleling these SGs. These national meetings would be held in the interval between the international meetings to prepare the administrations for the next Geneva meeting. The discussions in the national meetings were highly technical. The participants came from all national fields and represented many manufacturers, telecommunication companies, the television industry, many users such as public utilities, police, and others. Only a few of these people would be part of the international delegation.

Unfortunately, so far as I was aware, there was little or no participation in these national meetings although the DOC had indicated that such participation was acceptable.

Participation for WARC does include a number of national meetings, but we must be aware that these are not technical meetings. The technical meetings of the CCIR provided the CCIR recommendations as contained in the Green books, which would of course lend weight to the WARC in its decisions. It can be seen that the work of WARC will not be supported by the many specialists that we saw in the CCIR, but rather by a relatively few people that are directly concerned with the national policy. It is quite possible that many delegations will have no amateurs, and this a definite certainty in the delegates in those countries that do not now have any amateurs. It is also the case that some administrations that do permit amateur activity in their countries are somewhat indifferent as to amateur survival.

What I may not have brought out here is a fact that some amateurs are not fully aware of, and that is that all of the meetings of the ITU and its associated agencies are closed meetings. There is one and only one voice at these meetings, and that is of the official administrative voice of the United Nations current member countries.

It is difficult for me to understand how an almost "no face," an organization that has not actively participated in and identified itself in the technical area (the CCIR), can hope to justify its existence at a WARC meeting where it has no voice and where a number, too many, of the administrations either do not have or do not want amateurs. Not only that, but many administrations that are otherwise in favor of amateurs would have no scruples in subordinating this if it interfered with other national more pressing needs.

Probably I agree so fully with you because, like you, I have attended these meetings and thus could sense the direction in which they seemed to lead. I hope that we are both mistaken and that we will be able to enjoy amateur radio as we now know it for many more years. I would hate to have to go underground. Perish the thought!

As insurance against total insanity if we do lose out, I have infected myself with a counterinsanity. I am becoming active in the microcomputer field, having obtained a TRS-80. With the help of *Kilobaud*, I trust this new insanity will make me impervious to any bad news from WARC.

My best 73s and may your cassettes never become demagnetized so you will always be able to CLOAD!

H.F. Hannay VE7WO
Nanaimo BC
Canada

BLESSING IN DISGUISE

It looks like your brain is finally starting to soften up, Wayne. "Never Say Die" in the October, 1978, issue sounded like you've been experimenting with drugs more than radio. Docket 20777 would have been the best thing for amateur radio since **SSB**. Not perfect, maybe, but a lot better than what we have now. CW is okay, but to devote over half our HF spectrum to it is nonsense. Why doesn't someone look at amateur radio as it really is, not as it once was or as they wish it would be.

If amateur radio is gutted by the ITU next year, it will be a blessing in disguise. The deregulation you (and I) want will be an overnight fact. Once the challenge of "illegal" operation is overcome, things like bandwidth, subbands, bandedge, mode, power, and class of license all fade into insignificance. It will be almost as much fun as Peterborough to New York in 2½ hours! QRP, indoor antennas, and inexpensive fun operating CW would be reborn, TVI and tower problems would be eliminated, and licensing hassles would be forgotten.

Banning amateur radio would be the best thing that ever happened to it. No one outside amateur radio cares about it one way or the other. The only outside interest we get is bad (towers and TVI). If we went underground, the towers and TVI would disappear. We would have more operating freedom than we've ever had. As long as our operations did not interfere with "outsiders" and thus generate complaints, the FCC would remain sound asleep, as they have been for decades. What happens if they wake up, you ask? That would take millions of dollars, money they don't have and aren't likely to get.

Besides that, amateur radio is big business, and if for no other reason, we won't lose a single kHz of HF spectrum at the ITU meeting. We might even gain a little. Satellite communication, and the VHF/UHF frequencies required for it, is where we are going to lose our shorts.

Robert Seeber
Littleton CO

P.S. One of these days you are going to wish you had your 240Z back. However, I wouldn't trade my 1974 B200 Dodge van for anything.

STIRRED BLOOD

Congratulations on your finest editorial yet, Wayne, in the October issue of *73*.

Please bear with me, and I'll give you one more example of the stupidity of some of their hard and fast rules at the FCC.

In August, 1921, I took a written test and written code test from a Mr. Paul Ord, then assis-

tant radio inspector out of San Francisco. It was in Stockton CA, and I was a 12-year-old kid running errands for the men who built and operated KWG, and they believed it was to be the first commercial broadcasting station. I operated my own 1 kW rotary spark-gap transmitter and homemade receiver. My best DX was from near Stockton CA, to Bozeman MT. I had many friends ten years or so my senior, and they were always ready to answer my many questions.

My principal at the high school expelled me in my junior year because I was a bad boy for not studying my history, English, etc., and I was the least likely boy to succeed in this world!

I went to San Diego and joined the Navy. I taught radio classes and theory at the school for about one year and then went aboard the *USS Idaho* for the rest of my enlistment of four years. Aboard the *Idaho* less than one hour, the communications officer, Ensign Charles F. Horn, called me to his office. Could I make a new crystal-controlled oscillator, a 211 50-Watt tube followed by another 211 amplifier, work? Earlier, one of my seniors had explained how to "neutralize" an amplifier to prevent self-oscillation. It worked! The *USS Idaho* had the first rig that would work. The Bureau of Ships diagram had not included a system to neutralize the final! Ensign Charles Horn received all the credit, but he put me in charge of all radio maintenance, and I bought a folding cot and lived in the material repair shop.

From the US Navy, I went to work at KFSD broadcast station in San Diego, and my lifetime was devoted to the broadcast business—KFI, KTTV, KEYT-TV, KTTV, etc.

In 1925, I took my Commercial First Class test in San Francisco and was given a test covering arc and spark. No problem. So I still have my Commercial First Class Telegraph and Telephone licenses.

In 1934, I experimented with a copper toilet bowl float and stumbled upon what may have been the first cavity system. Professors at Cal Tech, Pasadena CA, at least thought so. I built one for a young student which was at about 300 MHz, with the antenna at the focal point of a 4-foot parabola which was made in the Cal Tech shops. A small "perch" was attached to the parabola at the focal point about one foot beyond the radiator and was used to study the effects of rf upon insects. As a result, the student obtained his master's degree.

Then came WWII and I was the first person to be interviewed on the west coast by Dr. Louis Redenour (a close friend of the young student at Cal Tech), who was recruiting research people to go to MIT and design radar systems. I professed to know nothing about radar. I was politely informed that he knew all about my past history, and that I was to prepare to leave for MIT the following day, *or else!*

At MIT, I soon learned that the country's leading physicists were really smart, but most did not know how to work with their hands.

I developed gun-pointing systems. They included the system for the black widow night fighter. Upon intercept of a "bogey," the pilot would throw the switch to automatic, sit back, and relax while the plane flew via radar-controlled autopilot to an intercept at about 1200 yards. The guns would automatically fire and the plane would start to follow the enemy toward the earth, at which point the pilot would throw the switch back to manual and fly away. I also developed the AN/APG-15 gun-pointing system for the tail gunner in B-29s. I outfitted five B-29s at Bedford Airport and took them to India with full crews and turned them over to Gen. Curtis Lemay. The first, second, and third nights out over Japan, one Jap fighter was shot down each night. The fourth day, they switched to kamikaze head-on attacks. (In the meantime, a contract had been let to built 10,000 AN-APG-15 systems! But we did not need them then!)

After the war, I went back into broadcasting. I designed and built the triband gamma match feed system for beams. Mr. Andy Andros called long distance after reading a small report in *QST* and wanted to know what I was going to do with the idea. I said "nothing" and that if he was interested, I would give him a written release. I did, and hence the "Hy-Gain Corp." Andy retired with ulcers; I'm fat and sassy.

I developed many other items such as antenna-measuring devices, a "better" noise bridge generator (*73*), etc.

So, to the point of my writing. About four years ago, after working full time to make a living, I decided to go to San Francisco and get my Extra Class license. I failed! I found that the years had caught up with me; I could not remember rules or sufficient math to answer the damned tricky Philly-lawyer's questions. My wife gently informed me she was well aware that my mind was not what it used to be! I walked out of the examiner's office in San Francisco in tears. I went to the parking lot and sat in the car for an hour before starting home. What a *terrible shock!*

At a Las Vegas convention about three years ago, I spoke to Johnny Johnson about my plight. No sympathy. I informed him that I was damned fed up with such bureaucracy, and that I would henceforth operate in any portion of the ham bands I chose, and that I would see the FCC in a Federal Court if any action was taken against me. And I have operated to some extent when I hear a long-lost friend.

I'm an old devotee of Col. Claire Foster 6HM, and I have hated the ARRL gang ever since. Yes, I subscribed to *QST* for one year, and that will expire within a month or so. No more!

Soooo, your editorial in *73*, October, 1978, stirred my blood, and I hope you can do some good. I've taken *73* steady since you first started.

My best wishes to you, and continued strength to fight.

Lloyd M. Jones W6DOB
Salinas CA

Thanks for taking the time to write, Lloyd. I enjoyed your letter.

Frankly, I don't blame Johnny for ignoring you. You can't fool me. That soft-in-the-head bit doesn't wash. You have no problem with remembering anything; you just don't want to bother boning up for that damned Extra Class exam. I don't blame you on that one. It will be a well-frozen-over hell before they get me down for that one.

But the fact remains that if you want to pass the Extra exam, you can. I'm willing to bet that you didn't do your homework on this one. Did you get my Extra Class book and read it? Of course you didn't.

It's a pity that someone doesn't do some research and do a good article on Col. Foster. Newer hams should know about him and his battles with the League. As I recall, he didn't really get mad at 'em until after Maxim had kicked the bucket. I suspect they were a lot better under Maxim. I've enjoyed all of the Maxim books and suspect that he and I would have been friends if I had come along 20 years sooner . . . or if he had lasted longer. I've also read a lot of Foster's editorials and they were right on the mark.

Keep it flying, Lloyd.—Wayne.

WHAT SAY, NSD?

I enjoy most of your editorial comments, in particular those regarding the ARRL. The remarks are, for the most part, exactly my sentiments, even though I am a life member of the League.

It seems to me, though, that you are overlooking one of the most important parts of the best argument for having such an organization. That is the fact that, even though many of us do not like it, they, through a very powerful membership, do represent amateur radio in making the laws and regulatory features of our licensing bureau, the FCC.

If a move were to increase the membership of this so-called organization to a greater level, including all of the amateurs who feel that the League is an outmoded, poorly operated, antiquated-in-thinking organization, perhaps a majority could overthrow the present continuity of the ruling hierarchy within the League.

Oh yes, there will be many who say, "What good is a vote; they have it all tied up." Yep, that's right, but no one has tried to change it to my knowledge, just abide with it, and continue to gripe or bury their heads in the sand and accept what is recommended.

A great deal of good things have come the way of amateur radio by the gripe system. A lot of amateurs who do the griping started out as Novices and wouldn't have a license at all if it were not for the League, so they have some good things to show in the past.

It takes a good organizer to control a giant, but it can be done and the control should be from the support team. Radio amateurs, why not put your editorial efforts into reorganization. Wayne, you seem to be able to say what should be done.

I for one will give you my support monetarily and though further agitation for this type of idea. What say, Never Say Die?

Peter S. Meacham
Waltham MA

FIELD MARSHAL THURSTON

I have recently re-subscribed to *73* because I find your editorials very thought-provoking and usually pretty much to the point. I normally do not respond in writing to editorials, but I felt compelled to do so when I read about Mary Lewis W7QGP.

I have been a supporter of Mary for about four years. During this time I have gained a lot of respect for her leadership qualities in administering the amateur radio affairs of the state of Washington; for this

Continued on page 82

CARF

Canadian Amateur Radio Federation, Inc.

CALGARY HOSTS SECOND ANNUAL NATIONAL SYMPOSIUM

The second National Amateur Radio Symposium, convened by the Canadian Amateur Radio Federation, Inc., wound up its two-day session in Calgary on October 1.

The conference, hosted by the Calgary Amateur Radio Association under the auspices of the Amateur Radio League of Alberta, made several important recommendations to the senior officials of the DOC who attended, concerning the future of amateur radio in Canada.

The more than 80 participants included amateurs representing major organizations and individual operators from all call districts except VO1, VO2, and VY1.

After a pleasant Friday evening cocktail party, the four workshops got down to business for a full-day session on Saturday, followed by a banquet, and a Sunday half-day general assembly.

The workshop on Digital and Computer Communications examined the new no-code Digital Radio Operator's Certificate in detail. John da Silva, the DOC headquarters consultant, gave the group an overview of data communication concepts. Technical discussions followed on their applicability to amateur use and the need to establish interim standards and specifications for amateur "packet radio." Asynchronous FSK was recommended for initial use for 1200 baud or below, with synchronous PSK or other techniques for higher speeds. Format recommended was ASCII with packet length of 150 characters with amateur callsigns for identification.

The working group made a number of other technical recommendations and has asked CARF to form a committee to devise protocol details.

Packet radio should be introduced slowly and deliberately, much the same as was single sideband, the group reported. The cost to amateurs should be minimal, and CARF will publish availability of surplus equipment. To get into packet radio should cost only about $150, according to the group's moderator, Croft Taylor VE3OR.

Probably of more importance to most amateurs was the work of the group on WARC '79 who heard at first hand from Ed Ducharme, head of the DOC WARC '79 planning, the status of Canadian plans as they affect amateurs. Adjustments to the Canadian position are still in progress with the objective of completing a position which will, in the view of the federal government, best meet the unique needs of Canadian radio users.

The DOC did not pursue the idea of a new band around 18 MHz because of what was termed "a lack of support from the amateurs," but is still proposing 10.1-10.3 MHz as a new band. Amateurs were advised that although the new frequency allocations may be decided upon in late 1979, it would be 1981 or 1982 before implementation of the changes would be effectively underway. The working group strongly urged the DOC to reconsider the lopping off of 200 kHz from 75 meters (3800-4000 kHz), although it would propose exclusive use for the remaining 3500 to 3800 segment.

The group was told that little world sympathy could be expected for any expansion of the present 40 meter band, but a proposal to reduce it to 6.9-7.1 MHz exclusive for amateur use could be a significant gain.

The exclusive slot for "packet radio" from 221-223 MHz came under fire and in both the working group and the general assembly, which heard and discussed all of the working group results, there was a unanimous reaction voiced to the DOC to let amateurs undertake their own band planning.

The DOC noted that it would consider providing space for ATV in other parts of the 420-450 MHz band other than those now authorized, because it proposes to reduce the band to 430 to 450 MHz.

The discussion in the WARC group covered a number of other frequency problems, details of which will be found in the symposium official report.

While WARC '79 will have a delayed impact on amateur operations, the recommendations of the workshop on regulations would have a more immediate effect, if adopted. It recommended elimination of the logkeeping requirement for mobile stations. The abolition of the FCC reciprocal permits for operating while in the U.S. is now being undertaken by the DOC. Special callsigns, the group concluded, should be eliminated, and the DOC headquarters will survey the regional offices to see if this step should be taken.

Clarification of the wording of the recent DOC notice concerning the new "digital" certificate and the frequency schedules was requested, especially with regard to operation in the 220-225 MHz band.

The DOC stated that all amateurs may work in that band now as before, using the modes noted in the frequency schedules (most modes, with a slot exclusive for packet radio message formats).

Recommendations to bring regulations up to date were made, such as the abolition of the requirement for frequency- and modulation-measuring devices.

In reply to a workshop query, the DOC said that the procedure in an interference complaint when the amateur set was "clean," and all efforts on the part of the amateur to cooperate with the complainant have been rebuffed, is for the DOC to write to the complainant stating that it will take no further action.

The perennial problem of local government legislating on tower matters was discussed and the DOC noted that such authorities cannot prohibit the erection of duly-licensed radio station towers as it is an area of federal control. They can, however, impose structural and safety requirements. Amateurs who sign private agreements or leases with restrictions on towers or antennas have no recourse to the DOC.

The conclusions reached in the workshop considering "certificates and examinations" did not meet with the unanimous support accorded other workshop recommendations in the general assembly.

The novice certificate was turned down by the group and the assembly. The group recommended a 5 wpm code test for persons over 55. The majority of the general assembly did not accept the idea. A proposal to extend the principle of the present 10 meter phone endorsement to 160 meters in order to encourage activity on that band met a majority approval.

A recommendation was made that the DOC be relieved of the task of code examinations, which would be delegated to amateurs approved by the DOC. It was also recommended that amateur exams be held once a month instead of four times a year as is now in force. Both ideas met with the approval of the Sunday general assembly.

In view of the flexible policy of the DOC in examining handicapped persons (for which the group commended the Department), it was felt that no waiver of examinations for the handicapped was necessary.

A move to restrict VHF phone privileges for new amateurs met with a mixed reaction from the general assembly, with about half for and half against the idea, which reflected the working group's tie "vote" in the matter.

In the general assembly, ideas were expressed that the present advanced exam be "upgraded" to reflect the state of the art, with more about VHF, UHF, and FM techniques.

Suggestions were advanced to issue the present station licenses and certificates in a card form in order to make them more practical to carry when operating mobile or portable.

A member of the general assembly noted that a "no-code" digital operator could use A1 according to schedule and suggested that Morse code for a "no-code" certificate was redundant. It was explained, however, that in this day and age, with modern technology, Morse could be sent by machine and received by machine.

Moderator for the symposium was Bill Wilson VE3NR, president of CARF. Moderators were Croft Taylor VE3OR for the Digital Workshop, Hugh Dollard VE7PB for Frequency Allocations, Art Davis VE6KT for Regulations, and Percy Crosthwaite VE5RP for Certificates and Exams. The senior DOC Regulatory Service Officer from headquarters in Ottawa was W. W. (Scotty) Scott. The DOC representatives from headquarters were Ed Ducharme, International Planning, John da Silva, DOC Systems Engineering Consultant, Vic Decloux, and Peter Fitzgerald. Regional and district offices were represented by Murray Watson, Bob Poirier, Jim Essex, Irwin Williams, Wes Garvin, and Larry Reid. Dr. Jack Belrose VE2CV represented the Federal Communications Research Center.

The meeting learned with regret that Dr. John deMercado, Director-General of the DOC Telecommunications Regulatory Service, who has been instrumental in originating these symposiums, was unable to attend due to a last-minute change in plans.

The CARF executive and those who attended are indebted to the Calgary Amateur Radio Association and the Symposium Committee members (VE6EX, VE6GQ, VE6MX, VE6AMU, VE6SA, and VE6CJC) for the interesting and productive meeting. Thanks, too, to the City of Calgary, the Prov-

Continued on page 167

RTTY Loop

Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

With the cold of the Winter of '79 upon us, and all huddled around the pot-bellied stove in the shack (would you believe an IC heat sink?), my thoughts turn to aligning and peaking the equipment up for best performance. I try not to do all that by hand; it's rough on the manicure. What we will look at this month is the test equipment that helps keep a RTTY station on the air.

Let's start with the non-specialized, rf-type gear, and then work back to the TTY stuff. I hope you have a good swr meter in the line, or at least can ensure that the swr of your antenna remains reasonably flat. Notice that I say "remains." While that super quad might have been 1:1 when you put it up two years ago, one maniacal sparrow can destroy all your careful pruning. There is nothing a modern transmitter dreads more than spending a long key-down period, i.e., a RTTY transmission, fighting a high swr. Definitely not conducive to long final life! Along the same lines, your transmitter should have the facility to readily measure plate current, and some means to taper it down if it helps the output stage. Changing from 175 W to 100 W produces less than a 3 dB change in signal strength, but is much easier on the tubes.

Moving now to the RTTY side of the shack, I feel that the minimum station test gear should consist of only two items: an inexpensive multimeter and a ROTM/GV (run-of-the-mill/garden-variety) oscilloscope. The multimeter, usually referred to as a VOM, for Volts/Ohms/Milliamps, is extremely useful wherever static diagnostics are needed. This means, for example, in setting up the TTY loop to 60 mA, measuring the plate voltage or Vcc of a supply, or analyzing the terminations of an unknown piece of equipment, using the Ohms function. With the use of this rather cheap piece of gear, under $20 from Radio Shack and others, you can perform most of the diagnostics needed to keep a RTTY station up and on the air.

Where the VOM will let you down is when you have to measure some ac or audio component, or where you have to troubleshoot some digital logic. That's where the scope shines! Over the last few months we have seen many ways in which the plain ROTM/GV scope can be useful. Audio filters can be aligned and tones calibrated using Lissajous figures and a known standard, without need for a frequency counter. A scope tied onto the output of the mark and space filters of your demodulator makes a cheap and accurate tuning indicator. Again, I am not talking about an expensive instrument. Old Eicos or Heathkits that are sold at hamfests for ten or fifteen dollars are more than adequate.

There comes a time, however, when even this veritable wealth of test equipment fails you! There are many specialized RTTY items that you can spend your money on. Let's look at one and see if we can put one together. When setting up a new piece of equipment, it is useful to provide a test signal that can check out all bits of the Baudot code. You may recall that the letters *R* (01010 in binary) and *Y* (10101 in binary) will do just the trick if sent alternately (RYRYRYRYRY . . .). There are several ways to generate this signal. If one is a reasonably fast typist, and one half of a pair of twins, one can type the RYs on the keyboard while making the requisite adjustments. Unfortunately, most of us are not so blessed. A standard way to generate the RYs is by use of a short tape loop, running on the station's TD. With chadless tape, the tape may simply be overlapped, and the punched holes will interlock into a continuous tape. Punched-through tape must be glued together, but the result is the same—a continuous stream of RYs emanating forth.

With the advent of digital electronics, one feels that there must be a better way, and there is. Let's look in detail at the signal produced by an RY tape. Fig. 1 will help Illustrate. First we'll send an R, including its start and stop bits, then the Y, with its delineators. Now string them all together and what have you got? Except for that stretched STOP pulse, it sure looks like a square wave, doesn't it? Don't you wonder if sending a square wave with 22 ms pulses would produce a string of RYs? Well, it will! Now, don't get me wrong, this is *not* the best way to generate an RY test signal, and it might not *always* work, *and* I absolutely would *not* send it out over the air, but, for around the shack, it can be helpful.

A rather simple circuit, shown in Fig. 2, can be designed around the 555 timer chip to generate the signal. The frequency is about 45 Hz (remember the 45.5 baud?) and, with the components shown, the duty cycle will be almost 50%. This means that mark and space will be about equal in length. The output of this circuit is TTL level, and how you use it is up to you. It can be

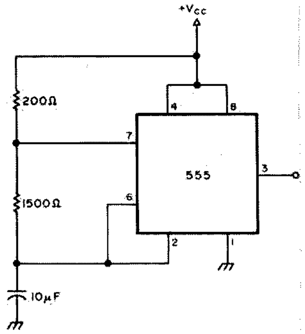

Fig. 2. 45-Hz generator.

used to drive an AFSK generator or through an optoisolator be inserted into your loop. Users of the ST-6 may be interested in the circuit of Fig. 3. This converter has a point which, when grounded, opens the loop, and the voltages are compatible with direct IC con-

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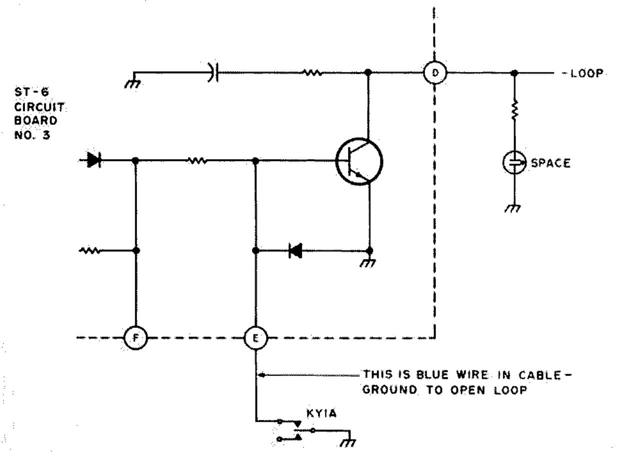


Fig. 3. ST-6 connection.

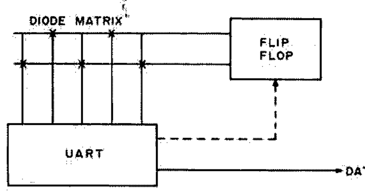


Fig. 4. Block diagram of "RY" generator.

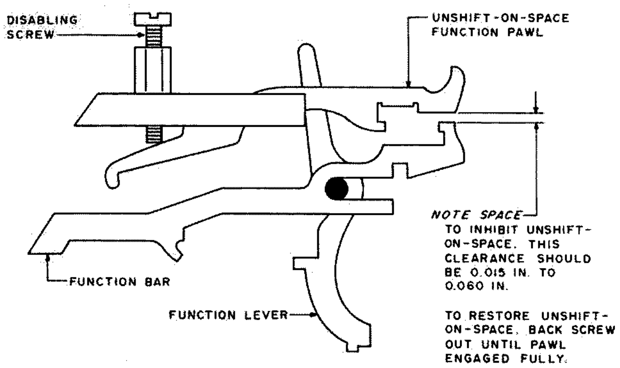


Fig. 5. Unshift-on-space for Model 28ASR.

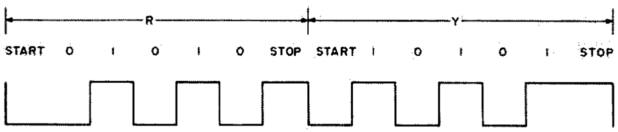


Fig. 1.

New Products

THE NEW YAESU FT-227RA

If your two meter FM operation is largely mobile, you probably prefer a crystal rig which you can tune from channel to channel without taking your eyes off the road. Of course, you have to have a pretty good memory, better than mine, to remember what repeater is on what channel.

About a year ago, Yaesu introduced the FT-227 "Memorizer" which allowed you to select a channel and automatically return to it when desired.

Those folks at Yaesu know how to gild a lily, for they now have announced their FT-227RA. It is quite similar in appearance to the earlier model, which, by the way, is not being discontinued at this time, as it sells for less money. The "deluxe" version provides an expanded memory capability as well as is able to scan the entire band up or down as you choose. This dandy idea is accomplished by pressing the UP or DOWN button on the microphone. The scanner will search for a busy or clear channel, as desired, or will scan indefinitely until halted by a press of the PTT switch on the microphone. Because of the various functions performed by the microphone, it is a specially-designed unit and has a 6-pin connecting plug (supplied).

There are four memory positions in the FT-227RA. Three are for simplex frequencies, designated M1, M2, and M3, and one is for a repeater frequency, M4. By punching in your pet frequencies before you head for the freeway, you need not even bend over to read the transceiver while driving, as it is now accomplished by the microphone buttons.

This makes it one of the safest of mobile radios. When you press the UP button on the mike, it will cause a shift of 10 kHz upwards, or vice versa, if you press the DOWN button. Holding the button down will cause the unit to continue scanning in either direction as just described.

If you place the scanning switch in the BUSY position, it will cause the scan to be halted whenever the squelch is tripped by a signal on the frequency being scanned. Placing the switch in the CLEAR position will cause the scan to be halted when the receiver is muted (no signal present). When the optional tone squelch is used, the scan will be halted according to the condition of the main squelch, not the tone squelch.

One may creep up or down the entire two meter band by 10-kHz steps simply by pressing the UP or DOWN button on the mike. Or, if you hold either button down, the scanning steps are automatic.

Frequency readout is by means of bright red LEDs which are easily seen in an automobile even on a bright sunny day.

Your pet repeater can be stored in the memory prior to use of the transceiver by storing the repeater uplink (input) frequency in channel M4, and then rotating the dial to the repeater downlink frequency. With the MR switch off, you will now be transmitting on the memorized frequency, but receiving on the dial frequency. Storing repeater or simplex frequencies does not entail getting into the "innards" of the unit. It is simply a matter of dialing up what you want and pressing the memory button. Of course, this must be done, if you so choose to operate this way, each time the set is turned on, as the memory storage is not permanent.

The FT-227RA looks very much like the FT-227, with the exception of some added switches and buttons for the memory functions. You also have the usual 600-kHz up or down switch for normal repeater operation. A switch on the bottom of the unit allows you to operate with either of two power outputs, your choice of one Watt or ten Watts.

Tone squelch is offered as an optional accessory; it is a simple two-minute installation which can be made by anyone. With very few fellows and gals needing this feature, at least as the case is in California, it does shave the cost for the customer in a highly competitive market. Of course the FT-227RA has all the usual goodies we've come to expect in FM units, adjustable squelch control and an "S" meter that serves for the received as well as transmitted signal. The FT-227RA retains all of the niceties of the FT-227 while adding all those "Gee, I wish they'd have done this" items which you hear hams talk about after looking at a new piece of gear.

A mounting bracket is supplied for mobile use, as well as one to be used if you operate the equipment as a base station. The base station bracket slips under the transceiver to elevate the front of the unit. Power required is 13.8 V dc plus or minus ten percent. It will operate as a base station with the usual 12 V dc 3 Amp regulated power supply.

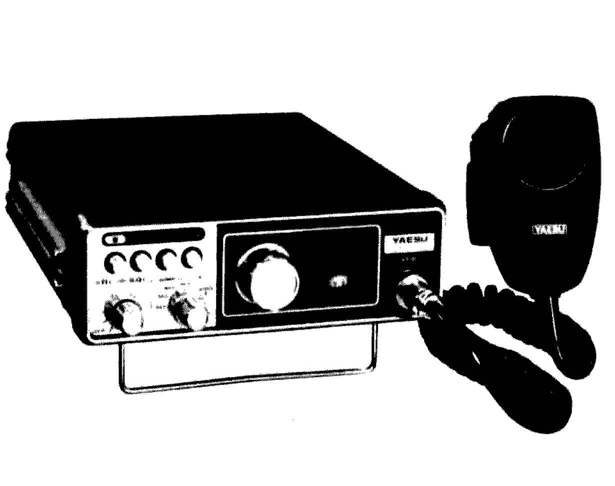
Operating the equipment is a pleasure, and once you have the knack of it, it is about as safe a piece of transmitting gear as you can have in your car, as it does so many things which would otherwise require you to take your eyes off the road to accomplish. Say, come to think of it, why didn't Yaesu design this rig so that it would audibly tell you what frequency it was on? Then we wouldn't have to look at it at all.

As a final comment, Yaesu has announced that the FT-227RA may have four repeater memory channels if you desire. A conversion kit is now available and the mod is simple to do! *Yaesu Electronics Corp., 15954 Downey Ave., Paramount CA 90723, (213)-633-4007.* Reader Service number Y1.

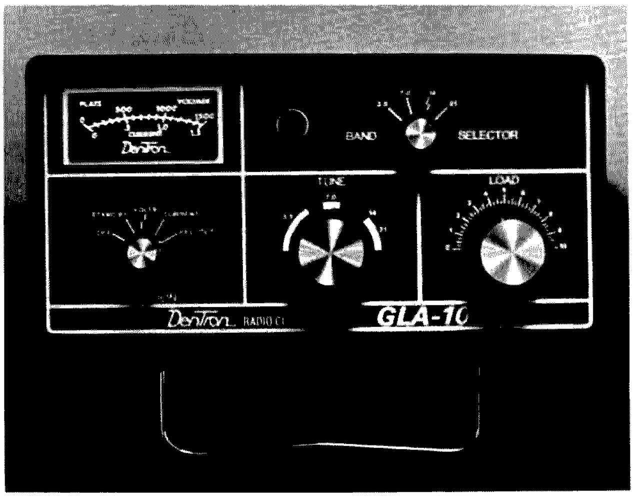
Glenn Malme W6OJF
Downey CA

NEW AMATEUR LINEAR AMPLIFIER FROM DENTRON

DenTron Radio Company is proud to announce a revolutionary new linear amplifier for the amateur frequencies, the new GLA-1000. Powered by four D-50A (6LQ6) final amplifier tubes, the GLA-1000 is rated at 1200 Watts PEP SSB and 1000 Watts CW input with features like a reverse scale black-out multimeter for monitoring of critical currents and voltages, complete compatibility with any exciter or transceiver, front panel bypass, transmit indicator light, and a built-in relative power monitor for easy tune-ups. The GLA-1000 is super compact, ideal for portable or fixed operation, shipped set up for 117 V ac mains, and has 80 to 15 meter frequency coverage (covers most MARS frequencies just outside the amateur bands). FCC type acceptance has been granted. The GLA-1000 is now available at DenTron dealerships worldwide. *DenTron Radio Company, 2100 Enter-*



Yaesu's FT-227RA.



The GLA-1000 linear amplifier from DenTron.

prise Parkway, Twinsburg OH 44087. Reader Service number D15.

THE AED ELECTRONICS FT-227R SCANNER

I recently acquired an FT-227R 2 meter rig. While this is an excellent rig on its own merits, one of the major factors influencing me was the availability of a good, inexpensive scanner for it.

Within days of getting the rig, I got a scanner in kit form, and installed it in the rig. It worked very well—exactly as advertised. For my $34.95 (plus $1.50 for postage), I got a mailing pouch well-packed with goodies. There are some 35 components in all, including 2 ICs and a glass epoxy circuit board. Right off, I was favorably impressed by the double-sided board with silk-screened component locations. This impression was confirmed by the high quality parts and the inclusion of sockets for the ICs.

Assembly took me about three and a half hours. This may be the all-time slowest record for doing the job, but when I work inside a brand new half kilobuck (in Canada) radio, I work verrrrry carefully!

The kit went together very easily, with no hassles. For a change, all of the parts fit where they were supposed to and the holes were drilled out to the right size. Other kit builders would be well advised to use a micropoint iron, as there are a lot of components packed into a small space. The circuit board measures about ½ inch by some four inches in length, so there's not a lot of room for error.

From the scanner board there are 11 wires going to various parts of the radio. The instructions are very clear, and there is no danger of putting the V+ to ground. The instructions themselves are much in the Heath tradition, well done and very clear. The only difference I noticed was that resistors are referred to by their values instead of by color. It's nice to know that someone still has confidence in us hams.

The scanner fits right inside the radio, along the side rail of the chassis as seen from the front. The only sign that the radio has been modified is the small toggle switch sticking out of the mike.

You could restore the unit to absolutely stock condition for the price of a new mike case. Instructions on how to modify the mike are included with the kit, along with the switch. For those who use the Drake TT mike, instructions are included for it as well. A nice touch, I thought, especially since I had one and used it with the 227R.

The kit comes with a complete schematic and board layout, so in the unlikely event that something goes wrong, a look at the circuit and a study of the theory of operation will make it easy to fix.

How does it work? Very well. It is, in fact, more of a sampler than a scanner as we usually know it. When you flip the switch on the mike to scan, it scans the band in 10-kHz steps until it locks onto a signal. It will then pause there for 3 seconds before it resumes scanning. This means that you can eavesdrop all over the band without lifting a finger. When you hear something interesting, you just flip the switch to the operate mode and the rig is ready to transmit.

This feature means that those repeaters which stay on the air using a tone to indicate that the timer has recycled won't cause your scanner to lock up on them. Both the frequency range and the delay are programmed by the user. You can cover the whole band or any portion of it in 1-MHz increments. Mine is set to cover from 146 to 148 MHz, as there is almost no activity below 146 here.

The scanner operates in conjunction with the digital readout of the 227R, so you always know where you are. If you disconnect the antenna, it takes about 8 seconds to go from 146 to 148 MHz. Once it hits the high limit, it starts back down again. The 227R has a very sensitive squelch circuit, so it locks up on any signal which is audible. Since the device uses CMOS circuits, it draws negligible current from the radio.

Frankly, AED Electronics makes a fine product. I have one of their scanners for the IC-22S in the car, and have been very satisfied with it. The new one for the 227R, with its digital readout, is even better. Locally, this rig has taken the market by storm, and almost everybody has a scanner as well. I've heard no complaints at all. My only concern is that AED Electronics can't be getting very rich selling so much product for this price. *AED Electronics Ltd., 750 Lucerne Road, Suite 120, Montreal, Quebec, Canada H3R 2H6.* Reader Service number A60.

Robert T. Rouleau VE2PY
Town of Mt. Royal
Quebec, Canada

Reprinted from the Canadian Amateur, *October, 1978.*

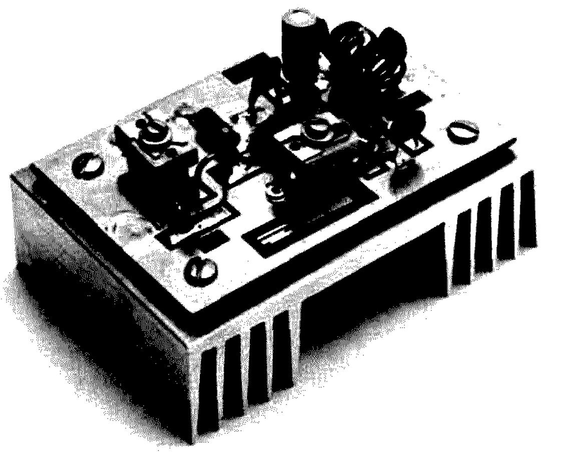
RF POWER LABS INTRODUCES MODEL V350 AMPLIFIER

RF Power Labs, Inc., is proud to announce the release of their newest amplifier, Model V350. It is a ¾-kilowatt dc-input all-mode VHF amplifier designed for base station and repeater use.

The V350 amplifier is designed for the radio amateur, but can be used on special orders over 5 MHz bandwidth, from 135 to 170 MHz. It is capable of producing more than 350 Watts of rf output power into 50 Ohms when driven with 10 to 15 Watts. The amplifier weighs only 52 pounds, including the built-in ac power supply.

For continuous duty operation, the F135 (115 V ac) or F235 (230 V ac) fan kit should be used.

For more information, contact *RF Power Labs, Inc., 11013-118th Place N.E., Kirkland WA 98033, (206)-822-1251.* Reader Service number R27.



Two meter amplifier kit from SST.

SST A-1 2 METER AMPLIFIER KIT

SST Electronics has added a 2 meter amplifier kit to their line of amateur radio equipment. The SST A-1 amplifier kit provides 15 Watts of output with 1 Watt in.

The SST A-1 includes everything necessary for a complete amplifier. A drilled G-10 epoxy solder-plated printed circuit board (2" x 3") makes assembly easy (approx. ½ hr.) with the comprehensive instructions. A large heat sink keeps the TRW power transistor cool. For ease of assembly, the coils used in the SST A-1 are pre-wound.

The SST A-1 is short- and open-protected—not damaged by high swr. Top quality components are used throughout. It is compatible with all 1-3 Watt 2 meter transceivers. The SST A-1 sells in kit form and also wired and tested. Instructions are included for a carrier-operated relay.

All SST products carry a 1-year unconditional guarantee and may be returned within 10 days for a full refund if you are not satisfied for any reason. To order, call (213)-376-5887 or

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Model V350 all-mode VHF amplifier from RF Power Labs.

The Italian Freq Generator

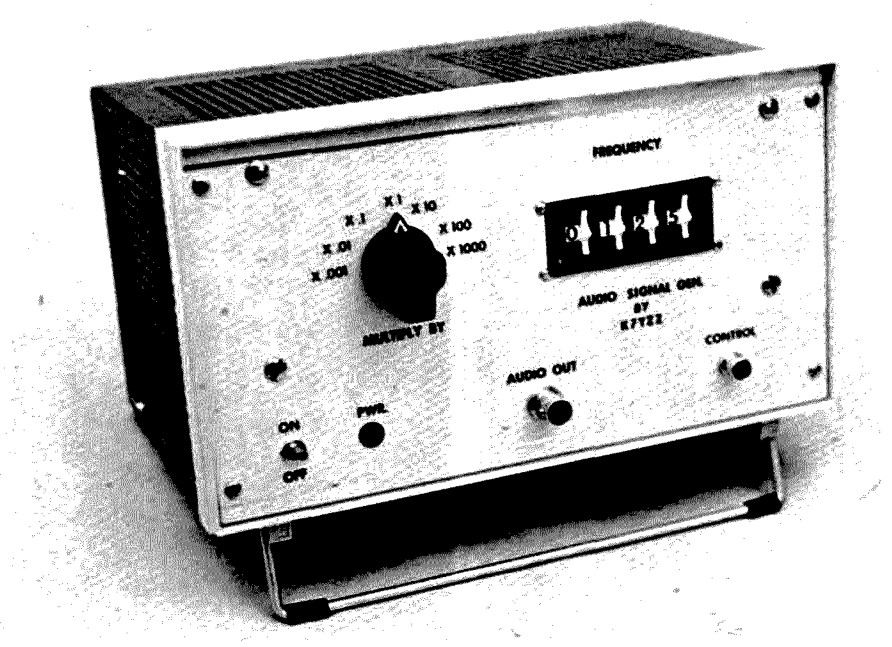
—from Bologna to you

A few years ago, this generator's qualities were found only in expensive, lab-type gear.

Louis I. Hutton K7YZZ
12235 S.E. 62nd Street
Bellevue WA 98006

During my recent visit to Sr. Franco Fanti I4LCF's ham shack, I was looking over his latest issues of an Italian electronics magazine called *CQ Elettronica*.[1] In the May, 1977, issue, I found a very interesting article on a phase locked digital signal generator.[2] I obtained a copy of that article and laboriously translated the major portion of it to get an idea of what the author, Sr. Mario Scarpelli I6THB, had to say regarding the unit. This looked to me like it was just what I needed in the way of a home-brewed signal generator to replace my aging Heathkit AG-1 audio signal generator.

An undrilled, blank PC board was obtained through I4LCF,[3] and a model was constructed in my shop. The generator provides a square wave from 1 Hz to 9.999 MHz at a TTL output level. The signal may be switched on and off through the control input port.



Circuit Description

The digital signal generator consists of six basic components as shown in the block diagram (Fig. 4). The circuit is basically a phase locked loop design with the oscillator searching through its frequency spectrum until it finds the frequency selected in the programmable counter. At this point, the loop locks. To expand the range of the unit's frequency coverage, I6THB added a logic detector circuit that enables the voltage-controlled multivibrator to switch to a different frequency range by changing the value of the frequency-determining capacitor.

The reference oscillator consists of a 1 MHz crystal oscillator, X1 (7400), with three frequency dividers, X2, X3, and X4 (7490). The resulting output frequency of 1 kHz from the divider is

used as a reference signal in the phase detector, X13 (MC4044).

Four thumbwheel binary-coded decimal (BCD) switches are used in combination with four 74192s, X5, X6, X7, and X8, dividers to provide a programmable counter. The four 7400s, X9, X10, X11, and X12, are buffer/inverters to provide the proper TTL state to the inputs of the 74192 dividers. The thumbwheel switches cover an input range of from 0000 to 9999. The output from the programmable counter is connected to the phase detector, X13.

The frequency range logic detector consists of X15, X16, and X17. This circuit is connected to selected segments of the BCD switches so that, between 0000 and 3399, the VCM frequency-determining capacitor is 133 pF. From 3400 to 9999, the capacitor is reduced to 33 pF by the switching relay, RY-1.

The phase detector, X17 (MC4044), compares the reference oscillator signal with the output signal from the programmable divider and converts this to a dc voltage level proportional to the phase error. This error voltage is fed to the input of the VCM, X14 (MC4024), to drive or hold it to the frequency displayed on the thumbwheel switches.

The output of the VCM is connected to the input of the programmable counter to complete the phase locked loop circuit. The output signal is also connected to the input of the output frequency selectable divider chain consisting of X18, X19, X21, X22, X23, and X24 (7490). The MULTIPLY-BY selector switch is used to expand the digits appearing on the thumbwheel switches into the desired frequency. For example, 2125 appearing

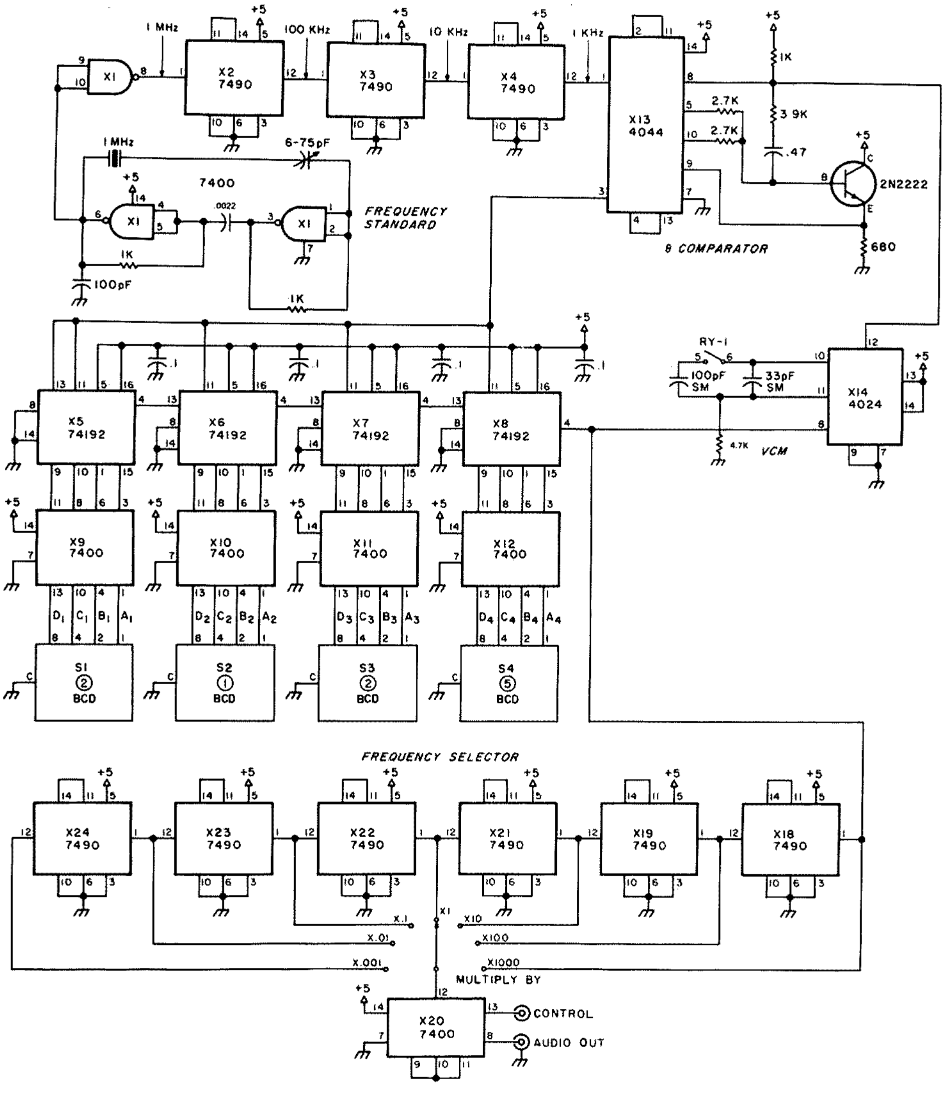


Fig. 1.

on the thumbwheel switches can, by proper MULTIPLY-BY selection, provide 2.125 MHz, 212.5 kHz, 21.25 kHz, 2125 Hz, 212.5 Hz, 21.25 Hz, or 2.125 Hz.

The control function is provided by the IC X20 (7400). Grounding the CONTROL input will inhibit the output. For example, if the CONTROL input were fed a square-wave signal of long time constant, the output would be keyed on and off depending upon the duty cycle of the signal on the CONTROL input.

Construction

The PC board I obtained from I4LCF was 8 by 5 inches and was not drilled. I built two mounting brackets from aluminum to hold the board at right angles from the front panel

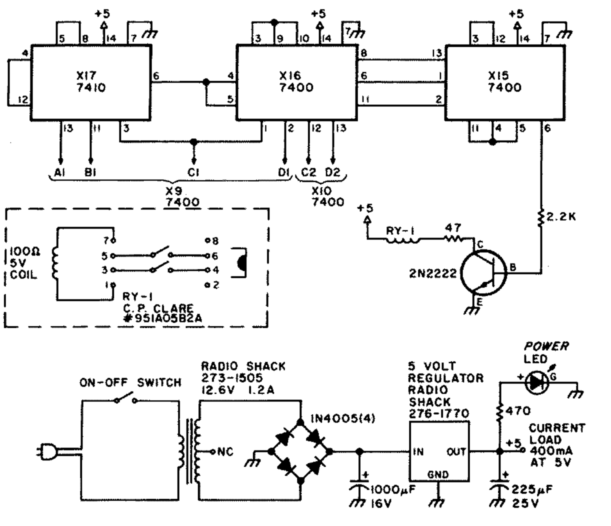


Fig. 2. Automatic switching circuit for VCM (top) and the power supply (bottom).

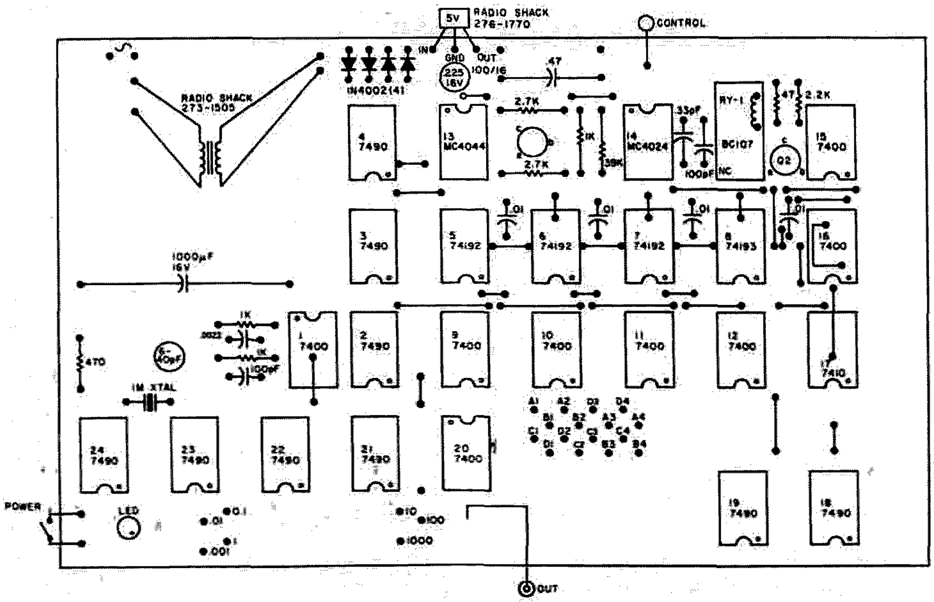


Fig. 3.

of the cabinet. The cabinet is Radio Shack part number 270-281 and is 5-7/8" by 9" by 4-7/8". The four BCD thumbwheel switches were purchased from a local surplus house, but may be ordered from Circuit Specialists Co., P.O. Box 3047, Scottsdale AZ 85257. You will need two of the end plates, part number 435245-2, and four of the BCD switches, part number 435308-2. If you buy your BCD switches at a surplus store, be sure they are coded as shown in the truth table.

The relay, RY-1, also took some doing to locate. From the photographs in the original article, I was able to get an idea of what it was, but the details in the write-up were pretty vague. I finally located a relay that seemed to meet the requirements and am happy to report that it works in the circuit just fine. The relay is made by C. P. Clare and is their part number 951A05B2A. I was able to buy it from the local branch of Almac/Stroum Electronics.

The original layout of the unit in *CQ Elettronica* had the 5-volt regulator mounted on the back of the cabinet. I had an LM309 in stock and used it mounted on the side panel holding the PC board. The original layout also had the power transformer mounted on the PC board. I mounted mine on the same bracket holding the 5-volt regulator, as shown in the photographs. The transformer is a bit oversize, as the circuit draws 400 mA at 5 volts.

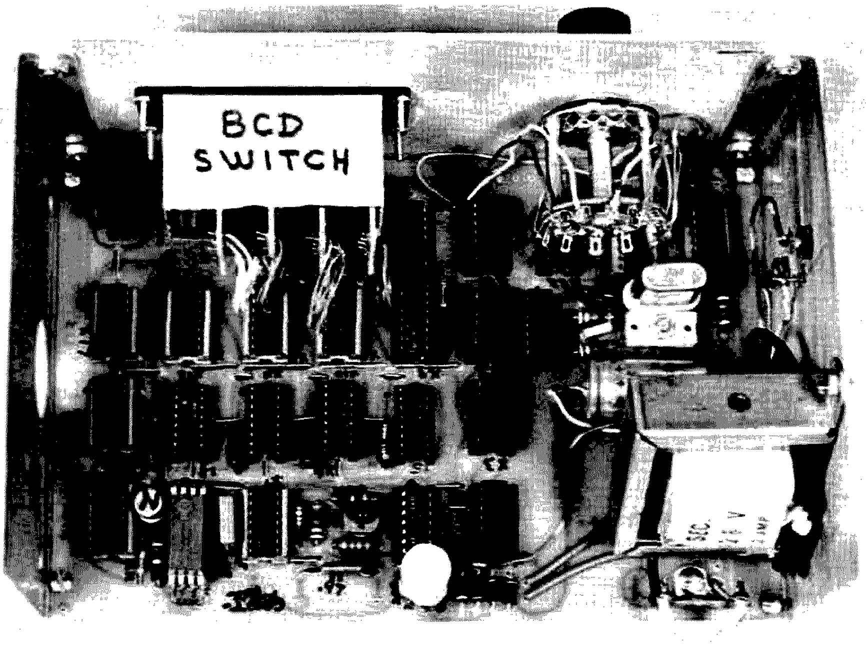
After the PC board is drilled, the jumpers should be installed before the IC sockets are soldered to the board. The layout of the sockets, jumpers, and components is shown on the drawing. The HEPC3806P is the equivalent of the MC4044. The HEP3805 is the equivalent of the MC4024.

Testing of the finished unit was done in a series of steps as follows. When the board was wired, the IC for the 1 MHz oscillator was inserted along with the crystal. Power was applied, the 5-volt bus checked, and a scope probe connected to pin 1 of X1 to confirm that the oscillator was working. It was monitored on a communications receiver at 10 MHz to zero beat it with WWV.

Then the X2, X3, and X4 ICs were inserted, and, again, the power was applied. A counter was connected at each test point (pin 12 of the 7490) to be sure that the divider chain was working. Sure enough, I found that I had used a bad 7490 from my junk box.

Next, the MC4024, X14, was inserted and, again, the power applied. A counter was connected to pin 8 to be sure that the VCM was oscillating. It should be oscillating somewhere between 10 and 15 MHz. Ground pin 12 of the VCM and the frequency appearing on pin 8 should change from 10 to 15 MHz to around 3 MHz. That checks out the VCM frequency shift by varying the input voltage.

The relay, RY-1, is checked next. Install the remainder of the ICs, apply power, and, while using a VOM, monitor pins 5 and 6 on the relay for closure of contacts as the thumbwheel switch in the first



digit is switched from 3 to 4.

The final check made after assembly is to monitor, with a counter, the oscillator frequency as it appears at pin 1 of X18. Then follow that frequency down through the MULTIPLY-BY divider chain, looking at pin 1 to see if it has been divided by 10 at each stage of the divider.

It has been noted during testing that, when the unit is first turned on from a cold start, it takes about three minutes before the VCM settles down and is locked into the oscillator. The accuracy of the output frequency versus the digital thumb switch setting seems to be very good (plus or minus 1 to 2 Hz) on the audio ranges up to several hundred kHz. In the MHz range, it may be off as far as several hundred Hz, according to my counter readout, which is still very acceptable for home-brewed equipment construction.

Conclusions

Although the unit as now constructed connects the output to a 7400 buffer, it was suggested in correspondence by I6THB to I4LCF that, if the builder wishes to provide more isolation and a better output load source impedance, an emitter follower circuit could be used with a 600-Ohm emitter resistor in the output. A transistor should be used that will handle up to 10 MHz signals.

I have had the unit in operation now for over ten months, and it has not given me any problems at all. Once the initial warm-up and lock-on has occurred, all that is required to get a particular frequency between 1 Hz and 9.999 MHz is to dial in the frequency.

I will try to answer questions from those who build this unit if I can and if they will please enclose a self-addressed stamped envelope. ■

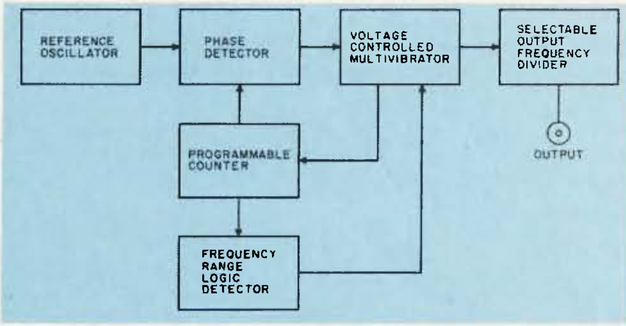


Fig. 4. Block diagram of the digital frequency generator.

References

1. *CQ Elettronica*, Via C. Boldrini, 22, Bologna 40121, Italy.
2. "Generatore di onde quadre a sintetizzatore di frequenze." Scarpelli, *CQ Elettronica*, Maggio, 1977, page 854.
3. PC boards obtainable from Sr. Franco Fanti I4LCF, Via a Dallolio n. 19, Bologna 40139, Italy.

Thumbwheel digit	BCD output 1	2	4	8
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1

1 = continuity
0 = open circuit

Table 1. BCD thumb switch truth table.

Happiness is a WE-800

—proud owner loves his Wilson

If 2m FM is your bag, this is your rig.

C. A. Kollar K3JML
1202 Gemini St.
Nanticoke PA 18634

Recently, Wilson introduced a new concept in two meter FM rigs—the WE-800. This compact unit is an all-around synthesized rig that can be used portable, mobile, or as a base. Its features include: 144 to 148 MHz coverage in 5 kHz steps, switchable 1- and 12-Watt output, 600 kHz up-down offset with two other positions available for other than 600 kHz, five priority channels on the front panel, and a meter light switch on the rear panel to conserve battery power.

After hunting around for a couple of months trying to locate a distributor who had one in stock, I finally located one, ordered it, and eagerly awaited its arrival. When it arrived, I installed a newly-purchased and -charged set of nicads and turned it on. My first impression was that the received audio (emanating from the combination speaker/mike) sounded extremely hollow and tinny. Figuring that the effect was because of the small size of the speaker in the speaker/mike, I continued with the test somewhat disappointed, and made a call on the local repeater. The subsequent QSOs revealed that the transmit audio was full, crisp, and clear. Apparently, there were no transmit problems, although that hollow receive audio bothered me. After four or five short transmissions, my fears were realized when, upon releasing the mike button, I was bombarded with a raucous squeal. The received audio section was oscillating! I made a call to Wilson to explain the problem, and George Tennell advised me to ship it back. Wilson had it in the shop only one day and it was on

Fig. 1. Front panel.

its way back. If it wasn't for the twenty-four days it took UPS to get it to and from Nevada from Pennsylvania (bad news), it would have taken me a lot less than the nearly four weeks it was gone to get it back.

After carefully unpacking the repaired unit, I turned it on and listened to a QSO in progress on the local repeater. I was pleasantly surprised at the nice audio coming from the speaker/mike. What a difference! Leaving the unit on and monitoring all day wore the batteries down pretty well, but there was no trace of audio oscillation. Wilson had done a great repair job on the radio. I've had it a month now and the WE-800 still performs beautifully. My enthusiasm for this unit prompted me to write this review.

Front Panel Switches

Frequency selection is accomplished by a three position digi-switch which can be seen in the photo located at the left of the front panel. This unit covers 144 to 148 MHz in five kHz steps (10 kHz/step on the digi-switch, plus an extra five thrown in by flipping the kHz toggle to 5). Additionally, a six-position switch located on the right side of the panel can be used to choose five "priority" channels which will be used frequently. With the switch in the "dial" position, any frequency dialed in on the digi-switch will be heard. In positions A through E, any one of five preprogrammed channels will be activated. Please note at this time that the *receive* frequency is always dialed in on the digi-switch, or programmed in on the six-position channel switch. Transmit frequency is offset up or down from the receive frequency or made the same as the receive frequency by operating the R/U-S-R/D toggle. R/U is used for 147 MHz repeaters, S for simplex, and R/D for 146 MHz repeaters. With the frequency coverage of the WE-800, you will have instant access to any repeater which may start up in the new repeater subband.

Programming priority channels is accomplished with diodes. See Fig. 2. As you can see, channel E is programmed for 147.18 (MHz—4, 2, and 1; 100 kHz —1; 10 kHz—8; and 1 kHz—0). 1N914 or equivalent diodes are recommended but, whatever you use, they *must* be small. The programming board is tiny and unless the diodes are small, they won't fit. Also, a subminiature soldering iron is a must. Without one, you wind up with as many solder bridges as solder joints.

The Hi-Off-Lo switch is operative only when using an external power source. When on internal batteries, either the Hi or Lo position will give you 1-Watt output. When on an external power source, the switch becomes operative, and selection of 1- or 12-Watt power levels is possible.

Rear Panel Switches

The rear panel switches are slide switches which provide a number of functions as will be explained. However, there is one big problem with them—they protrude too far from the chassis. I found that whenever the back of the radio brushed against something during normal use, the switches would be moved to some position I didn't want. I had the radio only two hours when I solved that problem by snipping off ⅔ of their length with a pair of diagonals. I've had no problems since that time and can still operate the switches easily.

The antenna select switch is the switch mounted nearest the SO-239 connector on the rear panel. See Fig. 3. This handy switch allows you to select from an antenna connected to the BNC connector on the front (rubber ducky, etc.), or from an antenna connected to the SO-239 on the rear. This comes in handy when going from portable or mobile to base.

The lamp switch in the "on" position illuminates the S/RF meter on the front panel for easy meter viewing. When on internal batteries, it can be kept off to prolong battery life. Power consumption is reduced considerably with the light off in standby. Squelched receive current with the light off is 50 mA and with the light on is 110 mA.

The power switch lets you select from an external power source or internal nicads or enables you to charge your batteries from whatever you have connected to the external power connector (power supply, cigarette lighter, etc.). The problem with this arrangement is the inability to monitor while charging batteries. This is a distinct disadvantage because it puts your radio completely out of service for 12 hours in order to recharge your batteries. I guess this isn't too bad if you can make certain your batteries go dead only before you're ready to go to bed. The other disadvantage is the design of the "charging system" itself. No provision has been made for current limiting, so if your batteries are very low, and you charge them from your cigarette lighter or power supply, the batteries draw a hellacious amount of current for a while until they charge high enough to begin drawing a reasonable amount of current. Back to the drawing board on this feature, Wilson! See Fig. 4.

The RPT switch with positions marked "600 kHz," "A", and "B" is a nice feature of this rig. This switch controls how much the transmit frequency is offset from the receive frequency you have set up on the front panel. In the 600 kHz position, the standard repeater offset is utilized. In positions A and B, any one of two other transmit offsets chosen by you is

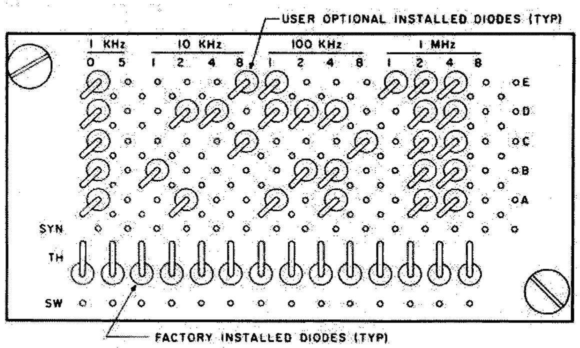


Fig. 2. Diode matrix frequency programming board (viewed from the top).

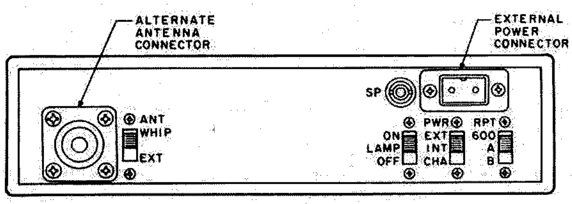


Fig. 3. Rear panel.

used. Transmit offset from receive frequency other than 600 kHz is accomplished by plugging the proper crystal in the transmit local oscillator in one of four possible positions (Pos. A—R/U; Pos. A—R/D; Pos. B—R/U; Pos. B—R/D).

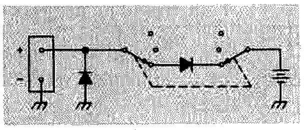


Fig. 4. Charge circuit.

Finally, a rear jack is provided for using an external speaker. Frankly, I can't get too excited over the speaker/mike and I think Wilson could have found a way to build in a speaker. However, the audio coming from the speaker/mike is surprisingly good.

Miscellaneous

Wilson's approach to the low-power position is to incorporate a separate 12-Watt amp which is switched in only when external power is used (if the Hi/Lo switch is in Hi). This was a wise approach and accounts for the low (290 mA) current drawn when operated in the 1-Watt position. This is a much better scheme than used in some other multi-power rigs which force a 10-Watt amplifier stage to run at 1 Watt, with resulting higher current drain resulting in lower efficiency. A 50-mA squelched-receive-current battery life is approximately 6 hours when monitoring a repeater of normal activity.

Conclusion

All in all, for someone looking for a 2 meter rig they can use portable, mobile, or base, the WE-800 is a wise choice. It has all the features you're looking for in a 2 meter synthesized rig, plus small size. It should provide years of enjoyment. ■

Looking *West*

from page 21

own users and say "to hell" with everyone else. The fallacy of this lies in the fact that making an open system into a private system will not make our jammer go away. He does not need the "secret tone" to jam—only the ability to capture the repeater receiver without the tone, which in effect shuts down the receiver. He won't be repeated, but neither will any user. A definitely ineffective solution.

The best suggestion to date came to me in a two-part conversation I recently had with NBC News correspondent Roy Neal K6DUE. It started one night on the phone and was completed the following week in Roy's office at the famous NBC peacock factory in Burbank. Roy's job has him traveling more than most of us, and therefore he is in a position to evaluate things that we might never get to see firsthand. Roy has some definite feelings on this subject, and his views make a lot of sense to me.

Roy's basic philosophy is that the big cities, where the real problems manifest themselves, should take a look at how the more rural areas operate. In most non-urban areas, repeaters are calling channels, places all amateurs monitor while they await a call. Should they be paged by some fellow amateur, they usually choose a simplex channel and QSY. Only under marginal conditions are repeaters used to carry on long-winded discussions. In the "outlands," repeaters serve the distinct purpose for which they were intended. It is rare that one gets jammed, and in those infrequent instances, the jamming is never given any form of recognition.

The big cities are another story altogether. Hour after hour, repeaters are tied up with useless conversation between groups of amateurs living within simplex range of each other or between mobiles half a mile apart conversing through a repeater twenty miles away. It's rare when you hear one station take another to a simplex channel to continue a QSO. It's not uncommon to hear stations a mile or two apart break an existing conversation in order to obtain the system for their own QSO—when they have no need for relay communication whatsoever.

Roy therefore feels that the best way to frustrate a would-be jammer is to simply go away when the repeater gets jammed. Don't fight it—that only gives the intruder the audience he seeks. Simply take your QSO off to another repeater or (preferably) to simplex. If your area is being heavily harassed by the jamming crowd, stay off the repeater(s) and thus take away their audience. Even if the jammer catches on and takes to harassing you on simplex, a carefully arranged schedule between you and those with whom you wish to speak will frustrate the life out of the sickies in our society. Even if it's necessary to purchase an amplifier to ensure constant communication, this is a far better approach than sitting on a repeater trying to talk over a healthy jammer. If enough users of harassed systems take this approach, and the band gets filled with simplex, a jammer will be very hard put to continue his antics. In the process, many will discover that repeaters are not always a necessary means with which to communicate. In fact, I spend more time talking to Roy on simplex than via any mountaintop box. Try it—it really works!

THE .76ERS

A noted local amateur recently said to me: "At least the .76ers had class!" He was referring to the mid-1960s, when a group known as the ".76ers" ruled southern California FM with a "tongue-in-cheek iron thumb." That was the pre-repeater era, when only a handful of hams inhabited two meters and even fewer machines existed. Over a period of years, the .76ers had developed jamming into an art form. But being jammed was part of being a .76er, and all on the "inside" looked at it as part of the fun. (The FCC took a far different view, however.) Much of what went on on 146.76 back then was recorded for posterity in a series of articles that appeared in various publications over the years. The series was called "The Chronicles of .76," and was written by Ken Sessions K6MVH. I understand that for anyone interested in knowing what it was like back then, the series is "must" reading.

The .76ers jammed because jamming was part of being a .76er. To them it was not malicious, but just part of their lifestyle. They abided by their own unwritten rules as to who, what, why, and how. While outsiders continually chastised them for their actions, they just ignored it all and kept on having "fun." You and I would probably have been appalled if we had tuned in on .76 in those days, but our life-styles and backgrounds were totally different and we would have judged what we heard in a different light.

I mention .76 for a few reasons. First, while you and I might have judged the .76ers' actions to be improper, one clear fact is that they never went out of their way to be malicious in the sense that they would venture away from .76. There were a few occasions, but they were very rare indeed. If you happened to venture into their spectral territory, you were fair game, but if you did not like .76 and stayed away, they could have cared less about you. The only time they jammed a repeater was when one would try to set up shop on .16/.76. To this day, though many have attempted to establish such a system in the Los Angeles/San Diego rf corridor, not one has ever lasted more than a day or two. The remnants of the .76ers remain a viable force today, still strong enough to keep .76 simplex. They remain very low-key, but are far from having dissolved into oblivion.

Happy New Year!

Corrections

In my article "PCs Are Easy" (December, 1978), line 3 of column 4 on page 271 should better have read: "After the full-size *positive* . . ."

Brian E. McArthur VE3CGE
Brampton, Ontario

There is one minor error in the diagram on page 188 of "Build the Brute" (November, 1978). The gate of the SCR is shown looking at the 8 uF capacitor discharged by a 470-Ohm resistor through the 14-volt zener. The anode of S1 should also be connected to the positive output of the supply.

Raymond W. Brandt N9KV
Janesville WI

Explore the World of VLF

—with this simple converter

A broadband preamp makes this unit tick.

Donald T. Morar W3QVZ
3663 Hipsley Mill Rd.
Woodbine MD 21797

After looking at available VLF converter data, I embarked on a design to facilitate some VLF listening. Because it was convenient relative to the communications receiver that I planned to use the converter with, a 10 MHz i-f was picked. This removed the i-f far from many possible sources of i-f feedthrough.

The circuit shown utilizes an LM318 as a broadband op amp, providing greater than 8 dB gain from 20 kHz up to 400 kHz. The mixer utilized is a 40673 MOSFET containing internal protective diodes (not indicated in the schematic). See Fig. 1. The local oscillator (LO) employs a 2N5458 FET as a rather conventional crystal oscillator operating at 10 MHz. LO injection is controlled by C_{inj} and tuning by C_t, although, of course, there is some interaction between the two capacitors.

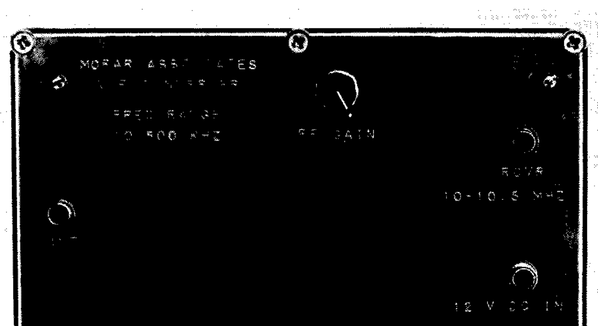


Photo A. Front panel, showing antenna input on left, 10 MHz out in the upper right, and 12 V dc input in the lower right. A tunable i-f output was added after this picture was taken (see the schematic). The tunable inductance core shaft was brought out as an operating control slightly to the right of the rf gain control. It can be seen in Photo C.

I used a low-frequency signal generator with calibrated output, and I adjusted C_{inj} for best sensitivity with a very weak signal generator output, while maintaining the LO frequency at 10 MHz. The receiver used had a tuning range from 10 to 10.6 MHz, yielding a converter tuning range from zero beat to 600 kHz. Other appropriate frequencies could be employed to accommodate the particular receiver to be used. It is recommended that the LO frequency be kept relatively high, say, at at least 40 meters, to ameliorate i-f spurious responses as previously mentioned. If a 40 meter ham band receiver is to be employed, simply use a 7.0 MHz crystal and retune the LC tank in the drain circuit of the 2N5458 FET. It may be necessary to add a bit of fixed capacitance in parallel with the existing 3-30 picofarad trimmer in order to tune down to 7.0 MHz.

The lower frequency limit of usability is, at present, about 10 kHz because of the 10 MHz LO feedthrough into the receiver. I think that a new layout would have to be made to further preclude this problem. A two-section lowpass filter is utilized on the input to the LM318 to preclude cross-modulation with strong signals in the broadcast band and above. The filter rolls off 6 dB by 500 kHz and is 20 dB down

at 750 kHz.

The converter was tried with several antenna arrangements. The most satisfactory was a 1000-foot longwire antenna that terminates in the shack. It still left much to be desired, so a separate antenna coupler was assembled. See Photo C. This greatly improved the reduction of cross-modulation and converter-usable sensitivity. Even with the low-pass filter at the converter input, strong local stations in the broadcast band plus local 100 kHz loran signals would cause objectionable cross-modulation problems without the antenna coupler.

I am also working on a fixed tuned TRF receiver for receiving WWVB, wherein a double-shielded tuned rotatable 27"-radius loop will be employed.

With the antenna coupler indicated in Photo C, it was possible to receive WWVB at 60 kHz at this location with an S-meter reading of S9, indicating an input in the vicinity of 20 microvolts. Without the antenna coupler, it was not possible to hear WWVB at all due to spurious responses about either side of 60 kHz. The converter requires 12 volts at 12 mA.

As can be seen from the accompanying photos, the converter is built on a 3½" x 6" single-clad phenolic board, utilizing vector mini-klip pins pushed into the holes of isolated copper pads, produced by an isolated-pad-Drill-Mill tool. See Photo B. The converter is housed in a Bud CU-247 Econo-box, with dimensions of 7-25/64" x 4-45/64" x 2-7/32". The antenna coupler is in a separate box, since it came as an afterthought and would have made the dimensions and layout of the converter unduly large anyway.

Fig. 1. shows the antenna coupler converter and Kenwood R599 reciever set up and connected to the 1000-foot longwire antenna which is 60 feet high. The antenna coupler was built in a 3" x 5" x 7" minibox, Bud CU3008. See Photo C. Coils were mounted on the selector switch so as to be as mutually perpendicular to each other as possible to minimize magnetic coupling. The Arco-type 315 compression capacitor has a range of 2525 pF tight and 1200 pF at 3 turns open. Using the inductances indicated, satisfactory tuning was obtained from 20 kHz to 200 kHz. Above 200 kHz, the converter had plenty of gain connected directly to the antenna without the coupler. Cross-modulation was not a problem in this region, either. ■

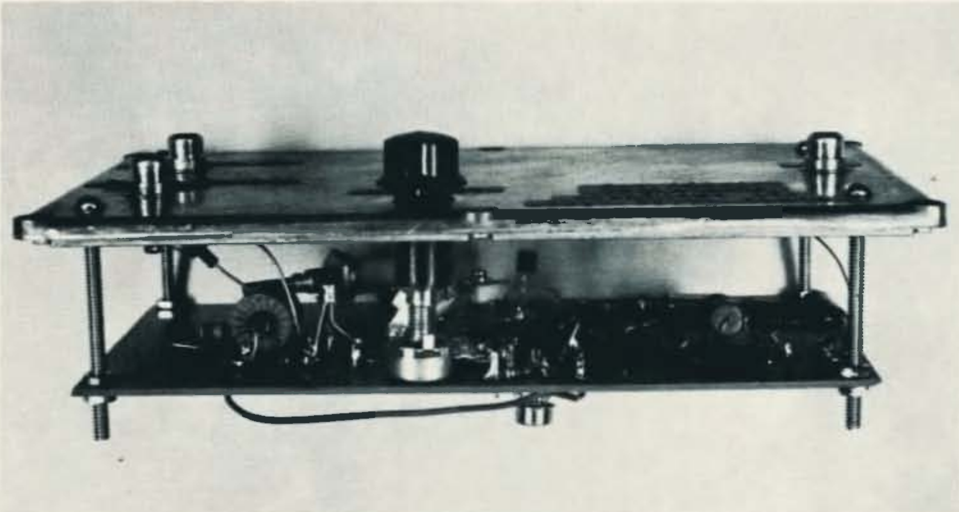


Photo B. Side (open view) of the converter showing the copperclad board and vector mini-klip construction described in the text.

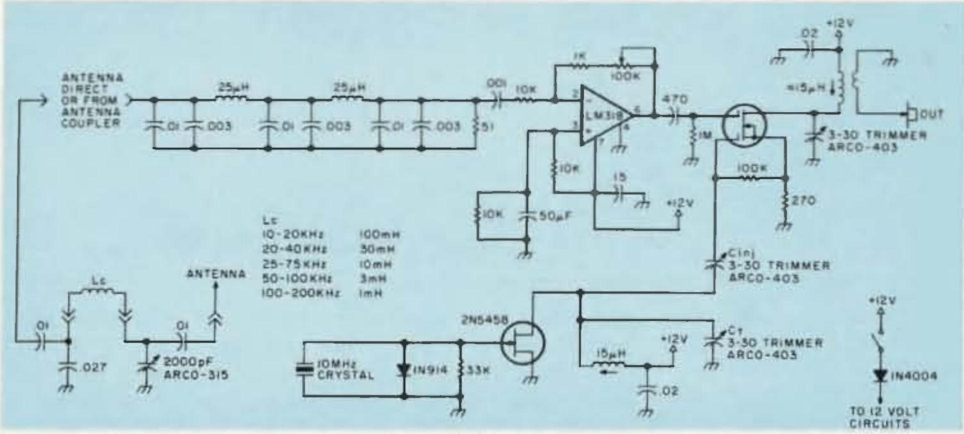


Fig. 1. VLF converter.

Photo C. The converter set up with the Kenwood R599 receiver. The antenna coupler can be seen at the top above the converter.

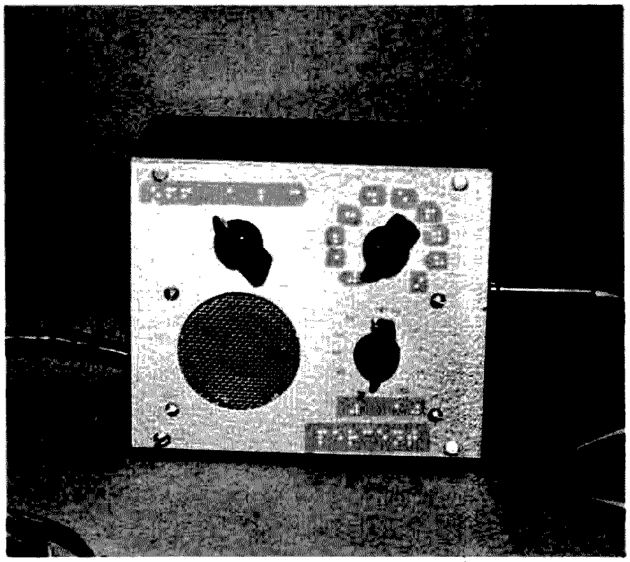
The S.H.A.F.T.

—special tuning gadget for sightless hams

You don't have to see to believe.

Burton H. Syverson K5CW
3401 Garner Lane
Plano TX 75023

Recently, a sightless ham friend of mine remarked that he had ruined the final amplifier tubes in his transmitter by exceeding the maximum plate current. I am sure that being unable to tune his own gear must be very frustrating. Like most hams, I remembered several articles relating to tuning aids for the blind. As luck would have it, a search of my old magazines did not yield much information. The idea of a voltage-controlled oscillator is not exactly new, but it is hard to beat. What articles I found, however, used this idea to tune for maximum or minimum indication.



Not finding what I desired, the search for a method of reading discrete values of current or voltage began. The method decided upon involves the comparison of a variable voltage source calibrated in percent of the full scale voltage drop of the moving coil of the meter (Fig. 1). Application of the voltage-controlled oscillator is used to indicate balance. I call the unit to be described "The S.H.A.F.T." This stands for the Sightless Ham's Aid For Tuning.

Safety is always the prime consideration in the design of any electronic gear to be used by blind operators. In order to assure the equipment case was grounded, ac operation is used. The connecting cables carry ground to the frame of the equipment whose meter is being monitored. When readings are desired using a multimeter, the shield of the connecting cable is used as an electrostatic shield only, because of the nonmetallic case. For the operator's safety, use of a multimeter should be restricted to resistance and low voltage measurements.

One of the features of this unit is that it can be used with three different meters (i.e., multimeter, plate current meter, or ratiometer). Operation of the unit is quite simple. Referring to the schematic diagram (Fig. 2), it will be noted that zener diode CR1 holds the voltage of battery B1 at 3.9 volts. This is applied to a series resistance network so that the voltage drop from the lower end of control R14 to the junction of R13 and R22 is approximately 40

millivolts. This is something less than the full-scale voltage developed across the moving coil of most meters. By use of control R14 and switch SW2, any voltage between zero and 40 millivolts may be obtained. This voltage is fed into the inverting input of an operational amplifier on IC U1. Control R14 is calibrated from zero to 10% and switch SW2 in 10% steps from 0 through 90. The settings are additive. Voltage from the moving coil of the meter to be read is fed in jack J1 through 2-conductor shielded cord to switch SW1A which selects control R1, R2, or R3. R1, R2, and R3 are used to adjust the full-scale meter voltage to the 100% setting of the R14 and SW2. The voltage across R10 is fed into the noninverting input of the same operational amplifier. The output of the amplifier is fed into null detector Q1. Q1 causes unijunction oscillator Q2 to increase in frequency whenever the output of the operational amplifier crosses zero volts. The output of the oscillator is connected to a second operational amplifier which serves as an audio amplifier. Note: The jumper connected from C2 to terminal 1 of U1 may be replaced with a suitable resistor if the constructor feels the audio level is excessive.

Due to the dc nature of the unit, the mechanical layout of parts is not critical. The size of the etched circuit board was chosen to accommodate its being fastened to the back plate of a 4" × 5" × 6" Bud cabinet (Fig. 3). Others may choose a larger cabinet for ease of construction. In my unit, switches SW1 and SW2 are rated at 1500 V dc breakdown and need not be insulated. However, control R14 is sub-mounted on a piece of vectorboard 2½" × 5" with enough clearance that the speaker frame (also on the vectorboard) does not touch the front panel. All parts (other than those on the etched board, and C3, F1, J1, and T1) are mounted on the vectorboard. Difficult to mount parts are held in place by epoxy cement. marking of the panel is done with embossed tape. Print wheels for embossed-tape writers are available with Braille symbols. Switch SW2 should be marked as shown on the schematic. Control R14 markings may be dots of nail polish with the zero and ten percent points identified with embossed tape. The in-between points may be determined with an ohmmeter connected from the contact arm to the lowest-voltage terminal of R14.

To put the unit in operation, connect a voltmeter (set to read 10 volts) across resistor R7 on the etched circuit board. Connect the meter you wish to use to input jack J1 through a suitable cable. Set R14 and switch SW2 to zero percent. With the power cord plugged in, operate switch

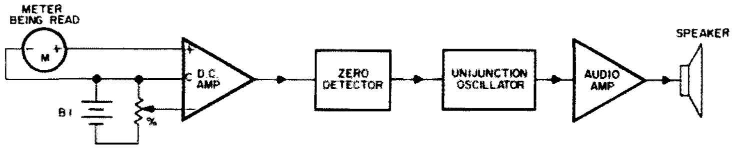


Fig. 1. Block diagram of the S.H.A.F.T.

Parts List

B1—3 type AAA cells in Keystone 169 holder
C1, C2—1 uF, 25 V capacitor
C3—.05 uF, 20 V capacitor
C4 through C6—200 uF, 25 V capacitor
C7—50 uF, 25 V capacitor
CR1—1N4730, 3.9 V zener
CR2, CR3—50 piv silicon diode
D1 through D4—1N34A diode
F1—3AG, 1 Amp fuse
J1—¼" 3-circuit phone jack
Q1—2N706 or equivalent
Q2—2N2160 unijunction transistor
R1 through R3—100k pot, Mallory type MTC 15L1
R4, R7—1.5k, ¼ W resistor
R5, R8, R10—47k, ¼ W resistor
R6—3.3k, ¼ W resistor
R9, R12—47 Ω, ¼ W resistor
R11—470 Ω, ¼ W resistor
R13—100k, ¼ W resistor
R14—Mallory type UA12L 100 with plastic shaft
R15 through R22—100 Ω, ½ W, 5% resistor
R23—10k pot, Mallory type MTC 14L1
SW1—4-pole, 4-position Stentite rotary switch, Centralab #2515
SW2—1-pole, 10-position Stentite rotary switch, Centralab #2503
T1—small 6.3 V ac transformer, 1500 V insulation
T2—small output transformer, 2k primary to voice coil
U1—Texas Instruments SN72747 IC
Speaker—3" PM speaker with 4 Ω voice coil
Misc.—cabinet, power cord, connecting cables to meters and assorted hardware

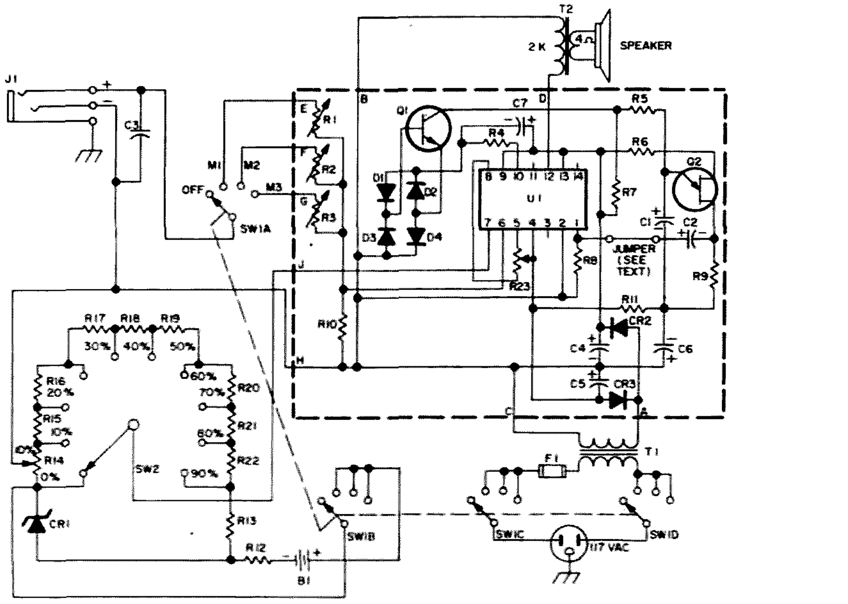


Fig. 2. S.H.A.F.T. schematic diagram.

SW1 to position M1.

A low-pitched raspy tone should be heard from the speaker. Resistor R5 may be reduced in value if a higher pitch is desired. I feel the shift in tone is more pronounced when a lower pitch is used. Adjust the offset control (R23) for minimum voltage drop across resistor R7. By external means, obtain a full-scale reading on the meter you wish to calibrate to. Observe the polarity shown at J1 on the schematic. Set control R14 to 10% and switch SW2 to 90%. Slowly adjust R1 until a point is found where the pitch of the tone peaks. Tune for the highest pitch. The same method should be used for any other meters you wish to calibrate to.

All that is necessary, now, is to provide the user with charts (in Braille) showing meter values versus percentage of the meter scale for each desired range. Due to the fact that meter scales are printed, the angular movement does not necessarily track. As a result, it may appear that the user's ability to determine the reading is no better than 2 or 3%. My tests indicate at least half of this is due to tracking error of the meter. For this reason, it is safe to assume the Braille calibration for dc voltages is a straight line function (i.e., 80% equals 8 volts on the 10 V dc scale).

This unit was not intended for ac measurements in an effort to discourage the user from trying to make readings of the commercial power line. Should this feature be desired, it will be necessary to filter the input to the unit. This will undoubtedly upset the calibration of the meter's ac ranges.

The unit shown in the photograph is a prototype and the panel markings are not identical, though similar to those shown in the schematic (i.e., 90% on SW2 is 9). Space limitations make use of ½" tape difficult. However, the Braille characters are easier for the user to identify.

Since semiconductor devices can overload easily in rf fields, trouble may be encountered when the unit is used in close proximity to transmitters. The same lead filtering methods used for TVI prevention should help. As no single solution can be expected to cure all problems, it may require some experimenting to get normal operation under these conditions.

As with any idea, it can be improved upon. At present, this design appears to be a good compromise between results and cost. The enthusiasm of two of my blind ham friends for this device made the effort most gratifying. I hope this unit will provide a means for the sightless ham to enhance his independence and more thoroughly enjoy amateur radio. ■

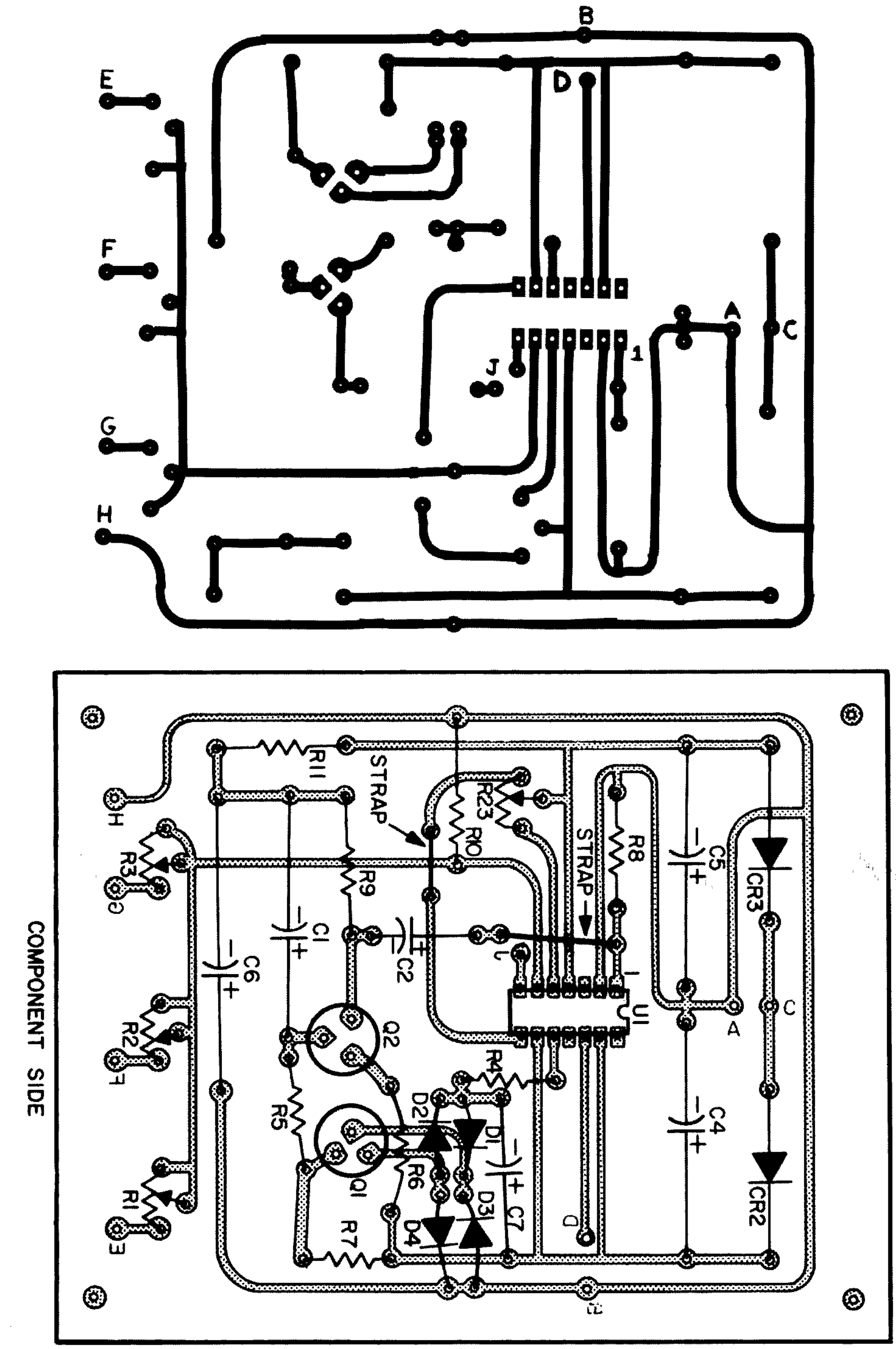


Fig. 3. PC board and component layout for the S.H.A.F.T.

A Remotely-Tuned Matchbox

—ultimate operating ease

This system will tune your Matchbox from 300 feet away—or more.

Guy Black W4PSJ
12317 Hanger Road
Fairfax VA 22030

My shack is among those where the path between the operating position and the feedpoint of the antenna system poses some problems. So, I decided to locate a Johnson Matchbox in the garage, some 75 feet away, so I could use tuned feeders for a classic-dimensioned multiband antenna — 135 feet long centerfed with 42-foot feeders (see the older ARRL *Handbooks*). The rf path to the Matchbox is RG-8, and the problem is to tune and change bands on the Matchbox from the operating position.

I thought other hams would like to know how I did this, though I doubt that any would exactly duplicate the oddball collection of relays and motors that I obtained at trivial cost at various hamfest flea markets. It turns out that motorized tuning, bandswitching, tuner dial indicating, and a grounding switch for lightning protection can all be done with the commonly available 8-wire cable normally used for rotators.

I had kept my eye open for gear-head motors suitable for turning capacitors for a number of years and finally picked up a very assorted group which do the job. Any reversible motor with 2-20 rpm output and a reasonable torque capability can be used. A common type of 110 V ac motor has a starting capacitor that is connected between two of three motor connections, the third connection being connected to one side of 110 V ac and the direction of rotation being determined by connecting the other side of 110 V ac to one side or the other of the capacitor.

Another common type of reversible ac motor has four connections, two of which are interchanged to change rotational direction. Dc motors with permanent magnet (PM) fields are generally reversible merely by reversing the polarity of the dc, though others — identifiable from connections — require reversing field or rotor connections.

One of the ac motors used was actually two motors on one shaft, each good for a different direction of rotation. This unit was made by the Merkle-Korff Gear Company and was so suitable for the purpose at hand that I contacted the company.[1] My motor was their type SG-25, now supplanted by model BF, and it turns out that the company has a national network of stocking distributors and can supply motors with various rotations down to one rpm with starting torques of 10-50 pound inches; torque is important, as the rotation of many big capacitors is a stiff job. These units are perhaps more appropriate to the intended function

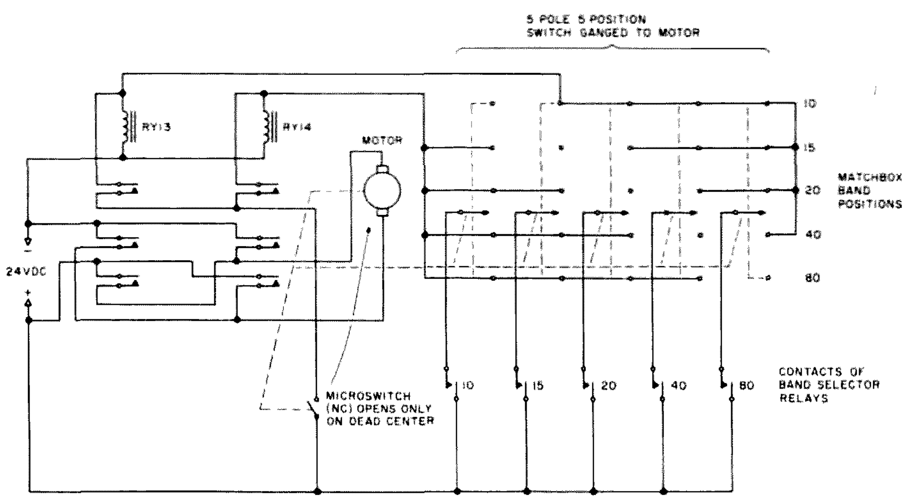


Fig. 1. Circuitry for motorized bandswitch.

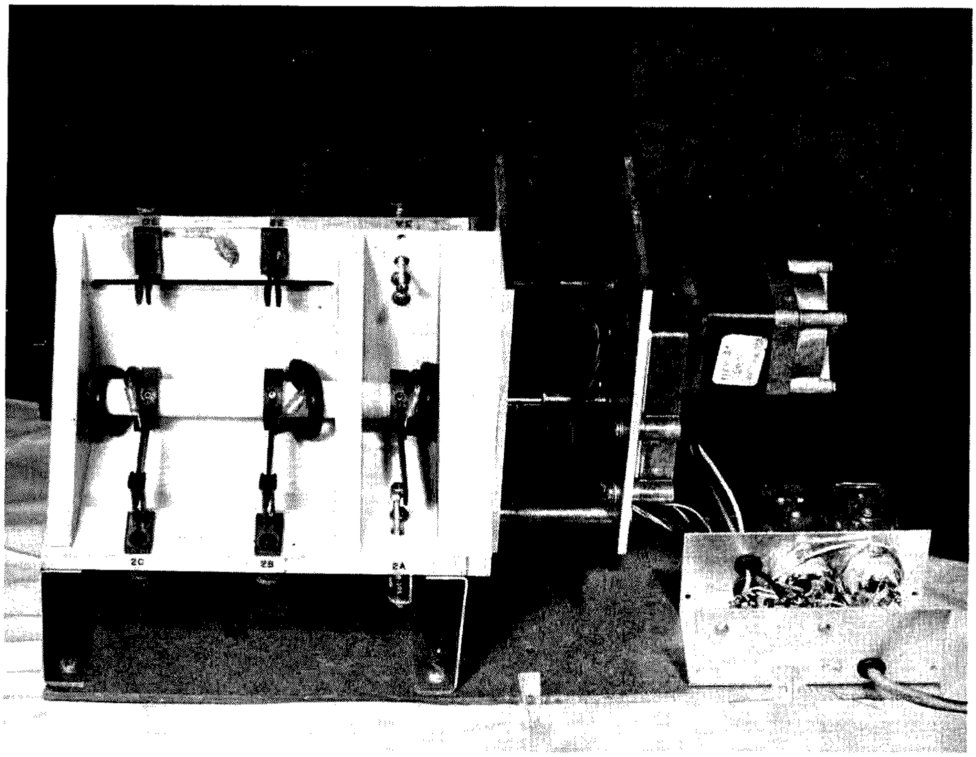


Photo A. Antenna grounding unit driven by reversible gear-head motor with limit switches to terminate rotation. Slack in the cotter pin holes lets the motor get up speed to overcome the torque required to turn the switch.

than the more elegant instrument motors manufactured by Japan Servo Co. (subsidiary of Hitachi, Ltd.).[2]

The functions which I wished to operate remotely included turning two capacitors of the Matchbox and bandswitching to any of five bands. In addition, it turns out to be essential to have an indication at the operating position of the setting of the matching capacitor. If this is once set, a vswr bridge at the operating position can be used to find the proper setting of the tuning capacitor merely by rotating it (remotely) for minimum vswr. However, attempting to tune the Matchbox without information on the setting of the matching capacitor is hopeless.

In addition to controlling the Matchbox, I added two extra functions: an arrangement for grounding the tuned feeders for lightning protection (the need for this was learned the hard way) and provision for switching the coax from the Matchbox to another antenna, which will be for 160 meters in my case, but could be anything.

Photo A shows how I adapted an antique knife-blade-type power switch obtained from a local surplus dealer for antenna grounding. While two of the knife blades switch the tuned feeders, the third activates limit switches that restrict rotation of the knife blades to a 90-degree arc by shutting off the motor automatically when the desired connection is made. Duplicating this switch should be within the capability of many hams.

Photo B shows the activating unit for the Matchbox, connected to it by angle-aluminum arms to existing screw holes of the Matchbox, which has not been permanently modified in any way. In fact, it is a simple matter to detach this unit, say for Field Day, and restore the Matchbox to its original condition. What is seen is a PM-field, dc gear-head motor of uncertain vintage operating the tuning capacitor on the left, the double Merkle-Korff motor on the right driving the matching capacitor via an internally-toothed belt (similar to an automotive timing belt), a selsyn indicator-transmitter for the matching capacitor, two boxes containing controlling relays and other associated parts, and an assembly to take care of the bandswitching function. Dials have been replaced by bushings with projecting wire indicators, for use in local adjustment.

Now, as the tuning and

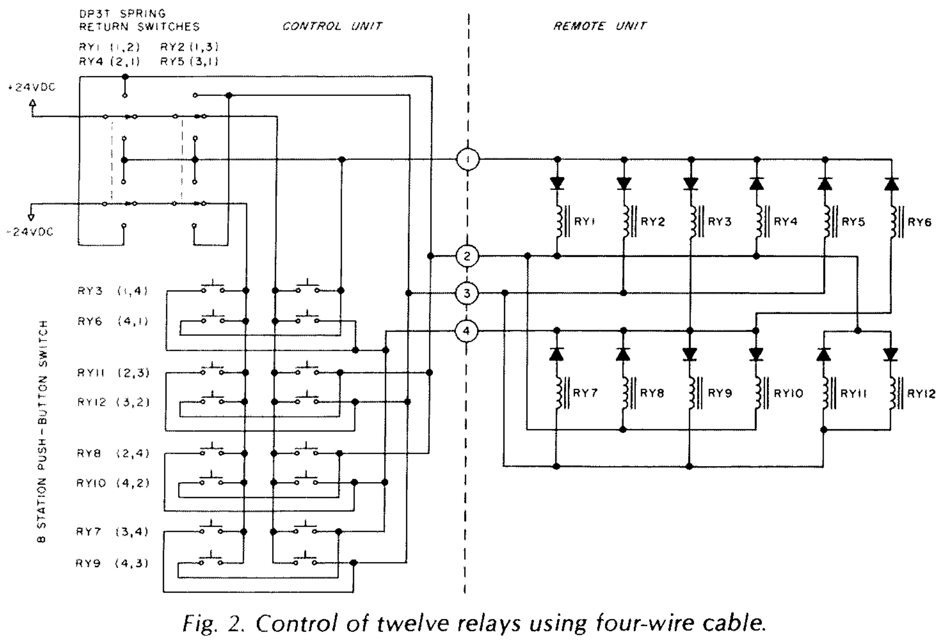


Fig. 2. Control of twelve relays using four-wire cable.

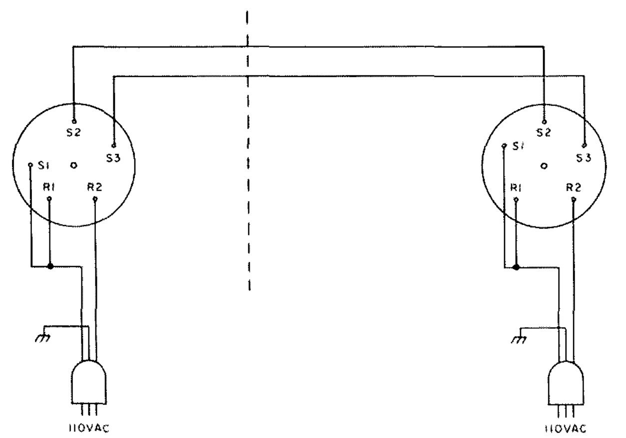


Fig. 3. Using household wiring to reduce to two the wires needed in a control cable for a synchronous transmitter-indicator.

matching capacitors can be rotated continuously, they present no problem for remote operating, but the bandswitching function requires a limit on rotation, and, further, the rotation must stop only when the switch is dead center on the desired set of contacts. To accomplish this requires the large switch seen in the center of Photo B plus a very important cam-driven microswitch concealed behind the mechanism, and gears in a 1:12 ratio.

Here is how it works: The large switch (it need only be a 5-pole, 5-position switch) is directly coupled to the Matchbox band selector switch. Both have 30-degree indexing. The common shaft is coupled into a 1:12 gear train which operates a cam that allows a microswitch to open only once in 30 degrees of rotation of the Matchbox bandswitch and coupled 5-pole switch. The small PM-field dc motor that drives the bandswitch takes a rotational direction determined by one of two relays in the small box directly behind it. But, once the motor is in motion, the microswitch is closed — and thus keeps the relay closed — until it is opened because the bandswitch is dead center on some set of bandswitch contacts.

The circuit diagram for this function is given in Fig. 1. A contact (in this case, a relay contact pair) is closed corresponding to the desired band to connect 24 V dc to the bank of 5 by 5 contacts. If some band other than the one to which the Matchbox happens to be set is desired, either RY-13 or RY-14 will be activated to connect the rotator motor for clockwise or counterclockwise rotation. Notice that two sets of contacts on each relay supply dc to the motor with opposite polarity. Once the 5-pole switch is off dead center of some switch position, the microswitch, being mechanically coupled to it, closes and holds the relay closed. Two conditions are required for rotation to stop: the selected bandswitch position has been reached and switch contacts are on dead center.

To accomplish complete remote control of the Matchbox and auxiliary grounding unit requires twelve functions: five Matchbox band positions; one auxiliary antenna in lieu of the Matchbox; tuning and matching capacitor rotation clockwise and counterclockwise; and antenna grounding and ungrounding. In addition, the position of the matching selsyn indicator must be transmitted to the operating position. To avoid the voltage drop in a long light-gauge wire, a 24 V dc supply and a source of 110 V ac were used at the Matchbox position, with the appropriate connections being made by a bank of 12 remotely activated relays. The simplest way, but most extravagant in its use of wire, would be to use an 18-wire control cable (including a ground return for the relays and five wires for the selsyn), but it is possible to reduce the number to four for controlling 12 relays and — provided 110 V ac is available at both Matchbox and operating position — two for the selsyn in-

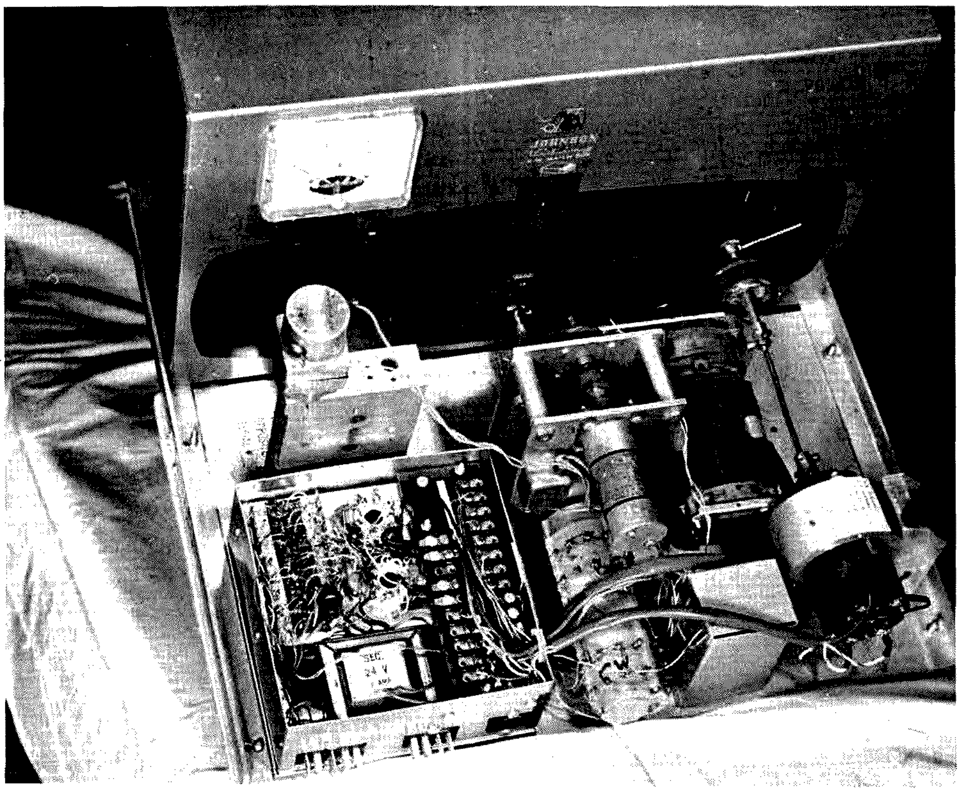


Photo B. Shelf for Matchbox motorizing units with control circuitry. Only the upper edge of the cam operating the microswitch is visible, near the center of the photo. Jones plugs in the small box connect the unit to the operating position control and the antenna grounding unit. By driving a matching capacitor with a timing-type belt, a shaft projection is available to drive the selsyn indicator.

dicator.

Fig. 2 shows how four wires can be used to operate 12 relays selectively. This circuit has been checked in breadboard, though not actually used in the pictured unit. The number of controllable relays has been doubled by using diodes such as 1N4004s so that each combination of wires one through four (e.g., 1-2; 1-3; 1-4; 2-3; 2-4; 3-4) can be used to select two relays. I plan to use a version of this for control of an EME setup.

Note, however, that this arrangement permits, in general, any one wire to be used for only one relay at a time. It works for circuits that do not require continuous relay energization. For example, if you wished to turn off the ac power for the 24 V dc supply and the selsyn from the operating location, it would be necessary to use an impulse-type relay because, while the ac circuit is activated, none of the other relays can be used; it's one relay at a time.

The operating console control unit shown in Photo C uses an eight-position push-button switch of the locking type, and some consideration had to be given to this configuration. Band selection, matching capacitor setting, and tuning capacitor setting must be done nonsimultaneously. This was ensured by using 2-pole, 3-position spring-return-to-center lever switches (Centralab # 1455s) for matching and tuning capacitor rotation. As shown in Fig. 2, operating either of these switches temporarily disconnects the push-button switch so that, temporarily, no power is applied to the respective relay and the center positions of the lever switches are in series. Note that a separate 24 V dc supply is in the control unit, though the 24 V dc needed for relay operation could have been obtained via the otherwise unneeded last two wires of an eight-wire cable. For relay operation, voltage drop would not be a consideration, as the current drawn is very light.

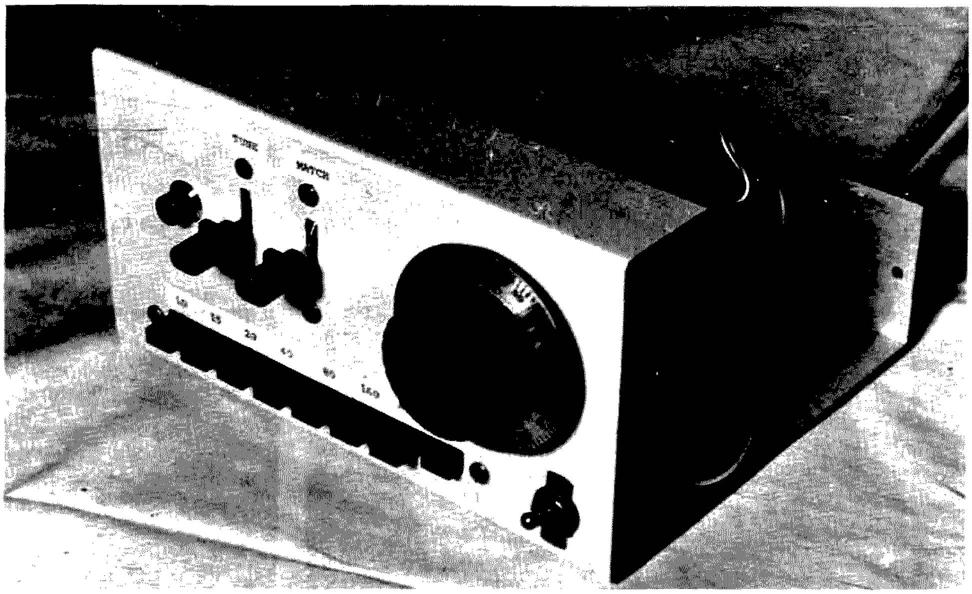


Photo C. Operating unit for remote control of antenna tuner, selection of antenna, and grounding of antenna for lightning protection. Dial is driven by a selsyn, which indicates the position of the matching capacitor. The unit is in a Ten-Tec MW-8 case.

As for the selsyn indicator, although conventionally five wires are used to connect the transmitter and indicator, all the textbooks show that the number can be reduced to four by using one common wire for rotor and field. But, if both indicator and transmitter are fed from the same household circuit, this circuit supplies two of the needed four wires and only two need be added in the control cable. It is possible that transmitter and indicator will be on opposite sides of a 220 V centertapped circuit, in which case rotor terminals will have to be reversed on one unit. Checking this idea out in breadboard verified that it worked, though it was not actually employed in the control unit pictured, which used a separate cable for the selsyn. See Fig. 3. With the common 8-wire cable, two selsyn indications (azimuth and elevation) and control for up to 12 relays (tuning, gain, etc.) for an EME setup could be obtained, given ac power at the antenna.

A few small points complete the story. I chose to use miniature 24 V dc relays where current requirements were light — e.g., closing other relay contacts — but I used heavier relays for operating motors. Because the relay supply had very poor regulation, it stood at 38 volts when in use for miniature relays but it was drawn down to 24 V dc for the larger relays. A regulated 24 V dc supply might be neater. I added series resistors to limit current in the miniature relays. Transient suppressors (G.E. type MOV-750) were used across the coils of the bigger relays and the 24 V dc motors.

That's about it. I've thought of more sophisticated systems, such as tone-controlled systems using SE567 tone decoder ICs or some shift register arrangement. I've also considered other applications for simple remote control — for example, tuning and gain-setting in a preamplifier mounted at the top of a tower, or changing polarization on a moonbounce or OSCAR antenna. As I've noted at several points, the circuit described is not the one used in the units pictured. This is because I built up the unit before figuring out how to minimize the number of connecting wires needed; however, all circuits diagrammed here have been checked out in breadboard form.

The collection of parts used and the construction are not what I'd use on a cost-plus government contract, but they are a good illustration of what is available at hamfest fleamarkets, to make an offbeat project feasible at trivial cost. ■

References

1. Merkle-Korff Gear Co., 11500 W. Melrose Ave., Franklin Park IL 60131.
2. Available through Japanese Products Corporation, 7 Westchester Plaza, Elmsford NY 10523.

Diodes of the Dead

—eavesdrop on the great beyond

Bored with ho-hum projects? This ghost detector will spook you!

Si Dunn K5JRN
3607 Binkley
Dallas TX 75205

Recently, in a Dallas bookstore, some eerie pink words suddenly glowed at me from shelves of psychic phenomena books: *Break Through—Electronic Communication With the Dead May Be Possible!*

In seconds, I was mesmerized. I paid $2.25 plus tax and rushed home with my very own copy of Konstantin Raudive's "amazing study (more pink words on the cover) that reveals how tape recordings can suddenly become the medium for voices from the dead!"

You see, all you really need to eavesdrop on the conversations of the spirits, the good Latvian Dr. Raudive claims, is a tape recorder, supplemented—if you really want to get fancy—by a small handful of electronic parts obtainable from almost any Radio Shack or ham's junk box.

Here, at long last, was a psychic challenge I couldn't resist. I don't have much extrasensory perception (ESP), and I've never bent any keys or spoons with my brain. But I do have a well-used Sony tape recorder and 24 years experience with radio parts and soldering guns. And I found, in my closet junk box, the parts to duplicate most of the psychic listening devices diagrammed in Raudive's treatise, recently imported to the American paperback market from the darkest corners of mysterious Europe.

In *Break Through*, Raudive describes three extremely simple techniques that he claims will record the voices of the dead and their messages from "beyond." And he includes transcripts—translated from Latvian, German, Russian and Swedish—of ghostly conversations that allegedly showed up on blank tapes.

In method one, you connect a sensitive microphone to your tape recorder, insert a blank tape, politely ask some of the dead-and-gone to speak to you, and sit quietly in your living room or ham shack. After a few minutes, you play back the tape and listen carefully for any messages.

It might help, incidentally, to be fluent in several tongues, since, Dr. Raudive claims, the spirits "speak in an unmistakable rhythm and usually employ several languages in one sentence; the sentence construction obeys rules that differ radically from ordinary speech . . . (and) identification of the voices is . . . often a remarkably difficult task."

In method two, you tune an AM radio to a frequency clear of rock 'n roll and other earthly interferences and place the tape recorder's microphone near the radio's speaker. A clear channel in the vicinity of 200 meters (1500 kilohertz) is recommended, since this seems to be a medium wavelength favored by ghosts in Europe.

I elected, however, to go first to method three, the exotic "diode-recording" technique, because it requires a few radio parts, and the quality of the voices received from beyond, Dr. Raudive promises, is "nearest to those of ordinary human ones."

Curiously, the device I wired from Dr. Raudive's schematic looks exactly like a crystal radio, the kind I constructed from Cub Scout handbooks when I was a pre-Novice of 10. The only significant differences include the use of a diode instead of a cat's whisker and hunk of galena and an antenna limited to no more than about three inches, instead of the traditional 100 feet.

Still, I didn't let suspicion stand in the way of experimentation. In science, anything is possible. If the dead want to address the living over crystal radios, I'll sure as heck listen.

As I soldered the last connections and readied my tape recorder, I considered the immense possibilities. Suppose I eavesdropped on a bitter argument between Babe Ruth and Plato? What if I received, live and direct from Franz Schubert, the finish to his Unfinished Symphony?

I might even hear the confused cries of all the souls lost in the Bermuda Triangle, if the skip was right. I would be able to write a new book: *Diodes of the Dead! Eavesdropping On Eternity With A Crystal Radio!* And while it sold millions from coast to coast, the *National Enquirer* would print excerpts and an interview, and movie producers would come to me in parades of limousines.

Raudive recommends taping for no more than 10

or 15 minutes at a time because "examination of voices received may take several hours."

Turning on the recorder, I felt my excitement sharpen as I read that "children and people with a musically trained ear have least difficulty in following the voices; military-trained radio operators achieve a high degree of accuracy, and, for some unknown reason, specialists of internal medicine and Catholic priests also seem to be able to discern the voices with relative success."

I'm no doctor or priest, but I can play a harmonica by ear. I was a Navy radio operator, and now I hold an Extra Class ham license. And some of my friends might argue that, at age 34, I'm still a bit of the old child. With qualifications like these, I might not even need a crystal radio to hear Raudive's "voices."

The first 10-minute taping seemed to last forever. I carefully straightened the three-inch whip, tapped the tiny 1N914 diode and imagined all types of conversations flowing smoothly onto the tape. Ernest Hemingway might even offer from beyond to help me write, if I—in this world—would ghost his next novel.

Time at last to decode the first offerings from infinity, the dialogues of the dead, the jokes, the lessons, the exhortations from eternity. I rewound the tape and turned my ear expectantly to the first snaps, crackles, and pops emanating from the loudspeaker.

Nothing. Absolutely nothing but the electromagnetic void. Not even a static crash or whisper.

Desperately, I rechecked the wiring, rewound the tape, tried new tapes and methods one and two. But

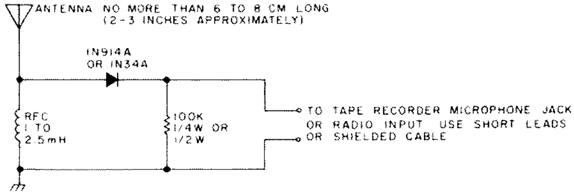


Fig. 1. Simple (too simple?) "voices of the dead" detector.

hour after hour, I heard nothing except the steady hissing of cheap cassettes and periodic moans and groans from the Sony's worn gears. At one point, the recorder stopped, as if seized suddenly by an unseen power. But it was only the batteries signaling that they were dead.

Sadly, I cast from my mind the outline for my best-seller. I threw Dr. Raudive's book into the pile to be sold soon at a used book store. But before I pitched the ghost detector into my junkbox, I hooked it to a 100-foot antenna and tried one more taping.

Voices poured forth in a babble: news, weather, sports, music. Just as I had suspected, I had not found the Bermuda Triangle, but I had reinvented the crystal radio.

The ghosts of the world probably laughed when I sat down at my typewriter and confessed: "Writer fails to communicate with dead despite explicit instructions." But ask me if I care. The *National Enquirer* probably will call me anyway, and I think I hear a movie producer's limousine pulling into my driveway right now . . . ■

Building an Economy Receiver

—junk box, here I come!

Broken radios and TVs are the mother lode for this project.

Tom McLaughlin WB4NEX
132 Bay Point Dr. NE
St. Petersburg FL 33704

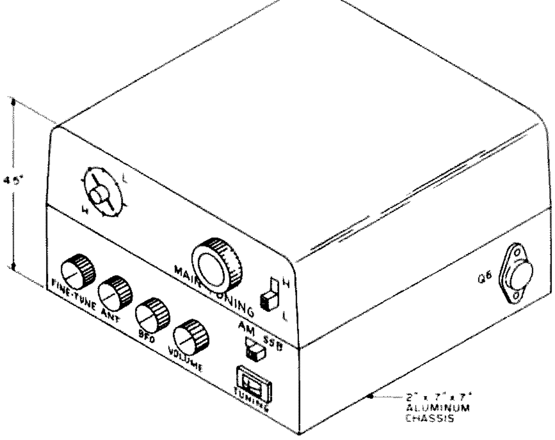


Fig. 1. Isometric view of the 6-15 MHz receiver.

Several years ago, I decided that I needed a good general-coverage "communications" receiver, one that had switchable bandwidth, CW filter, i-f and rf gain controls, etc. After looking for a while, I bought a used tube-type unit that would do everything except tune itself . . . ha.

I remember three or four occasions when I tuned the receiver to an AM broadcast station after warm-up, only to return a couple of hours later to find that the beast had moved itself up near the next station on the dial. This, of course, was an electronic and not a mechanical phenomenon and afflicted all bands. I worked on it for several months, but never did discover what was causing the drifting.

After having been properly educated in general-coverage receivers, I decided that I would look for something cheaper, something that offered less chance of getting burned. I wanted a fairly sensitive transistor unit, good selectivity, bfo for receiving SSB, and coverage of international shortwave and 20 and 40 meters; all this should be for less than $30 or so. I looked for quite a while. Obviously, I would have to build one myself.

Then along came the December, 1977, issue of *73*, and in it was the article "Build A Useful HF Receiver." Essentially, that was the basis of my receiver, although I have greatly expanded and mod-

ified the circuit. My design uses a 120 V ac supply, bfo, adjustable i-f gain, and tuning meter; it can be modified to suit any particular need. The tuning range is limited only by personal preference and coil-winding ability. Even without going to extremes, there is less than 100-cycle drift after a twenty-minute warm-up, and adjacent channel rejection is good. You may want to add more tuned circuits in the rf section to improve image rejection, but, for my purposes, the circuit as shown is more than adequate.

Most of the components can be salvaged from broken radio and TV sets; the whole setup is based on using readily available stuff in order to keep the cost down. For example, I used the power transformer from a 12" black and white transistor TV I found in someone's garbage, the main tuning capacitor from an AM radio, some transistors from the AFT board out of a color TV, and the tuning meter from a smashed tape recorder. I had some pieces of scrap vectorboard which I used to make the subassemblies. After they were all working, I installed them in the chassis.

Rf Section

An NPN rf transistor, Q1, is used to isolate the antenna from the mixer stage; the NE-2 bulb is added to absorb any static discharges from the antenna. An FM trap and a 2 MHz high-pass filter are used to eliminate spurious signals. I recommend using these additions because of the high gain provided by IC1. Several high-power AM and FM transmitters nearby caused problems without the filtering. C6 on the FM trap should be adjusted to null out any FM stations coming through after the receiver is working.

Rf chokes for the 2 MHz filter can very easily be obtained from a color TV; loads of them are used in the color circuitry. The coding is like resistors', except that two or three dots of color indicate the inductance as follows:

green + blue = 56 μH
red + black + brown = 200 μH
yellow + violet + white = 4.7 μH.

I-f and Audio Section

The mixer stage is a dual-gate diode-protected MOSFET, Q2, followed by a Miller 8901-B 455 kHz i-f transformer. Oscillator injection is provided by the vfo which supplies about ½ to 1 volt rms. Although the Miller 8901-B is supposed to be followed directly by the 8902-B amplifier module, I decided to add a differential IC i-f amp, IC1, between the two in order to improve the sen-

Parts List

C1	AM BCB variable capacitor, air dielectric; (a) antenna section, 10-365 pF; (b) oscillator section, 7-115 pF
C2, C4	variable capacitor, 5-50 pF (approximately) air dielectric
C3	variable capacitor, 1-7 pF (approximately), air dielectric; use one rotor and one stator plate, adjust spacing for desired tuning range.
C5, C6	ceramic trimmer capacitor, 8-50 pF, N750
C7, C9	ceramic trimmer capacitor, 5-25 pF, NPO
C8, C10	ceramic trimmer capacitor, 3-12 pF, NPO
IC1	CA3028A differential rf/i-f amp
IC2	MC1306P integrated audio amp/preamp
L_L	14 turns #22 enamel wire closewound on ½" diameter slug-tuned form, red slug; tap at 1¼ turns from ground end
L_H	6 turns #22 enamel wire closewound on ½" diameter slug-tuned form, red slug; tap at 1¼ turns from ground end
L_{OL}	31 turns #30 enamel wire closewound on ¼" diameter slug-tuned form, red slug
L_{OH}	14 turns #30 enamel wire closewound on ¼" diameter slug tuned form, red slug
L_B	AM BCB tube-type radio oscillator coil
Q1, Q3, Q4, Q5	2N4124 silicon NPN rf transistor (or equivalent); many types will work
Q2	40673 dual-gate MOSFET, gate protected
Q6	NPN power transistor, 10 Watts or more
D1, D2	1 Amp, 100 piv silicon rectifier diodes
ZD1, ZD2	8.2-volt, 1-Watt silicon zener diode
ZD3	10.0-volt, 1-Watt silicon zener diode
S1	three-pole, two-position slide switch
S2	DPDT slide switch
T1	power transformer, 120 V ac primary; 35 V ac, .5-Amp secondary, c-t. (can also use 24 V ac).
8901-B and 8902-B	i-f units, 455 kHz, made by J. W. Miller Co., Los Angeles.

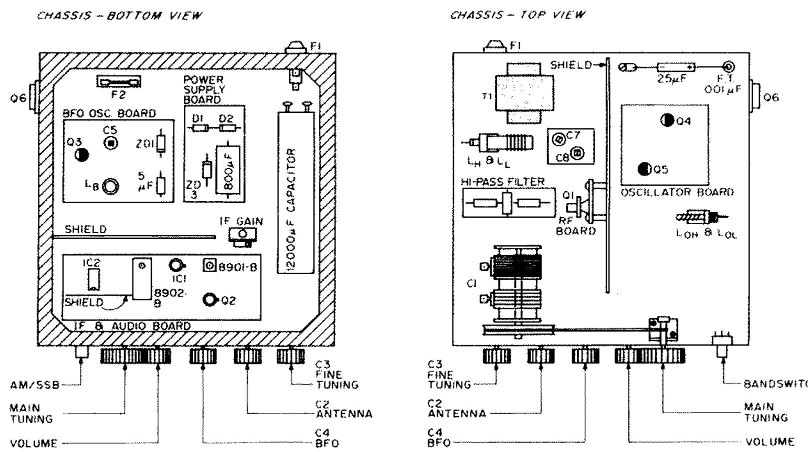


Fig. 2. Chassis and circuit board layout and component placement.

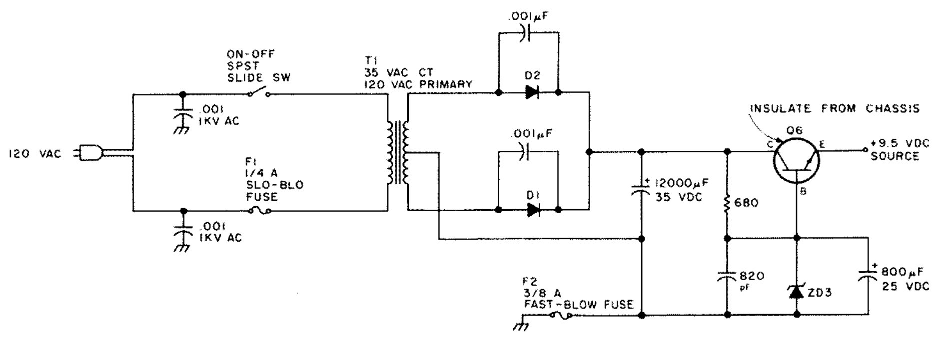


Fig. 3. +9.5-volt dc supply.

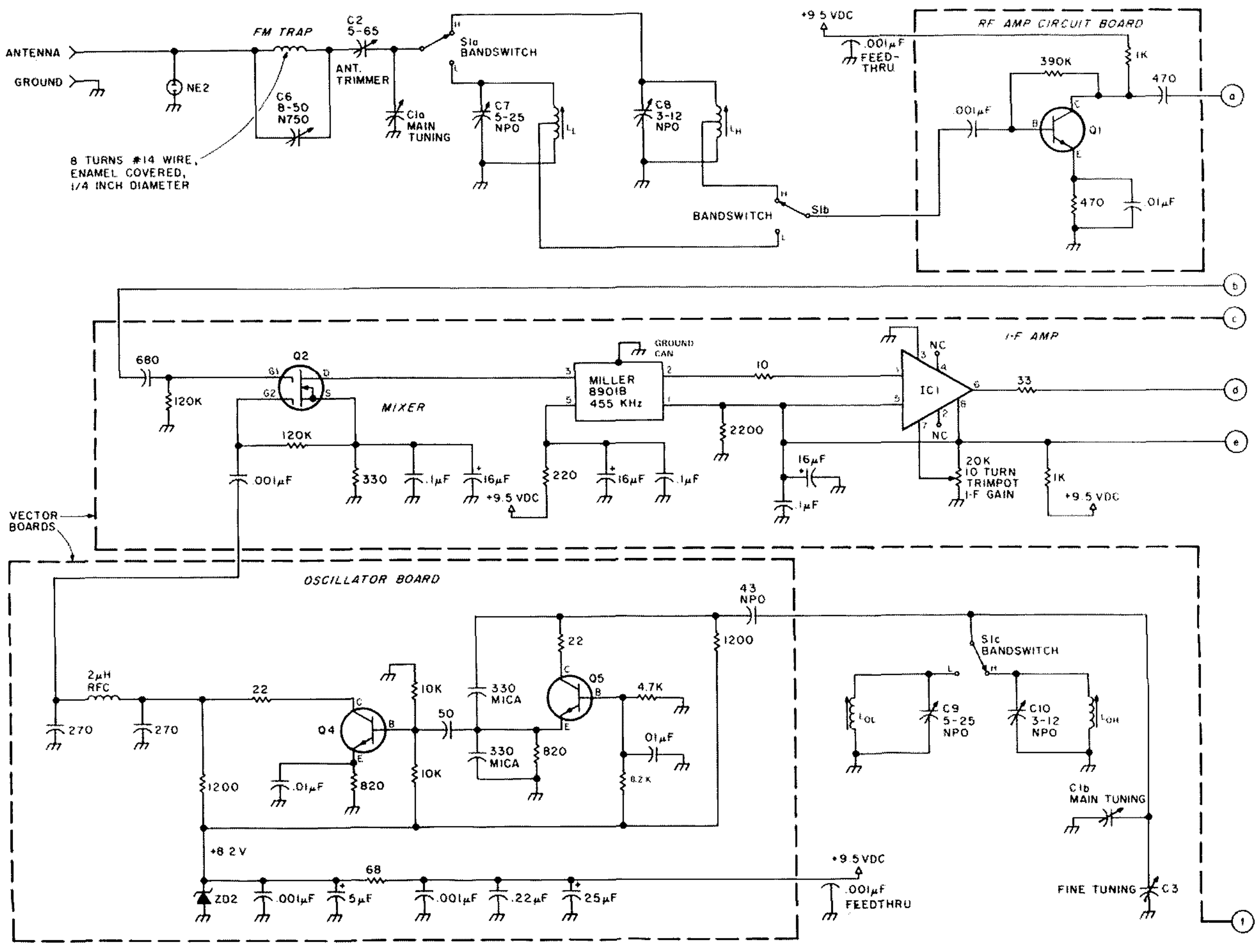


*Fig. 4. Circuit diagram for the 6-15 MHz receiver. *See text. L = 6-9 MHz; H = 9-15 MHz. Electrolytic capacitors are 25-volt units unless otherwise noted. All capacitor values are in picofarads. All resistors are ½-Watt, 10% tolerance.*

sitivity. This combination works very well, and you will find that the i-f gain is so high that you will not be able to use the unit with the gain control set all the way up. This is a tremendous advantage in a cheap receiver because you can compensate for the losses in the filters as well as for weak signal strength due to a lousy antenna.

Audio can be taken directly from pin 7 of the 8902-B module, or it can be taken from "pin 8" and run through a product detector for SSB and CW reception. Note that the module as supplied by Miller does not have pin 8 connected. You must remove the metal can and use a tiny piece of wire to connect pin 8 to the anode of the built-in AM detector. This is a very simple operation and does not require any particular skill. After you have replaced the metal shield, you are ready to install the module. If you choose not to use a tuning meter, you must ground pin 5 for dc return, or the module will not work.

Audio leads between the detectors, AM-SSB switch, S2, and the audio preamp/amp, IC2, should be kept as short as possible. The audio IC also has an extremely high gain, which is good for weak signals but creates a bad feedback problem if you don't use a small metal shield to separate the input components from the output circuitry.

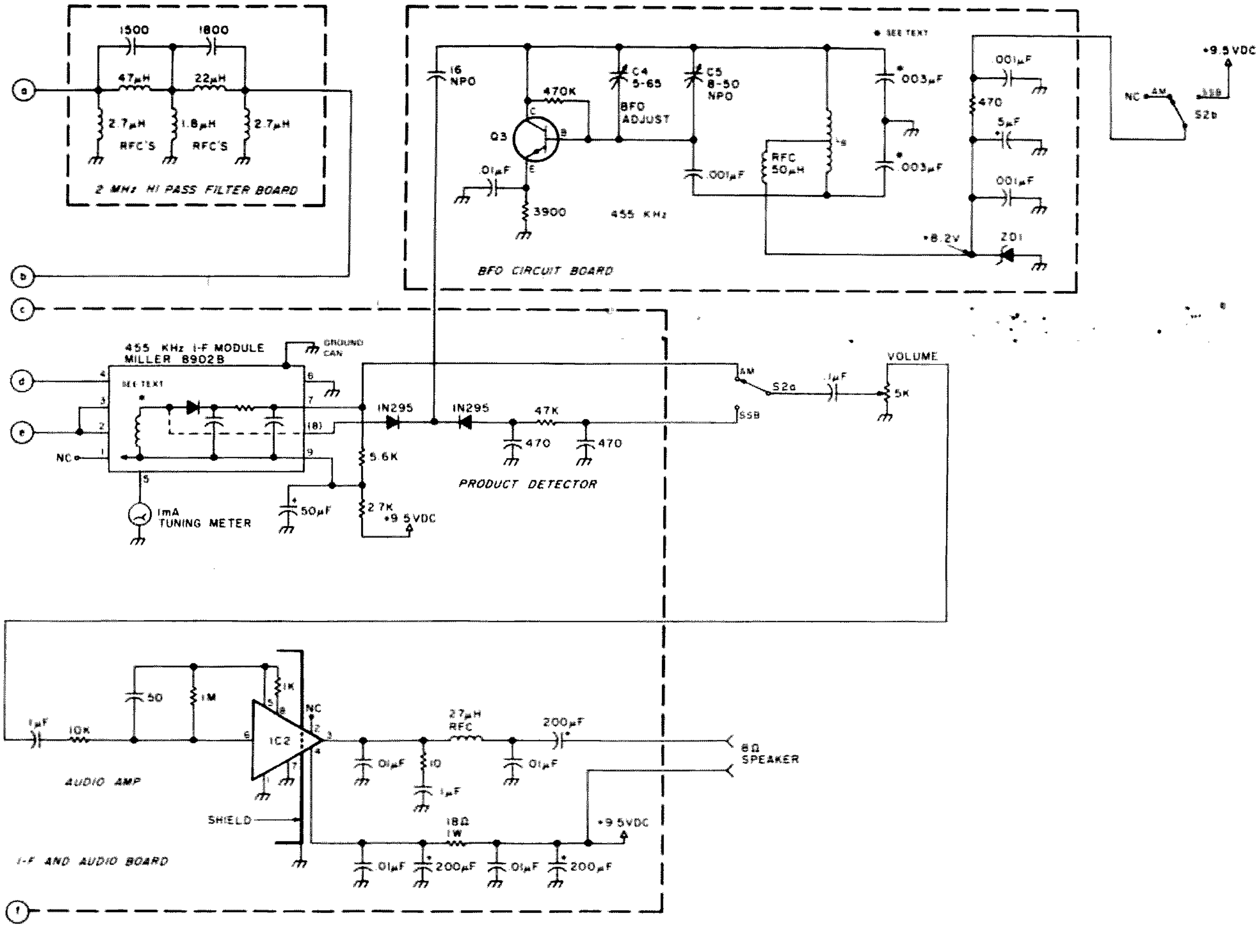
Vfo

The local oscillator is a two-stage setup consisting of a grounded-base oscillator, Q5, which is capacitor-coupled to a buffer amplifier, Q4. The output is fed to the mixer stage through a low-pass harmonic filter using two 270 pF capacitors and an rf choke. Rf chokes are not used to supply dc to the transistors; the circuit works very well without them and they may cause oscillation on two or more frequencies if they are used in this manner. Main tuning for the oscillator is provided by a parallel LC tank circuit using the oscillator section, $C1_b$, of a dual-ganged variable capacitor from a tube-type AM radio. The larger capacity section of this capacitor, $C1_a$, serves as tuning for the tuned rf tank circuit in the rf section.

It is important to use all the bypassing shown in the diagram to keep rf out of the power supply and to keep audio from modulating the vfo. I had a good bit of trouble with this, and I finally eliminated all of it with the .22 uF and 25 uF capacitors in parallel across the feedthrough capacitor supplying dc to the vfo board.

Bfo

Good stability for sideband reception is provided by an NPN transistor in a Colpitts configuration. The oscillator coil, L_b, is from a tube-type AM radio oscillator circuit, also. You will have to pad this coil to get it down to 455 kHz. Two .003 uF disc ceramic capacitors connected as shown worked with the coil I used, but these may have to be altered slightly with other coils. The location of the



tap is not too critical because an rf choke is used here for dc feed. Once you have the oscillator working near 455 kHz, the bfo adjustment capacitor, C4, should be set to its midpoint and C5 should be adjusted so the oscillator frequency is at the center of the i-f bandpass. Then you can adjust C4 at the front panel for upper or lower sideband.

Conclusion

Although this receiver is not a project for a beginner, it is really not complicated. A 15 MHz scope and a frequency counter were available to help get my unit working, but it is possible to finish up using only a high-Z voltmeter and rf probe, a general-purpose rf generator, and a grid-dip meter. You can use the receiver i-f and audio sections to tell what the other stages are doing, so it's a good idea to make those sections first. Be sure to use all the electrolytic capacitors shown so there is no audio feedback through the power supply. Note that the stages are separated from each other either by chassis placement or aluminum shields. ■

References

1. Edward M. Noll, *Second Class Radiotelephone License Handbook*, 1967 edition, p. 156.
2. *73 Magazine*, December, 1977, pp. 216-217.
3. *Ham Radio*, November, 1977, p. 14.
4. A.R.R.L., *Radio Amateur's Handbook*, 1969 ed., p. 191; 1977 ed., pp. 240, 278, 280.

The ST-5 Plus

—improvements on a favorite TU

Two easy additions to the ST-5 double its performance.

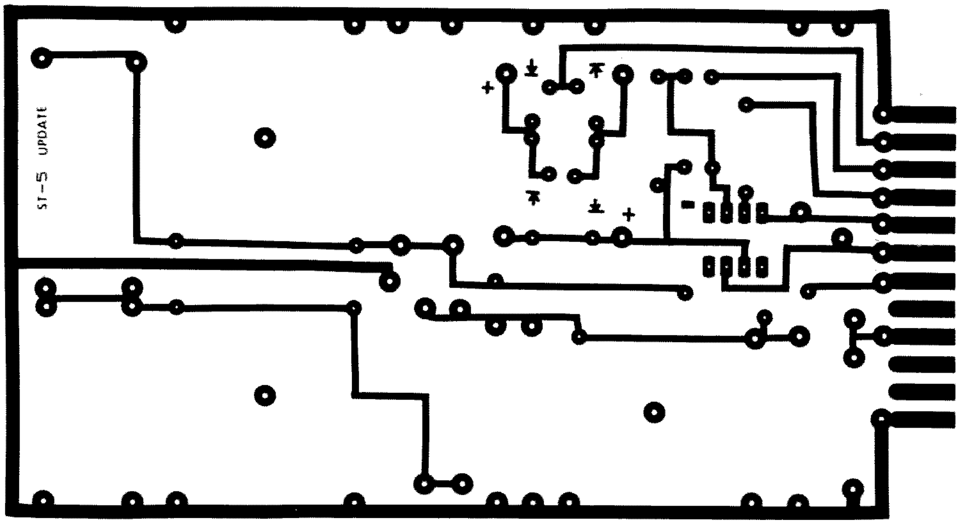
Dick Sander K5QY
110 Starlight Drive
Plano TX 75074

The ST-5 is a popular radioteletype (RTTY) terminal unit that has been around for a long time. It has been offered as a kit, and many home brewers have built it from scratch. Unfortunately, I found that QRM on the HF bands easily wiped out the print on my ST-5. I made two modifications to improve its performance. First, I added a bandpass filter for 170 Hz shift (I included a bypass switch in case I wanted to receive 850 Hz shift). The 170 Hz shift input filter is directly from the ST-6 terminal unit. Next, I added an automatic threshold detector which is described in *Ham Radio*, November, 1973 ("Variable Shift RTTY Terminal Unit," by K. Sueker W3VF). The improved performance from these circuit modifications justifies the effort required to incorporate them.

To start, build the 170 Hz shift bandpass filter and automatic threshold detector on a printed circuit board. A printed circuit board for mounting and wiring the modifica-

Fig. 1. Printed circuit board; (a) foil side; (b) component side.

A



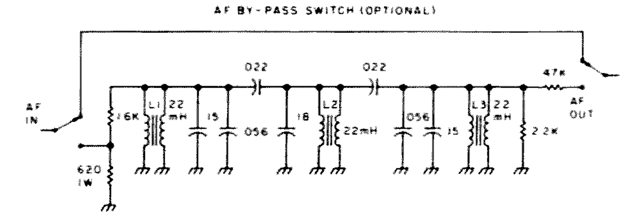


Fig. 2. 170 Hz shift input filter.

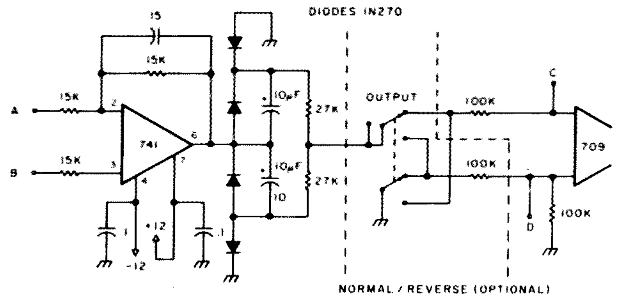


Fig. 3. Automatic threshold detector circuit, allowing copy of space keyed telemetry.

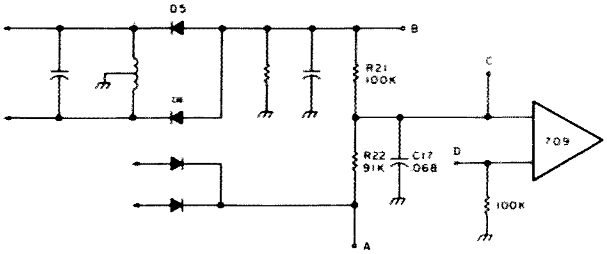


Fig. 4. Basic ST-5 discriminator.

tions is shown in Fig. 1. A breadboard is fine if a printed circuit board is not desired. A schematic for the bandpass filter is shown in Fig. 2. The 22 mH toroids are 88 mH toroids with the parallel windings in proper phase (sleeved ends together).

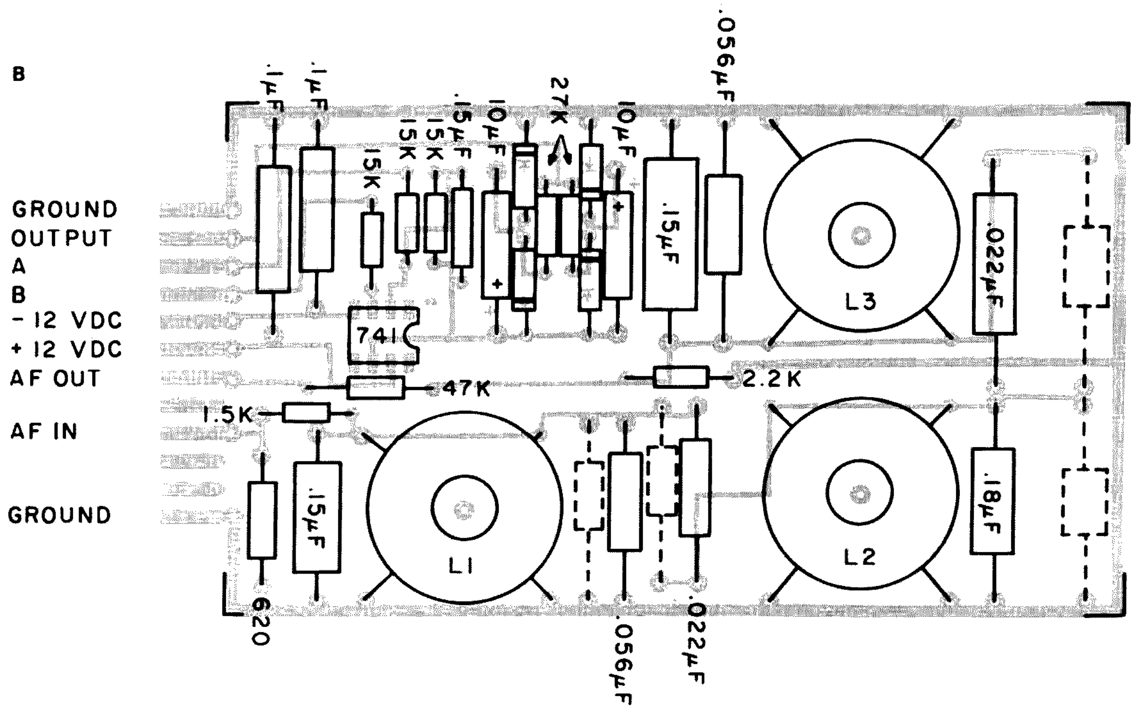
After the detector-filter board is complete, tune the 170 Hz shift bandpass filter, and then wire the automatic threshold circuit into the ST-5. Tuning the 170 Hz shift input filter is not critical. However, addition of a small capacitance may be required to correct the likely high-frequency response of the filter. On the printed circuit board, extra holes are used for trimmer capacitors. Tune each toroid to 2195 kHz as follows:

1. Tune the first 22 mH toroid, L1, to 2195 kHz with the 0.15 uF, 0.056 uF, and 0.022 uF coupling capacitors shorted to ground.
2. Tune the second 22 mH toroid, L2, to 2195 kHz with the 0.18 uF and second 0.022 uF coupling capacitors shorted to ground.
3. Tune the third 22 mH toroid to 2195 kHz with the 0.056 uF and 0.15 uF capacitors.
4. Reinstall both 0.022 uF coupling capacitors from ground back to the proper toroid.
5. Wire the 170 Hz shift bandpass filter to the ST-5 input.

To wire the automatic threshold detector into the ST-5, make the following changes and see Fig. 4:

1. Remove the 100k and 91k resistors and 0.068 uF capacitor from existing circuit.
2. Reverse the 1N270 diodes, D5 and D6.
3. Wire the automatic threshold detector into the ST-5 at points A, B, C, and D as shown in the schematic diagrams.
4. Wire the 741 operational amplifier to +12 and −12 V dc.
5. If desired, a NORMAL/REVERSE switch may be installed into the ST-5. See Fig. 3.

There are no adjustments required for the automatic threshold circuit. After both circuits are wired into the ST-5, you will find tuning a RTTY station is very easy and QRM will not interfere with the pictures you're trying to copy. ■



Build a $10 Digital Thermometer

—hundreds of uses

Gary McClellan
2500 Harbor Blvd.
Fulleton CA 92634

You may not realize it, but a digital thermometer may be very useful around the home, lab, and shack. Besides using one to determine how hot or cold it is outside, and checking out cheap thermometers, you can do far more! For example, around the home, you can use a thermometer to check for heat loss (energy waste) in furnace and hot water heater insulation, check refrigerators and freezers for proper operation, and adjust the temperature of your hot water supply. Then, in the lab, you can check your home-brew circuitry for hot spots that cut component life, look at temperature rise in electrolytics and power transformers, and then adjust other thermostats or temperature controllers for proper operation. In the shack, use one to check crystal ovens, check rf power transistors to see if more heat sinking is needed, and so on. Or, how about using a thermometer to monitor the heat sink temperature on your transmitter finals to prevent damage. This could sure cut down on those long QSOs! If you can't think up more or better ideas for a digital thermometer by now, you disappoint me! Let's see what you can do.

The digital thermometer circuit presented here is a low-cost unit, costing around $10 to build, yet it works well and will measure temperature from 0°C to 100°C with an accuracy of ±1°C. This unit is really a companion to our model 101 DVM kit or MC-1405 DVM.* It puts out a dc voltage which is equal to the temperature in degrees centigrade. You may also use a 0-to-1-volt analog meter, or any digital multimeter if you wish. Calibration is fairly easy, too, and I have found a way to make it easier! There will be more on this, later.

The temperature limits of a thermometer are important, too. This one measures from 0°C to 100°C, or from the freezing point of water at sea level to the boiling point of water under the same conditions. You can measure temperatures slightly outside of this range at reduced accuracy. For example, I have a thermometer that is in calibration at 0°C. I dunked the probe into a −55°C temperature bath and the thermometer was 5 degrees off. I checked calibration at +125°C and calibration was off only 2 degrees! So that shows how far you can go. The sensor in this unit is a silicon diode, and the two temperature extremes are the maximum ratings of the diodes.

Here's an assembled digital thermometer. It gives good accuracy at a very low cost.

*"DVMs Get Simpler and Simpler," Gary McClellan, *73 Magazine*, February, 1977.

Fig. 1 shows a simplified schematic of the thermometer module. This unit is based on the fact that silicon diodes have the property of the junction voltage changing linearly with temperature. Actually, most solid-state devices have some sort of voltage change with temperature. In this case, a cheap 1N4148 diode will change 2.2 mV per degree centigrade. So all we have to do is bias the diode in the conducting mode, then amplify the signal and adjust it for a reading in degrees centigrade. A precision, dual-tracking power supply of ±12 volts completes this circuit, and assures excellent long-term accuracy.

You should be aware that there are other methods of sensing temperature, but none offer the combination of accuracy *and* low cost. For example, there is the thermistor sensor. Lots of thermometer construction articles using thermistors have appeared in other magazines, but thermistors

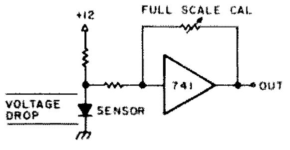


Fig. 1. Simplified schematic diagram of thermometer.

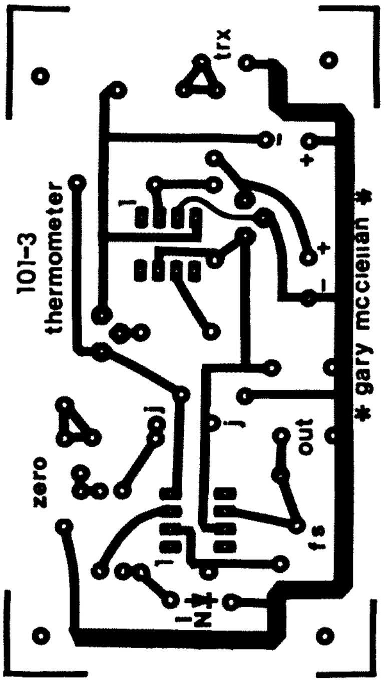
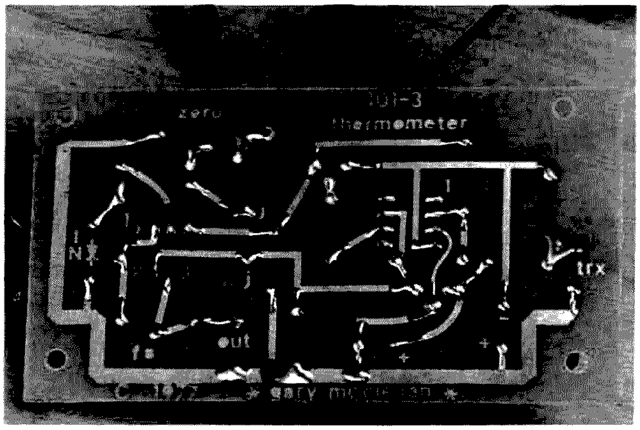


Fig. 2. PC board layout.



Underside of the thermometer circuit board.

in the proper resistance ranges are usually hard to get and must be special ordered. Also, if you step on it or destroy it in some way, you must order another one and wait, wait, wait by the mailbox. Then you must recalibrate your box for the new thermistor. With my unit, if you break the diode, a new one costs only pennies and is readily available. You still have to calibrate your module, but a new sensor is easy to get. That's a big reason why I use diodes. I have accidentally broken sensors of both types, and I would much rather break a diode any day! Another type of sensor is the thermocouple. This is the original electronic sensor, and I'm sure most old-time people in the temperature measurement field will doff their hats at the mention of the word. This is just two pieces of wire (made of different materials) clipped together at one end. Thermocouples have the advantage of being able to measure a wide range of temperatures, and also they are interchangeable without recalibration on a thermometer. One of the most popular thermocouples, the type K, or copper-constantin wire, has a temperature range of −270° to over +600°C!

Quite a difference from that diode. But thermocouple thermometers are much harder to build, and thus cost more. There are a good many $300 boxes out there on the market. So, by now, you can see why I am using that diode as a sensor, and perhaps appreciate how it relates to the other sensors.

Construction of this project is easy. A full-size printed circuit layout is given to aid you (Fig. 2). Simply duplicate the board, drill it, and stuff it with the parts, an easy two-evening project. The complete schematic diagram is shown in Fig. 3.

After you have the board, you will want to scrounge the parts. Good sources for IC3 might include *73* advertisers. Another place is Active Electronics, PO Box 1035, Framingham MA 01701. They have had them for 29 cents each plus postage. It's the same deal with the op amps. They do have a $10 minimum order, but their prices on the 78L12 regulator is tops as I write this, so you may have to combine several projects' worth of parts to place an order. One very important thing: Do not use re-tested junk parts in this project. If you do, it probably won't stay in calibration. A word to the wise is sufficient. The next problem parts are the pots. I used surplus Beckman Instruments type 89PR10K for the 10k pot, and a Beckman type 89PR100K pot for the 100k unit. These are available from Beckman distribu-

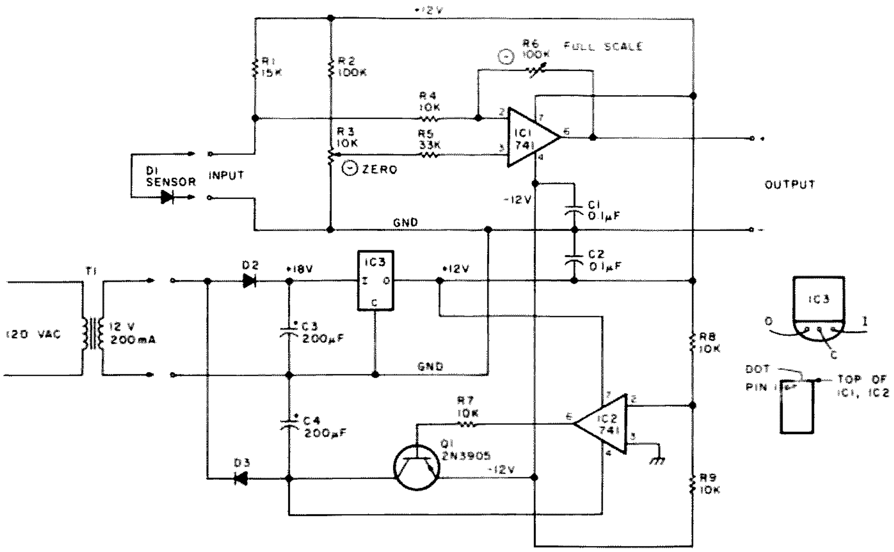


Fig. 3. Schematic diagram of Model 101-3 digital thermometer.

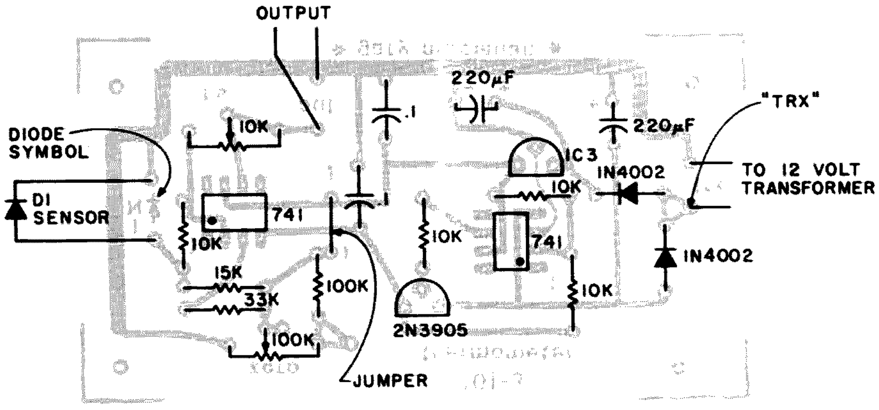


Fig. 4. Component layout. Don't forget the jumper!

tors, such as Fisher-Brownell here on the West Coast and others. They cost about $1 each. If you can't find these pots, drop me a line. They are the 3/4-inch long rectangular, cermet units. Others will work, however.

The next step is obvious—build it! Just follow the Fig. 4 illustration and you will have no problems. After you are done, attach leads for the output, and connect the transformer. Then do the usual checks for wiring errors, etc.

The sensor deserves special comment. It is just a diode on the end of a 2-foot piece of wire. For best results, get Teflon® hookup wire. Number 24 stranded wire with Teflon will do fine. You could use a short length of speaker wire here, but this type of wire has insulation that softens considerably at 100°C. Try not to use it—especially if you plan to do a lot of 100° measuring! Fig. 5 shows the details. There are several ways to construct the probe. A good universal probe can be made as shown by first slipping a 3-inch piece of Teflon tubing over the wires as a handle, then forming the diode leads and attaching them to the other leads. It might help to punch several holes along the edge of the tubing for the next step. Epoxy doesn't stick too well to Teflon. Finish up the general purpose probe by dipping it into epoxy. Cover up the end of the tube and let the epoxy set. You can make a special probe, such as for attaching to heat sinks, etc., by obtaining a small crimp-on lug from an auto parts store. Epoxy the diode and wires inside the lug (insulate so they don't touch it) and you are all set.

After you finish with the wiring, plug in the transformer, and check the voltages on pins 7 and 4 of IC1. They should be plus and minus 12 volts respectively. Then measure the voltage across the input terminals. It should be around 0.5 to 0.6 volts. If not, reverse the input leads and recheck. If it is still not right, the sensor is bad.

Finish up with the calibration. First, prepare a dish of cracked ice, and then return it to the freezer until needed. Also, heat up a pan of water until it boils. Turn your attention to the module and put your voltmeter between ground and pin 3 on IC1. Adjust R3 (zero) for a reading of 0.510 volts. The sensor should be at room temperature right now. Then connect your voltmeter to the output leads and adjust R6 (FS) for about 25°C or whatever the current room temperature is. These adjustments will put your thermometer in the ball park. Get out the cracked ice and place it within easy reach of the boiling water. Plunge the sensor into the ice and adjust R3 (zero) for 000 on the 1- or 2-volt scale of your meter. Then transfer the sensor to the boiling water, wait a minute until the meter settles down, and adjust R6 (FS) for a reading of 1000. Return the sensor to the ice, wait a minute for things to cool down, and readjust R3. Repeat with the boiling water and R6. For best results, do these steps at least 5 times. If

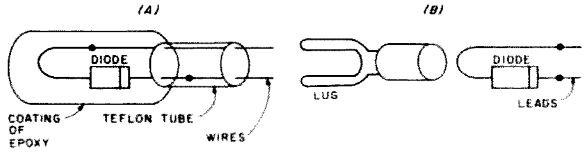
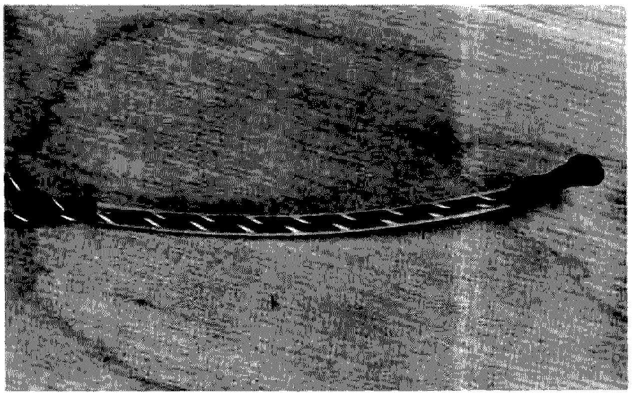
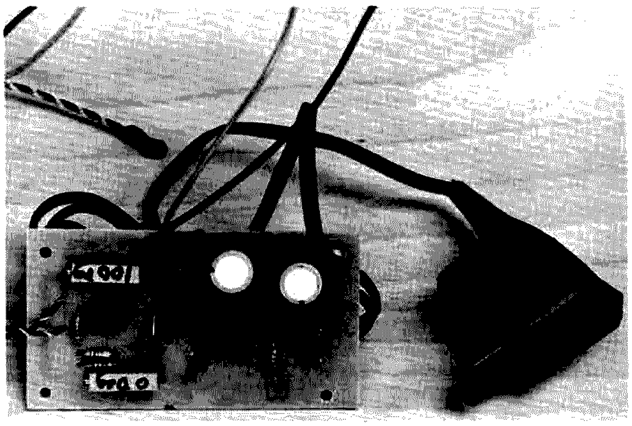


Fig. 5. Thermometer probe construction details: (a) general purpose, (b) mountable probe for heat sinks, etc.



This is a shot of the universal sensor probe. Try not to use as much epoxy over the diode as I did; the excess epoxy slows down response time.



Top view of the completed thermometer option. All that's needed is a digital voltmeter for operation.

you do, you will be within a few degrees of the correct temperature. For even better accuracy, use a well-calibrated commercial digital thermometer to compare with your thermometer.

Using your new thermometer is a snap! Simply touch the probe to the surface you want to measure. Then wait a minute or so for the temperature reading on your voltmeter to stabilize (always use the 1- or 2-volt scale) and note the reading. Your meter will show, if it is digital, degrees and tenths of degrees. So 390 on the meter is 39.0°C, 1001 is 100.1°C, and so on.

Now that you have a thermometer, why not think up some more uses for it and let all of us know about it! How about solar heating applications? More ham radio applications, etc.?■

Parts List

C1, C2	0.1 uF, disc capacitor
C3, C4	200-470 uF, 25 V electrolytic capacitor
D1	1N4148 diode
D2, D3	1N4002-1N4007 diodes (1 Amp)
IC1, IC2	LM741CN Op Amp (mini-DIP)
IC3	Fairchild-type 78L12, 100 mA voltage regulator
Q1	2N3905 PNP silicon transistor
R1	15k
R2	100k
R3	10k, 10-turn pot
R4, 7-9	10k
R5	33k
R6	100k, 10-turn pot
T1	117/12 V ac, 200 mA wall plug transformer
Misc:	Model 101-3 PC board, 16 Molex® pins, hookup wire

DX

from page 6

kHz at 1500Z is a good place to snag a few new ones. As with any net, listen until you understand the correct call-in procedure.

Congratulations to the new officers of the Iowa DX Association. Doug Byal WØSML is the president. Gary Letchford KØLUZ is VP, and Fred Benson KØAT is the secretary/treasurer. If you would like to join up, drop Fred a note in Cedar Rapids.

CO2FA notes that it takes four IRCs and 1¢ from his own pocket to purchase one air mail stamp. This is another case where one Yankee dollar is better for all concerned.

Often stations are heard signing /4U, and many have been wondering what exactly they count for in regard to DXCC. You can get DXCC credit for their actual location, and it helps if the QSL shows the exact QTH. This is straightforward, but sometimes confusing.

If you work any stations signing EI8H/, it will be a pirate. EI8H is for real, but someone has been using his call portable from such locations as PYØ, GU, HV1, etc. All are phonies.

WA3HUP has been reported as having some VU2ANI/VU7ANI logs on hand. If you need a card, you might drop Mary Ann a line to see if she can help out. She has long been one of the top QSL managers around.

Jerry McManus, who operated 4W1GM back in 1975, says he received verbal permission to operate, but since that official was later assassinated, he is somewhat reluctant to try. Jerry feels that any present 4W1 operation would be open to question. Work 'em first, etc.

K5YY became seriously ill upon his return from Africa, and the QSL chore was delayed for a while. Remember this, if your card seems late in arriving.

During his VS6HK operation last September, W6MJE took a side trip and operated CR9AJ. These QSLs will be sent out automatically via the bureaus, so don't bother QSLing CR9AJ for contacts on September 20/21.

Tuvalu has been assigned the prefix block T2A to T2Z. VR8O will now be signing T2O.

If you still need a QSL for the last operation from Heard Island, VKØHM, in 1970, try W7PHO. Bill has all the logs.

4LØ calls are Russians operating north of the Arctic Circle.

Although the U.S. *Callbook* shows only about 20,000 JAs licensed, JARL figures show the total to be 359,005 as of last August. The discrepancy stems from the fact that, due to language problems, the *Callbook* must depend on individual Japanese amateurs to advise them of their QTHs.

At the IARU Region III meeting in Bangkok last October, VS6AW noted that there were some 350 Hong Kong Chinese waiting to take the written portion of the amateur exam in December and that many more waiting for the next opportunity. Look for an influx of VS6s if everybody passes.

Speaking of the IARU Region III meeting, Fred Laun HS1ASD reports that there was a good turnout and lots of support for WARC '79.

The People's Republic of China responded to an invitation to attend the Region III conference by stating that since amateur radio activities had not *yet* been restored, it would be difficult to send an observer. Read into that anything you wish. If Clipperton, Iraq, Somalia, and Bouvet, then why not China?

3F75 prefixes are being used by Panama stations through February 3, 1979, to celebrate the 75th anniversary of Panama's independence. HP1KC will sign 3F75KC, etc.

Jacky F6BBJ apparently ran into difficulties with his planned Abu Ail operation. But those in the know stay alert. You never can tell what the day will bring.

Speaking of staying alert, the Italians are hinting at big doings from ZA (Albania).

Apparently, lack of interest and some confusion over the new callsigns has caused the KS6 QSL bureau to fold. Local advice out of Samoa suggests you QSL direct wherever possible.

Several PY stations were planning a PYØ swing during December or early January, covering Fernando de Noronha, Rocas Atoll, St. Peter, and St. Paul. Rocas Atoll has a new autonomous administration and the PYs feel it should count as a new one. No doubt there will be more on this later.

4LØKR was a special call to mark the 350th anniversary of the city of Krasnoyarsk in central Siberia. QSL to UKØAAB.

Speaking of Siberia, UK9AAN has up a five over five on ten meters spaced ten meters apart on top of a 14 story building. UK9AAN is at the Ural Polytechnic Institute in Chelyabinsk.

The great New England Schrodfest attracted Father Moran 9N1MM along with PY1RO, to tell about the recent St. Peter and St. Paul operation, and well-known DXer Don Riebbhoff.

If you worked FH8DK and he said to QSL via WA6BJS, forget it. Herb says he is the QSL manager for no one.

Although K5OVC, subject of our December DX Profile, was recently mentioned in a Personal Communications Foundation advertisement as having TVI problems, Lenny wants it known that everything is serene in Arkansas. The TVI problems were in New York when Lenny was W2OVC, and are now just a bad memory.

Many Pacific Ocean stations can be found on one or more of the nightly Pacific DX nets. P29JS invites stateside check-ins on 14222 from 0600Z. ZL1ADI holds forth on 14285 from 0530Z, and N2KW MCs the East-West Net on 14247 from 0430Z.

The new address for any future DX activity by VE3FXT is George Collins, Box 89, Lynden, Ontario LØR 1TØ, Canada. Arrangements have been made to have the mail collected from the box daily and the QSLs processed. George also notes that his February, 1978, activity from H5 (Bophuthatswana) was actually from Thaba Nchu in the southern province of that country. Many feel that the present DXCC criteria will make this a separate country from the north province.

The sunspot count countinues to climb beyond expectations. Many of those predicting an early doom for cycle 21 now say that it may prove to be one of the best ever. The real truth probably lies somewhere in between.

Larry LeKashman W9IOP, one of the founders of the CQ WW DX test, passed away recently, and the 1978 CQ WW test was dedicated to his memory.

The FT-101 that was shipped to YI1BGD by the Northern California DX Foundation is still being held by the SWISSAIR office there in Baghdad, with delivery efforts going to no avail. The airline wants $250.00 to ship it back,

Continued on page 127

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CB to 10

—part XVI: a CW conversion

Change one crystal and work the world legally with 5 Watts.

With three years of operating 10 meter QRP using converted CB rigs behind me, I decided to look for ways to monitor band openings by taking advantage of the CW beacons around the world. At the same time, 10 meter CW sounded like a lot of fun. In order to accomplish these goals, I established the following criteria which I wanted incorporated into the finished product:

1. 10 meter beacon coverage;
2. CW transmit capabilities on both General and

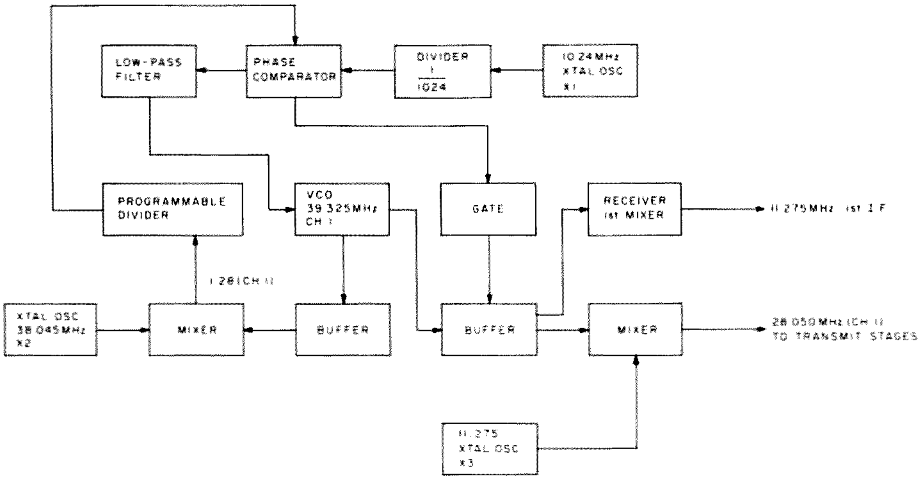


Fig. 1. Block diagram of phase-locked loop circuitry in the Sharp CB-800A with frequencies indicated for 10 meter coverage.

Ch.	fo	fvco	÷n
1	28.050	39.325	1.28
2	28.060	39.335	1.29
3	28.070	39.345	1.30
4	28.090	39.365	1.32
5	28.100	39.375	1.33
6	28.110	39.385	1.34
7	28.120	39.395	1.35
8	28.140	39.415	1.37
9	28.150	39.425	1.38
10	28.160	39.435	1.39
11	28.170	39.445	1.40
12	28.190	39.465	1.42
13	28.200	39.475	1.43
14	28.210	39.485	1.44
15	28.220	39.495	1.45
16	28.240	39.515	1.47
17	28.250	39.525	1.48
18	28.260	39.535	1.49
19	28.270	39.545	1.50
20	28.290	39.565	1.52
21	28.300	39.575	1.53
22	28.310	39.585	1.54
23	28.340	39.615	1.57

Table 1. $f_o + 11.275 = f_{vco}$; $f_{vco} - 38.045 = n$.

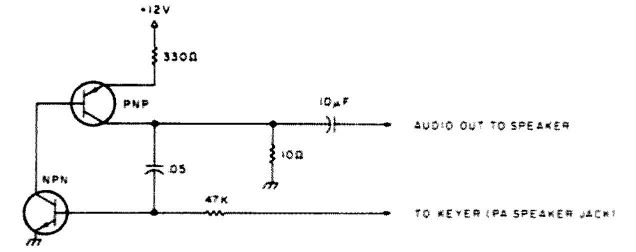


Fig. 2. Sidetone oscillator circuit. Transistors can be any general-purpose audio types. The .05 uF capacitors may be changed to vary the tone.

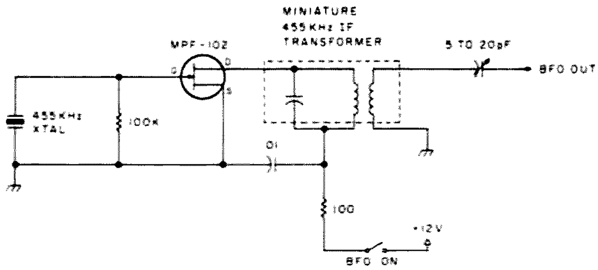


Fig. 3. 455-kHz bfo circuit.

Novice frequencies;
3. QRP operation of 5 Watts or less; and
4. price range between $30 and $40.

After researching the market, I decided on the Sharp model CB-800A phase-locked loop AM transceiver, which was readily available in my area for a price well under forty dollars.

An examination of the service manual for the CB-800A indicated that I would be able to meet the above goals. The frequency coverage I decided upon is shown in Table 1 with the beacon frequencies and identifications listed below:

Ch. 9	28.150	WA1EOB
Ch. 10	28.160	PY1CK
Ch. 11	28.170	ZL2MHF
Ch. 12	28.190	3B8MS
Ch. 12	28.190	DLØIGI
Ch. 13	28.200	JA1GY
Ch. 14	28.210	N4RD
Ch. 15	28.220	GB3CX

The first step in the conversion is to review the PLL frequency generation as shown in Fig. 1. As can be seen, the vco stage is the heart of the unit. In the original circuit, a vco frequency of 38.240 MHz was mixed with a received frequency of 26.965 MHz (Ch. 1) to produce a first i-f frequency of 11.275 MHz.

In the transmit mode, the vco output was mixed with an 11.275-MHz crystal oscillator to produce the 26.965-MHz transmit signal for channel 1. From this information, we can generate a formula to determine the vco frequency to enable us to transmit and receive on 28.050 MHz for channel 1. Thus, $f_o + f_{i\text{-}f} = f_{vco}$, where f_o is the operating frequency and $f_{i\text{-}f}$ is the frequency of the first i-f. With an operating frequency of 28.050 MHz for channel 1, the vco frequency must be changed to 39.325 MHz. It is very important, when converting a PLL circuit, that the original division factor for the programmable divider be maintained. As can be seen in Fig. 1, the division factor for channel 1 is 1.28. By changing the frequency of the original 36.960 MHz crystal (X2), we can do this. Thus, $f_{vco} - 1.28 =$ 38.045 MHz, the new frequency of X2.

With the new 38.045 MHz installed, perform the following steps to align the PLL circuit:

1. Place the channel selector switch to channel 12.
2. Connect an rf voltmeter to C220 at the output of Q206, and tune T203 for maximum output at 38.045 MHz.
3. Disconnect the rf voltmeter.
4. Connect a frequency counter to TP206 at the output of the vco transistor, Q203, and tune T201 for 39.465 MHz.
5. Disconnect the frequency counter.
6. Connect an rf voltmeter to TP2 at the output of the vco buffer transistor, Q202, and tune T202 for maximum output at 39.465 MHz.
7. Disconnect the rf voltmeter.
8. Connect a frequency counter to pin 15 of IC203, and verify the existence of a 1.42-MHz input signal.
9. Disconnect the frequency counter.
10. Measure the dc voltage at TP206. A voltage of approximately +2.7 indicates that the PLL circuit is locked. Zero indicates an unlocked condition.

This completes the PLL alignment. The receiver circuit alignment is as follows:

1. With the channel selector switch in the channel 12 position, connect a 28.190-MHz signal to the antenna jack.
2. Tune transformers T1, T2, and T3 for maximum S-meter indication.
3. Disconnect the signal generator.

This completes the receiver alignment. The transmitter alignment is as follows:

1. Connect a 50-Ohm dummy load to the antenna jack.
2. With the channel selector switch still in the channel 12 position, key the transmitter and tune T302, T303, T304, L302, and L303 for maximum rf output.
3. With a frequency counter, verify that the transmitted frequency is 28.190 MHz.

This completes the transmitter alignment, and you are now ready to make the necessary modifications for CW operation. The first step is to establish a method for keying the transmitter. This is accomplished by disconnecting the wiring to the existing PA switch located on the squelch control. Use this switch to energize the T-R relay in the CW mode. Unground the emitter resistor of Q303, the first rf amplifier in the transmitter, and connect it to the now-unused PA speaker jack. This will be the keyer connection. One word of caution: The ground side of the PA speaker jack is connected to the chassis. Before making any connections to the jack, break the connection to the chassis and connect the ground side of the jack to the circuit board ground.

The sidetone oscillator circuit shown in Fig. 2 and the receiver bfo circuit shown in Fig. 3 work very well and are small enough to fit inside the rig with no external mounting necessary. The output of the bfo circuit is high enough so that no direct connection to the receiver i-f is necessary. I simply positioned the wire from the bfo output across IC1, the receiver i-f circuit. Remember that in both the sidetone oscillator and the bfo circuit, ground connections are to the circuit board ground and not to the chassis ground.

Whether you decide to use the rig as a beacon monitor or a QRP rig, you will find it very enjoyable. I have had many contacts with it and all with good reports of CW quality.

So trade in your mic for a key and have fun on 10 meter CW! ■

Try a little KISS

—you'll love it

Reliable portable power has been right under your nose.

J. Tom Badgett K8AO
400 Albemarle St.
Bluefield WV 24701

Almost as familiar in hamdom as Murphy and his laws is the KISS formula: Keep It Simple, Stupid. When general considerations are at stake, most of us believe in KISS. It is when we pursue solutions to personal problems that we frequently lose sight of the fact that "simple" usually is best. Here's a case with some general and specific lessons which may be of value.

I blew my bank account recently for an ultracompact cassette recorder with the ruggedness and frequency response I need as a writer. The Sony TC-150 worked beautifully from the beginning, but the carbon-zinc AA-cells didn't last through even the first interview. The company wanted nearly $50 for rechargeable batteries and an automobile adapter, so I decided I might do something cheaper.

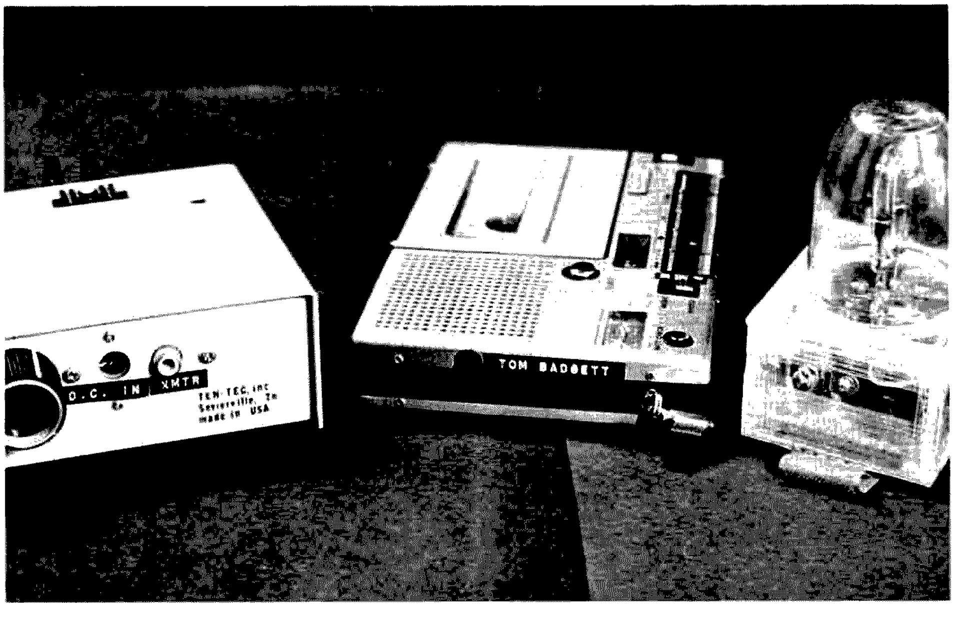
I solved the automobile converter problem first. The circuit in Fig. 1 reduces the vehicle's 12 volts to the six volts my recorder needs, gives excellent voltage regulation, smoothes out spikes and hash which might be generated by the electrical system, and provides recorder protection in the event of failure of any of the converter components. With junk-box parts, the total cost was around two dollars.

The circuit is a fairly common one, using a zener diode to control a pass transistor. One of the three-terminal regulators probably would handle all the current of most recorders or similar devices and would be simpler still. As shown, the circuit draws about 12 mA with no load across C-D, so, if I forget to unplug the unit from my car's cigarette lighter, there's no real harm done.

Naturally I was concerned about the safety of my $200 tape recorder, so, once I got the converter functioning, I shorted and opened leads while monitoring output voltage. Nothing I did produced excessive voltage at C-D. I had first experimented with a simple zener-resistor regulator, but found that such a circuit could deliver 12 volts to my six-volt recorder if the zener opened. With this circuit, an open zener simply will stop conduction through Q1. A shorted zener drops the output voltage to zero (and might blow a fuse in your car's electrical system). Should R1 short, the output voltage will rise a few tenths of a volt and probably cause excessive current to flow through VR1, but still no harm is done to the recorder. A short across any of the terminals of Q1 produces a slight rise in output voltage, but less than a one-volt increase was observed. Apparently the circuit is a safe one.

Obviously, it took some experimentation and breadboarding to get this circuit "perfected." Guys with more design experience could come up with a better circuit a lot quicker. But when I let KISS take over and studied the problem somewhat more objectively, I found another solution—one which made all that experimentation and design obsolete.

Even with the converter,



Here's some of the equipment I regularly power from a six-volt lantern battery. The keyer (left) is a Ten-Tec KR-1 paddle assembly with an Accu-keyer squeezed inside. My tape recorder is in the center, and on the right is a compact strobe I strap to my bicycle luggage carrier when I'm caught out after dark.

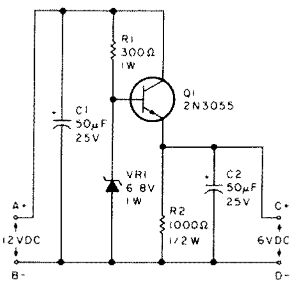


Fig. 1. Dc-to-dc converter.

I hadn't addressed the real problem: How can I have long-lasting battery power to record extensive interviews? Frequently I want to interview people outside, moving from room to room, or in an office situation where access to the mains isn't easy.

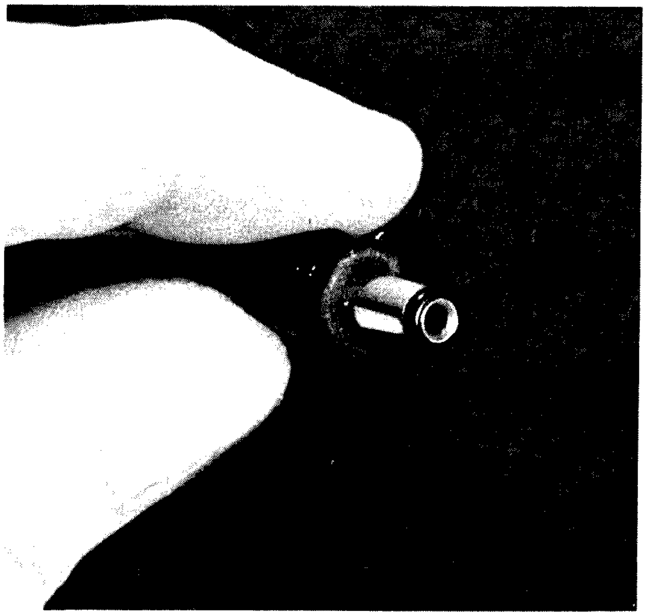
I checked several industrial and specialty battery suppliers for a rechargeable AA-cell which could deliver more than the 500 milliampere hours so commonly available. Apparently that's the largest AA-cell made and four of those will run my recorder less than three hours. It isn't unusual for my machine to run eight hours or more some days. Besides, these cells take anywhere from 5 to 12 hours to recharge, time I sometimes don't have in my business.

My recorder has an external dc input jack. I was using it with the ac converter in my office one day when the light dawned. I almost always carry the recorder in a small briefcase, so why must the power be self-contained? I found a plug to match the machine's dc input terminal and hooked it up to a six-volt lantern battery. I had found the (almost) ultimate long-life portable power supply.

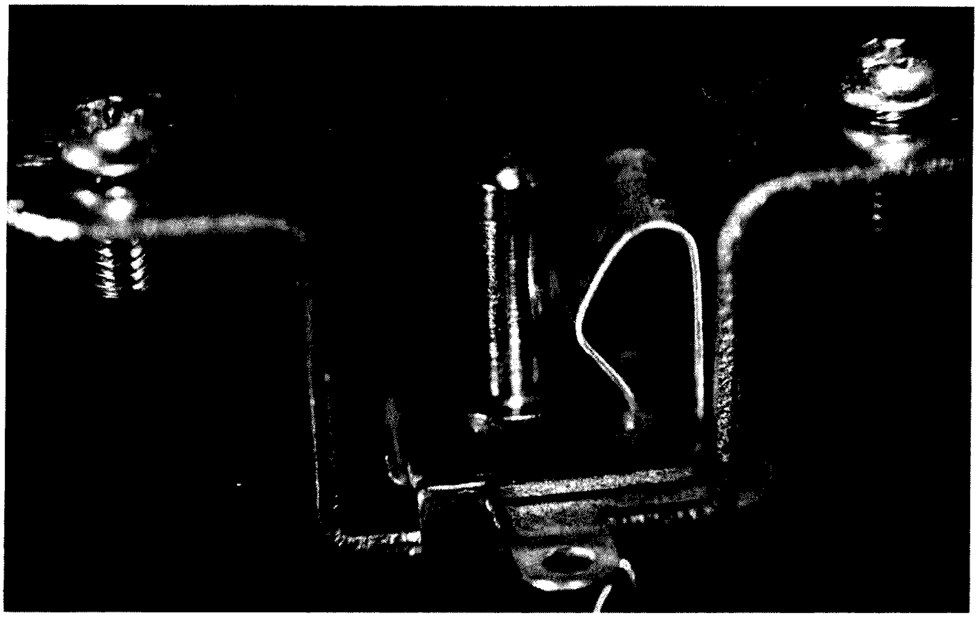
These batteries are rated for about five Ampere-hours. My tape recorder draws 150 mA during playback and record and 300 mA with the motor stalled after rewind, a short-term condition. I was getting over 30 hours of continuous use from each battery at a cost of less than two dollars. Since I was carrying the battery anyway, I no longer needed the automobile converter I had worked so hard to design.

Then other benefits became evident. This lantern battery with its power plug became a very useful bench supply. Cautiously at first, then with an increasingly cavalier approach, I began using the six-volt battery to power my five-volt circuits. I haven't found anything that couldn't take the slightly higher voltage with no harm. It is especially suited to power CMOS devices with their low power drain and wide voltage ratings.

I've improved the system now. I replaced the original dry battery with one of the new Gould rechargeables. With ac charger, interchangeable screw terminals, and spring contacts, the battery costs around $20, but it is worth it. Now when I build up a new project, I automatically install one of the little chassis-mount power plugs so common on tape recorders. They're available from Radio Shack and others for about four bits. They have an extra contact, so the internal supply (if one is installed) is disconnected when the external plug is inserted. Even with heavy recorder use and multiple uses around the shack, my six-volt rechargeable only has to be charged about



This tiny power plug attaches to lots of my ham equipment these days. Remember when wiring up one of these that the positive side is the outside of the barrel and the center conductor carries the negative current.



A close look at the chassis-mount jack that's going on more and more of my projects. Note the spring-type switch that can be used to disconnect an internal power supply. These jacks come with .085" or .097" diameter center posts. Most recorders use the smaller one, but I've found that some of the mating plugs can interface with either size. For some applications, you may have to isolate this jack from ground because the ground side is the positive side; the center post carries the negative current.

The ultimate in portable power: a six-volt, five Ampere-hour rechargeable battery. It comes with ac charger and interchangeable terminals for around $20.

every three weeks.

Now I'm a lantern battery convert. I don't see how any ham shack can get along without one. If you shop the discount houses, you can pick up the nonrechargeable version for a couple of bucks and you're buying a lot of power for your money.

But for heavy use, I recommend the rechargeable battery as a better buy. Mine lasts so long I've given up using my ac converter altogether. In fact, I even use the battery with my recorder when I'm loading and dumping programs from my home computer.

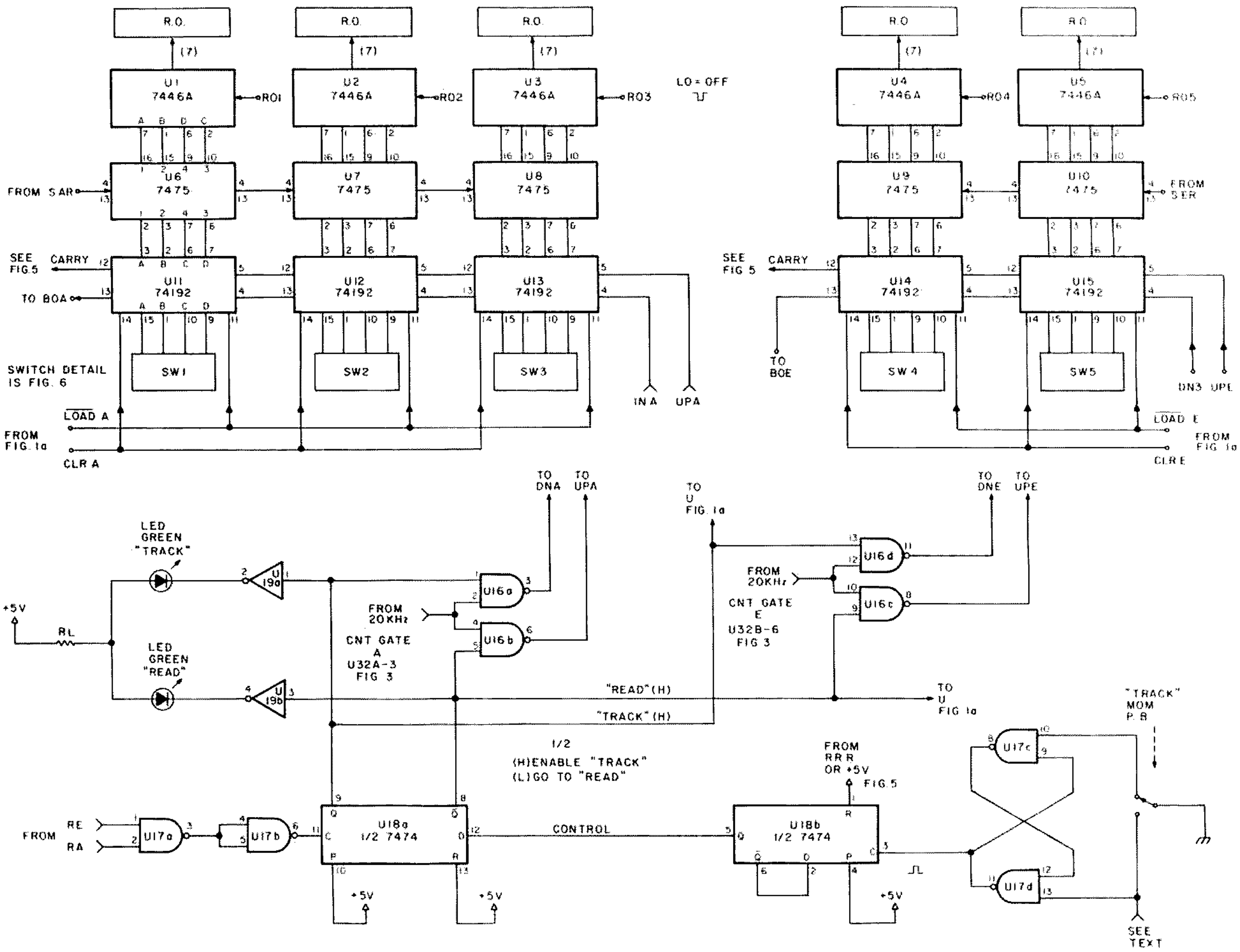
Hardly a day goes by when I don't find some useful purpose for the six-volt lantern battery, and that always reminds me of the time I wasted solving my portable power problem until I KISSed it. ■

✓ Reader Service—see page 227

Autotrak II

– chase OSCAR with ease

With automated antennas, the OSCARs are at your doorstep.



IC	Pin Vcc	Pin Gnd			
U1-5	16	8	U16-17	14	7
U6-10	5	12	U18	14	7
U11-15	16	8	U19	14	7

Fig. 1. Counter and read/track contents. U16—7400; U17 —7400; U19—7406.

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As a follow-up to my original article on Autotrak (*73 Magazine*, July, 1977), this article will reflect what a year's change in overall use, my continued system development, and a lot of reading have done for the original system. "Had I only known then . . ." seems to be an adequate phrase because the new system is as different from the old as night and day are from one another.

The Autotrak II system performs the same chore of aiming celestial-type antennas (El-Az mounting) to chase such things as the moon or OSCAR, but does so with some vast improvements over the old system. Some of these are:

1. The BCD entry system from the antennas no longer needs the BCD or gray-code-encoded "wheels" of the Autotrack I, and, therefore, is easier to set up and adjust. It uses, instead, the 500-Ohm pot found in nearly all commercial rotators sold today—no BCD wheels and no extra control or sense wires!

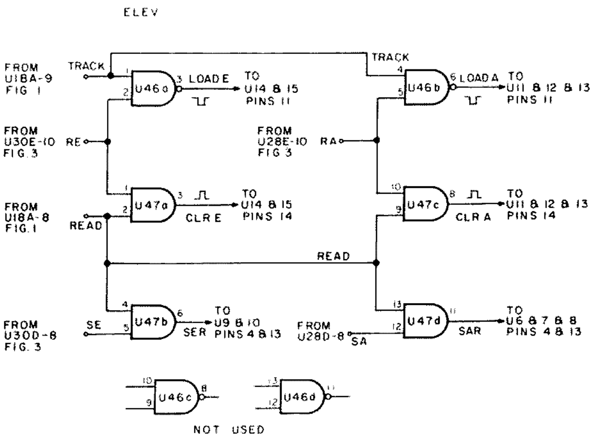
2. The system has good resolution (crystal timebase) and is very temperature stable, as all systems electronics are indoors at a relatively constant temperature, as opposed to those which are outdoors at the antenna end.

3. There is a large reduction in hardware, especially if you leave off the "frills" of Fig. 5. If you don't want the automatic feature, but do want accurate setting (BCD switches) and digital readout (7-segment LEDs), the circuit becomes even easier by eliminating most of Fig. 6.

4. My sincere thanks and credit are due to W6URH and his article in the November, 1977, issue of *Ham Radio* magazine. The article was on a digital locked receiver, but the counter scheme really got me thinking about its use in my Autotrak system. If you compare the two articles, you will no doubt see the striking similarities.

5. There was one major system fault which held up improvement until now. If you use any kind of pulse counting (ratchet wheel and microswitch at the antenna, etc.) system, the whole thing comes apart when you get to the counter part. If a ratchet were used, what would happen when you returned days later and turned power on? A memory, perhaps?—no, because of cost and constant power drain. Add that to a 90:1 change in elevation, or 360:1 change in azimuth, and vco's seem ruled out, too. But, in truth, they are not. You only have to use them properly, and the ratios suddenly become far less.

6. Finally, an idea I used in an earlier device to make a highly versatile tachometer circuit and a method used when counting low frequencies struck home. If you choose a good stable timebase of the right frequency as the "counts," or degrees, and allow the count gate time (period) to vary, a whole new picture develops. I have done just that on Autotrak II. The timebase is a crystal-derived 20 kHz, or 1 pulse per 50 μs. By making the window the right width, the right count occurs.



IC		Pin Vcc	Pin Gnd
U46	7400	14	7
U47	7408	14	7

Fig. 1(a).

7. Further, I do run vco's for both elevation and azimuth. The 566 IC can easily change frequency 2:1 on the modulation input pin alone. By choosing the right frequency for the vco clocks and gating properly, 2:1 windows are formed which count just what you need for proper readout. The count is never zero. (I'll cover that better further into the article, but, for now, just be advised that that solves all my linearity and VLF-vco problems.)

Since a counter scheme started the whole ball rolling, that seems to be the logical place to begin my system explanation. If you consider just U11, U12, and U13, or U14 and U15 with the gating of U16, you have very simple 3- and 2-digit frequency counters, respectively. U16 is the count gate, and, for the moment, I will consider only up counting as you are used to seeing in frequency counters (U16b and c). As I mentioned, the same 20 kHz timebase frequency is applied to both the azimuth 3-digit and elevation 2-digit counters through U16. This is true in both up and down counting. The count gate window is formed by the externally generated frequency, much the same as period counting in a period/frequency counter is. Ignore the preload lines with SWs connected to them and the load lines' pin 11 for the moment. You have then a simple up counter that "reads" X number of 20 kHz pulses depending on the window period, which depends on the vco frequency, which in turn depends on the antenna position and 500-Ohm rotor pot.

The generation of timing I will cover in detail in discussing Fig. 3, so, for now, I'll just give a sequence. The gates produce a count period, then a strobe period, then a reset period, and, last, an unused period (x). The entire sequence is repeated over and over. The period of each window and the overall sample period is determined by the particular controlling vco. As an example, look over Table 1, and note that the elevation vco runs at 100 Hz for 00 degrees and 50 Hz for 100 degrees. In order not to have the vco ever have to go to a zero frequency, I decided to

have it go from 100 Hz (period .01 seconds, count window = p/2 or .005 seconds, 100 counts of a 20 kHz signal) to 50 Hz (period .02 seconds, count window = p/2 or .01 seconds, 200 counts of a 20 kHz signal) and ignore the 100's digit. This produces a 00 (100) to 99 (199) degree readout if you take the 100's digit and further ignore the 00 (200) for now. It is detected and taken care of by other means.

So the counter counts for the count period the proper number of counts representing a degrees position of the rotor pot. That's normal frequency counter operation. Remember that there are two separate and distinct counters at work and that they work in identical ways, and you won't get lost. During the strobe period right after count, the BCD information is passed from the outputs of U11, U12, and U13 to the outputs of U6, U7, and U8 for azimuth, and from the outputs of U14 and U15 to the outputs of U9 and U10 for elevation. Remember the two independent counters. The next period is reset, and, neglecting the how for now until we get to discussion of Fig. 1(a), this generates a clear (⊓) pulse for pins 14 of the counters. The up counter mode is called the "read" mode because that is just what you do. The read mode counts the antenna position, and via U1, U2, and U3 for azimuth and U4 and U5 for elevation, displays it in the proper readout. That sums up the up counter/read mode. It is merely a "Where am I at?" function.

Still in Fig. 1, you have no doubt noticed that the 74192s possess a few lines and functions which are missing on the more familiar 7490/7493 family. These include the load line and preload lines connected to the SWs I had you ignore and a down counting function. Starting with the latter, in an up-count-only-type IC, only one IC input is needed for two reasons—one, you are only counting one way, and two, the counter "knows" when it fills up (counts to 10 in a decade counter) to pass a 1 on to the next MSB counter as an up count or "carry" function. For the same reasoning, an up/down counter must have two inputs—one each to count each way, and two more to tell the next MSB to add a 1 or to subtract it. These further two lines are called "carry" and "borrow," respectively.

For the first down counter example, let's consider that all the SWs are decimal (0-9) reading and BCD output switches very common on the market today. You can set in a number desired (azimuth and/or elevation) in the 0-9 form you are used to using (ten-position switch), and the outputs are 4 BCD lines from each switch. When you connect these at the SW positions, BCD information for where you want to go is available to input on the preload lines of the 74192s. Since the down counting occurs in what I call the "track" mode, look at the bottom of Fig. 1 and I'll explain how to get to that mode.

To the far right of the schematic is a push-button momentary switch. Each time it is pushed, you change modes from read, to track, to read, etc. Pushing the push-button produces a clean TTL pulse out of U17d-11 to the U18b-3 clock input. U18b uses the leading edge of the pulse to put into the Q-output whatever is on the D-line at that time. The D-input, in this case, is merely the $\overline{Q}$-output of U18b-6. If U18b is in $\overline{Q}=1$, then Q becomes 1, forcing $\overline{Q}$ to 0. If U18b is in Q = 1, then $\overline{Q}$ = 0, and Q becomes 0, forcing $\overline{Q}$ to 1. It's a simple toggle switch. If this high in one mode

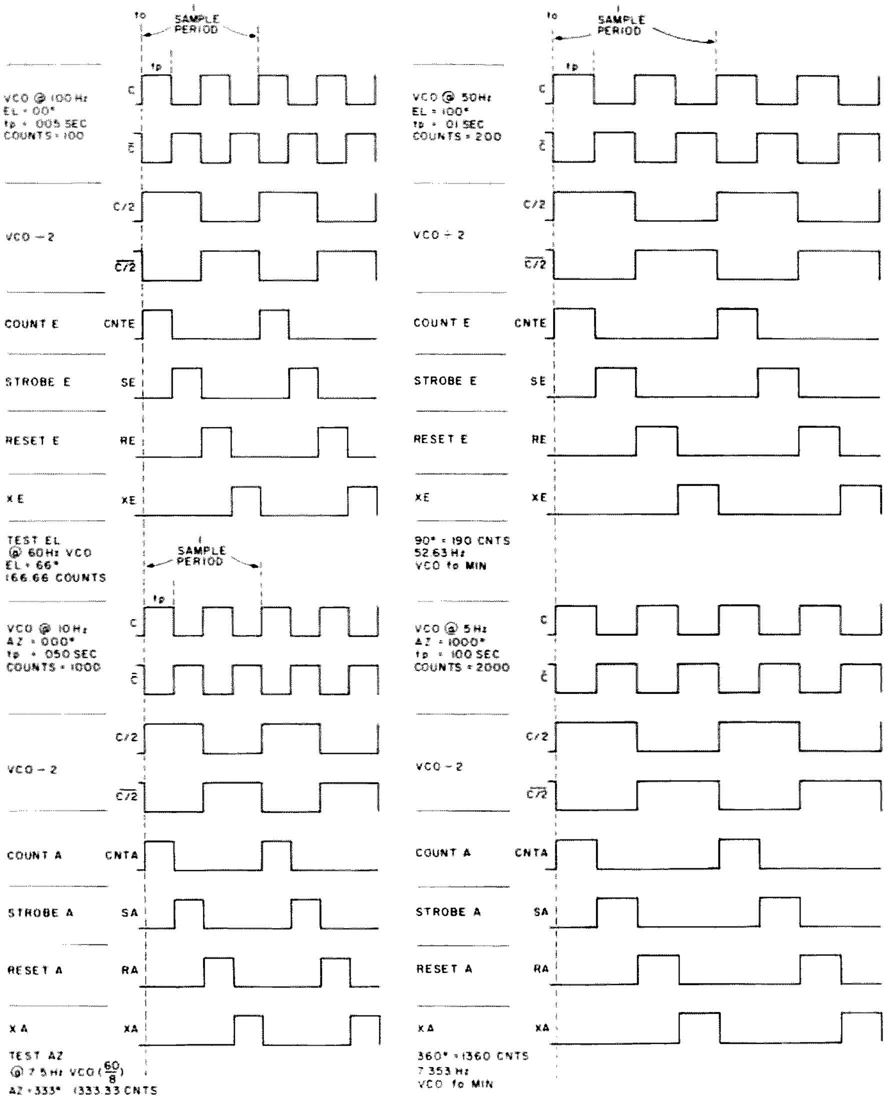


Table 1. Timing chart.

and low in the other mode were directly used to control the read/track mode changeover, all kinds of strange things could happen in counters, latches, and readouts. Remember, in a counter of any kind, timing is everything! I keep the strange things from happening by using the other half of U18 to determine when the mode change will occur in a sample period.

Start in the read mode you were in. A count period occurs (up counting the counters), and the strobes cause independent loading of the 7475 azimuth and elevation latches. Now, when both counters are in the reset period (data all locked up for the counters and readouts), and only then, does the U18a put the level on its D-input (output from U18b-5, high for track, low for read) onto its outputs by forcing its Q-output to go to D-level (input). When U18a-9 (Q-output) is high, the $\overline{Q}$ on U18b-8 is low. This enables the down counter gates and disables the up counter gates.

Since you are in the reset part of the sample period, the gating of Fig. 1(a) causes two things to happen. First, the strobe that has been causing the latches to pass data to the readout is disabled, causing the readouts to continuously display where you were when the mode button was pushed to the track mode. Also, the reset line is rerouted and used to cause a load command. The counters are no longer cleared, but rather preloaded in the reset period. As you are in the reset mode now, the contents of the BCD switches (SWs) are loaded into the counters directly, just as though you had counted to get there. Next comes the extra period (x) where nothing is done, and then it's on to a new sample period.

When the next sample period begins, the counters are already loaded with a number. Let's use azimuth and the SWs set at 180 (degrees—due south). Suppose further that the antennas were at 270 (degrees—due west). The display will remain locked up at a 270 readout during the entire track mode operation, since strobe is disabled then from getting to the latches. The gates have switched to down count, and the number 180 has been entered into the counters during reset (a load command when in track mode). The first operation of a new sample period is count, and so the counters begin counting down. Note that the count gate will be long enough to allow 270 counts to pass. This causes the MSB counter U11 to "underflow" and generate a borrow command normally used to steal a count from the next MSB counter. There is no such counter here, so it is used to operate other control circuitry we can now begin to cover in Fig. 2. Let's stay with the azimuth example.

The borrow pulse enters U20c-10 once for each sample period that the antenna readout numbers exceed the desired switch input numbers. Borrow is a negative-going pulse (⊔) that causes a positive-going set condition on U20c-8 if it is not already set. The previous $\overline{RA}$ into U20d-12 assures this is the case. The leading edge of the positive-going sets condition clocks U22-3 and causes the $\overline{Q}$ output U22-6 to go low. This low is used

IC	Pin Vcc	Pin Gnd
U20	14	7
U21-22	14	7
U23-24	16	8

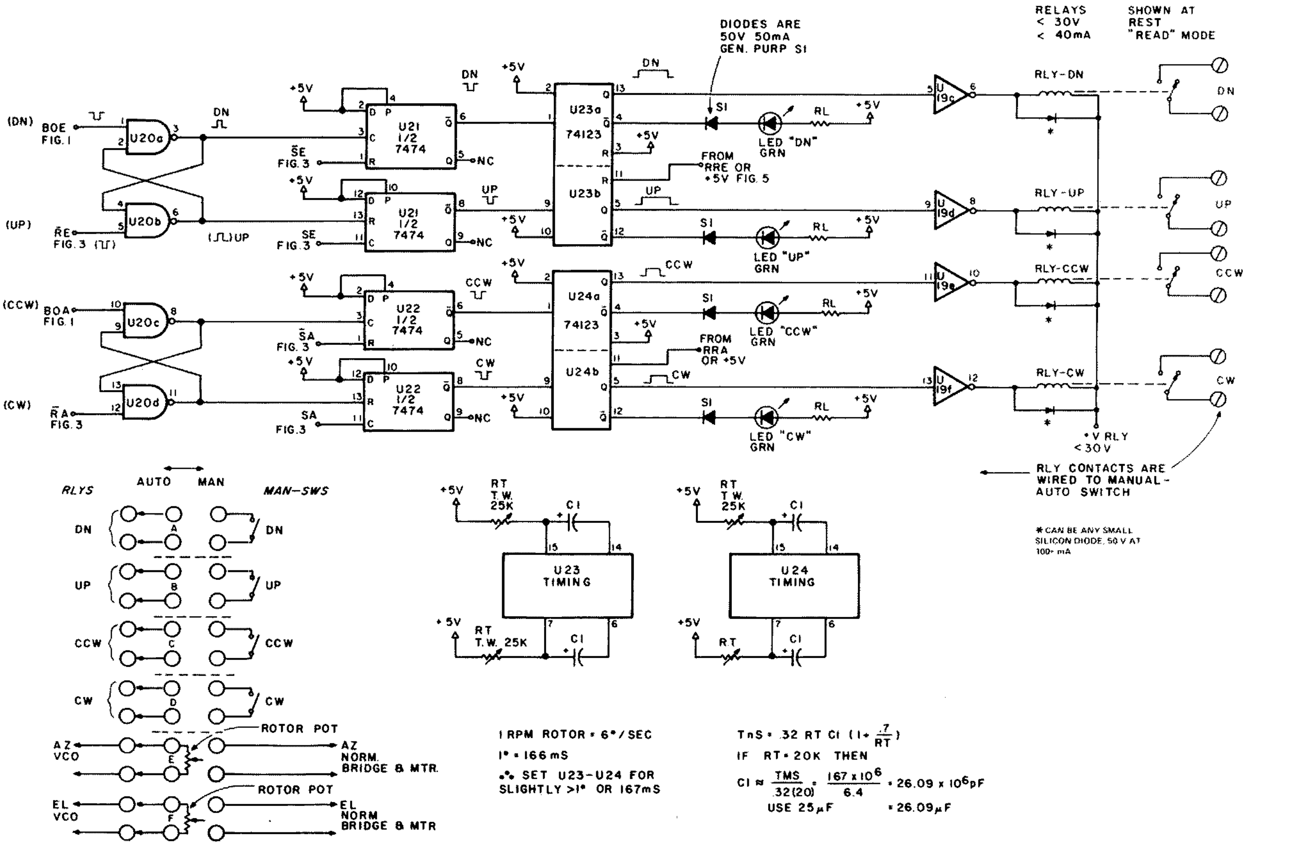


Fig. 2. Antenna control. C1 is tantalum capacitor 15 V; RT in kΩ; C1 in pF. U20 = 7400.

to clock a one-shot, U24a, to output a positive-going pulse at U24a-13. This one-shot period is made longer than a 1-degree change in the rotor (or 166 ms) to give a carryover effect from degree to degree. Since this departs from the original author's ideas, here's why:

The original system used in a receiver used these output-pulsed lines from U21 and U22 to control devices which charged or discharged a capacitor whose dc voltage was used to control the vco of the receiver—hence it had digital afc. Since I am controlling relays and did not want them pulsing on and off rapidly at the sample period rate, I use the one-shots to stretch the pulses into a long enough period to hold the relay closed from degree to degree. If triacs or the like were used and the rotator used did not object to pulsed power, the pulse stretchers would not be needed. Since I already had the relay panel in the Autotrak I system and didn't know the rotator motor's nature about pulsed power, I went my way.

In my example, the CCW relay would pull in. CCW refers to a top view of the antennas. CW does the exact opposite. In elevation, the up/down terms are self-explanatory, with 00 being straight ahead and 90 being straight up. CCW is the desired result in our example, and the antenna degrees begin decreasing with the sample period until the count just equals preload (180 = 180). At this time, no borrow pulse occurs. Due to the timing of gate U20 and the control lines to U21 and U22, this condition (=) causes no pulses out of either the CW or CCW part of U22—no pulses, one-shot period runs out, relay drops out, and antenna stops. How we get back to read and a proper display will be covered later.

Changing the example slightly, make the SWs the same 180, and change the original antenna position to 90 (degrees—due east). I am using large examples to show that several sample periods occur. For the antenna to turn either way through 90 degrees of both examples takes about 15 seconds in the average 1 rpm rotator. This is many ms-type sample periods. When the antenna position in degrees is less than the desired SW input in degrees, the following occurs. First of all, you enter track mode the same way, and strobe disable, countdown enable, and preload take the place of clear. Track mode is the same for both ways of rotation, with only the down count result changing. If the 180 figure is preloaded into the counters during the first period of resets (load), then, during the next sample period first window (count), the counters will again count down. This time the count window only allows fewer counts to be counted down than the

IC	Vcc	Gnd
U25	14	7
U26-27	5	10
U28-29-30-31-32	14	7
U33	4	11

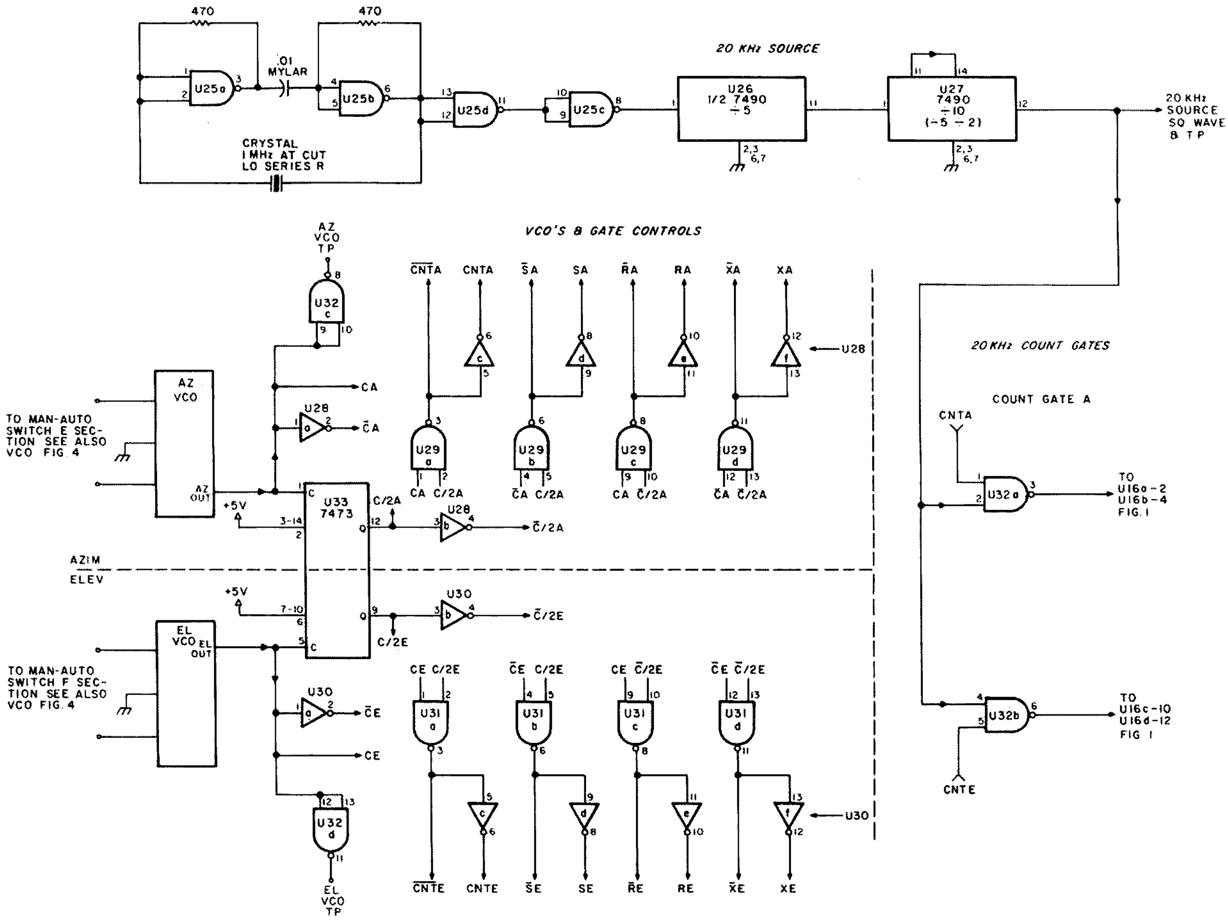


Fig. 3. Vco's and gate controls. U25—7400; U28—7404; U29—7400; U30—7404; U31—7400; U32—7400; U33—7473. ¼ W film resistors.

preload figure, and no borrow pulse occurs. With U20d-11 now in the set (high) mode, the reset line U22-13 allows U22-8 to toggle low whenever a clock pulse comes along on U22-11. This happens during the strobe period following a countdown, and the leading edge of a pulse (strobe) toggles U22-8 low. The one-shot follows through as before, using U24b this time, which turns on the CW relay. CW is increase azimuth degrees, and the antennas drive toward 180 from their 90 start point. When 180 is reached, again the (=) exists and the antennas stop. Whenever the (=) exists and the track mode is entered, the timing of U20 and U22 is such that no relay pull-in occurs. That completes a run through for azimuth.

For elevation, exactly the same events occur, but on a 2-digit counter group. It is as simple as that. What you have is a complete duplicate counter set for elevation from what an azimuth-only setup would be. For just that reason, you could very well build the azimuth-only version for normal on-the-ground communications not requiring elevation changes on the antennas. You cut everything just about in half except the read/track mode circuitry. You would have one 3-digit counter set, all the read/track circuit, half the antenna control (U20, U22, U24, and U19e and f), CW/CCW relays, one vco (azimuth), the same 20 kHz timebase, and whichever switch option you want from Fig. 6.

As usual, I have left for last the best and most important part of the explanation of Figs. 3 and 4. Fig. 4 is just a detail drawing of the vco part of Fig. 3. On Fig. 3, the easiest part to cover first is the timebase, and it is very straightforward. A quite common TTL oscillator uses a 1 MHz crystal that you can trim by using one of the harmonics beat against WWV if you desire. I did not trim mine, so no trimmer is shown. Remember that you are dividing by 50, and, if you send any reputable crystal manufacturer the circuit schematic, the error in the crystal will more than likely be erased by the divide-by-50 process. Also, you have control over the count windows, so you can fudge things there for small errors if need be. I didn't have to, as the crystal I got, when plugged into the circuit, ran at 1.00000126 MHz (divided by 50 = 20.00002520 kHz). The error is further spread over all 20,000 Hz, and only a small part (4000) is the maximum ever used. Resolution is resolution, but don't get ridiculous! The clock out is applied to the count gates as a fixed 20 kHz signal.

Jumping to Fig. 4 briefly, the vco's are quite standard use of the 566 vco, so I won't go into any more detail than the formulas and tips supplied on the figure. Suffice it to say that the elevation vco outputs 50 to 100 Hz, and the azimuth (due to an added divide-by-10) would put out 5 to 10 Hz were it not for the setup. That will be covered in the Fig. 4 notes and the calibration procedure.

Back on Fig. 3, and again using azimuth as our example, the 7+ to 10 Hz coming from the azimuth vco is applied to four places.

IC	Pin Vcc	Pin Gnd
U33	14	7
U34	5	10
U35-36	8	1

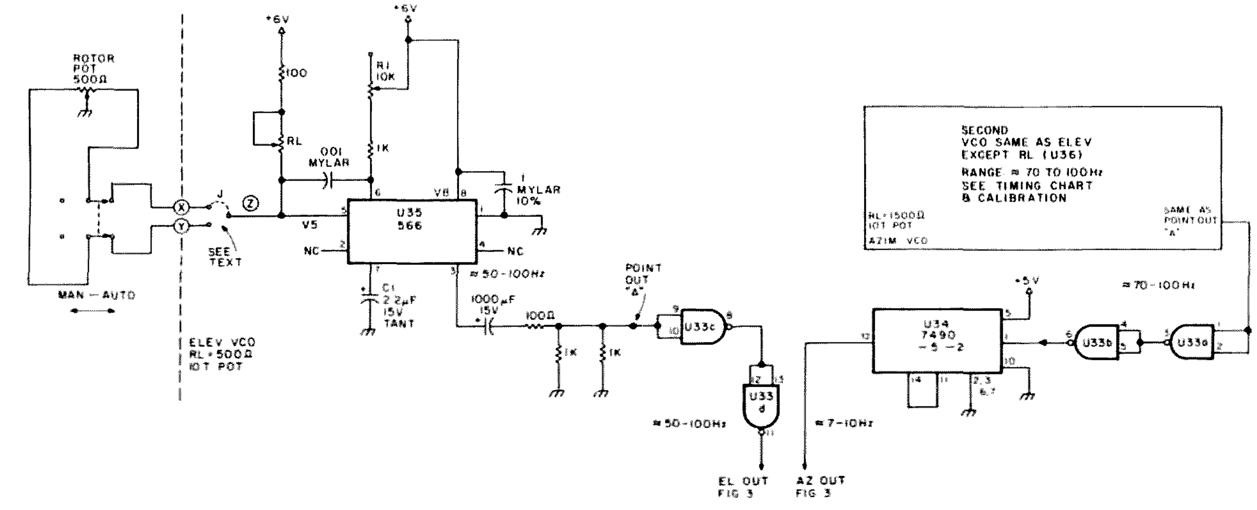


Fig. 4. All resistors are ½ Watt metal film for temperature stability, 5% tol. U33—7400; U34—7490; U35-36—566. Vco formulas: $f_o = 2(V_8 - V_5)/(R1C1)V_8$.

With V_5 gnd (by rotor pot) and RL_{EL} set at 400 Ω:

a. $f_o = 2(V_8)/(R1C1)V_8 = 2/R1C1$

With V_5 + 3 V (rotor pot set at 500 Ω) and RL_{EL} set at 400 Ω:

b. $f_o = 2(+6 - 3)/(R1C1)6 = 1/R1C1$

c. With R1 set at ≈9091 Ω and C1 = 2.2 uF, $2/9091(2.2) \times 10^{-6} = 99.999$ Hz (≈100 Hz).

d. With R1 set at ≈9091 Ω and C1 = 2.2 uF, $1/9091(2.2) \times 10^{-6} = 49.9995$ Hz (≈50 Hz).

e. For azim., R1C1 same, RL = 1500 Ω, part a. same for 100 Hz ∴ ÷ 10 for 10 Hz frequency. Low frequency = 1360 counts x 1/20 kHz = .068 sec. CNT a. For .068 sec. CNT, period = 2T (or 1 cycle) = .136 sec. 1/period = 7.3529412 Hz. That frequency = 73.529412% of 10 Hz. If V_5 = 0 V is 100% and V_5 = 3 V is 50%, 0 V > V_5 < 3 V is 73.··· %. 73.··· % of 6 V = 4.4117647 or V_5 = 6 − 4.41··· = 1.5882353 V = V5. V_5/500 Ω = 3.1765 mA. V_{RL} = 4.41··· ∴ $V_{RL}/I = RL_{(total)}$. $RL_{(total)}$ = 1388.89··· Ω − fixed 100 Ω = 1288.89. Set RL at ≈1290 Ω and follow calibration to trim.

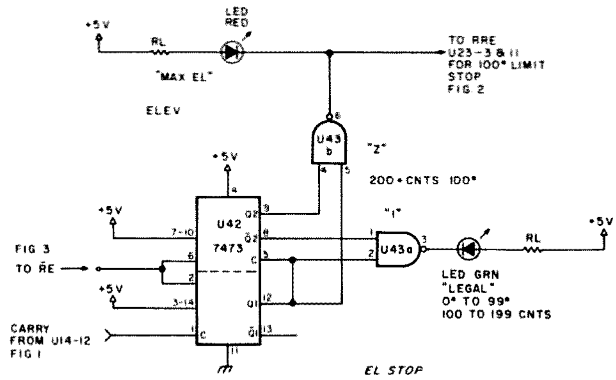
U32c is merely a buffer whose function was not needed for anything else and whose output is a frequency counter test point (TP) for vco setup. The vco output becomes one of four gate primary signals, Ca, and, via inverter U28a, a second gate primary signal, $\overline{C}$a. Through a divide-by-2 stage, U33, the Ca signal becomes C/2a, and, via inverter U28b, the last primary gate signal $\overline{C}$/2a. These four commands are further gated in U29 to form four distinct and separate low periods during any sample period and, via the rest of the U28 inverters, the high period inverses of the four periods. Not all are used, as you will see, but, when I build timebases and control circuits, I like to allow for future plans and expansion. As an example, the $\overline{\text{CNT}}$ a is not used, but it is what is detected, and it must be then inverted to get the CNT a needed. These gates and inverters are the cheapest TTL available, so "spend a bit more and keep versatility" has become my motto!

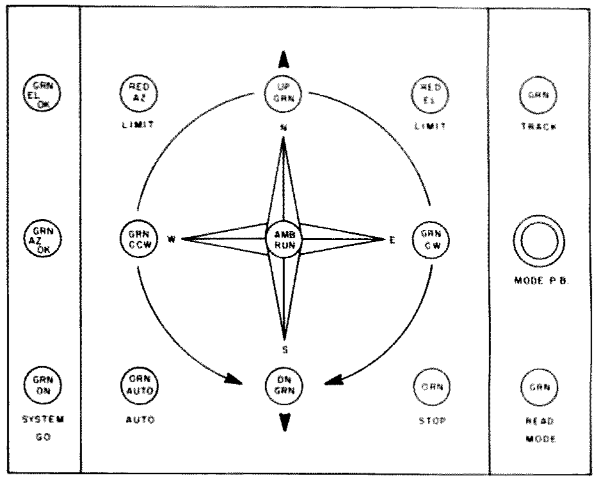
All the required signals for count (CNT), strobe (S), reset (R), and an extra (x) are formed in both polarities by U28 and U29. The elevation is a carbon copy derived from the elevation vco frequency and is used to control the elevation counters and gates. (Incidentally, the little letter a denotes azimuth, and the letter e denotes elevation, just so you can follow the schematics more easily.)

At the proper time, the CNT a (⎍⎍) is applied to U32a-1 to pass 20 kHz to the azimuth read/track gate. The same goes for CNT e (⎍⎍) and the elevation read/track gate. And that's all there is to Fig. 3.

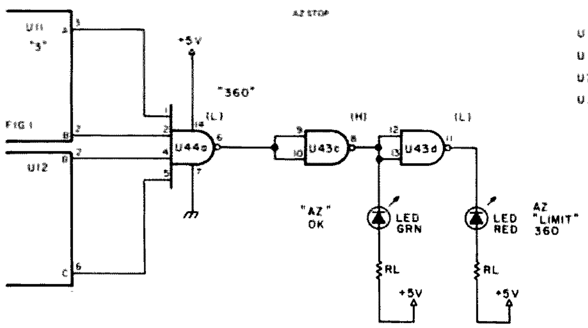
Fig. 5 contains circuitry that may prove necessary to some, options to others, and maybe crazy to yet a few more. I, quite frankly, did not use the "El stop" and "Az stop" circuits. They are preventative medicine. They form positive electronic stops to avoid the almost nonexistent errors that can occur. Using the calculator inputs, I will explain with Fig. 6 the limits of the formulas and the calculator ICs I used. No answers over 90 degrees elevation or 359 degrees azimuth will occur anyway after the program is up and running right. On the manual switch entry version, in elevation, you only have enough switches to enter up to 99 degrees (two switches), so there's no problem, as 00 to 99 degrees are all legal commands in this system. In azimuth, you can only go from 000 to 360 degrees (mechanical stops), but the switches required (three switches) allow a manual entry of all that plus from 360 on up through 999 de-

IC		Pin Vcc	Pin Gnd
U43	7403	14	7
U44	7420	14	7
U45	7403	14	7





PARTIAL PANEL LAYOUT



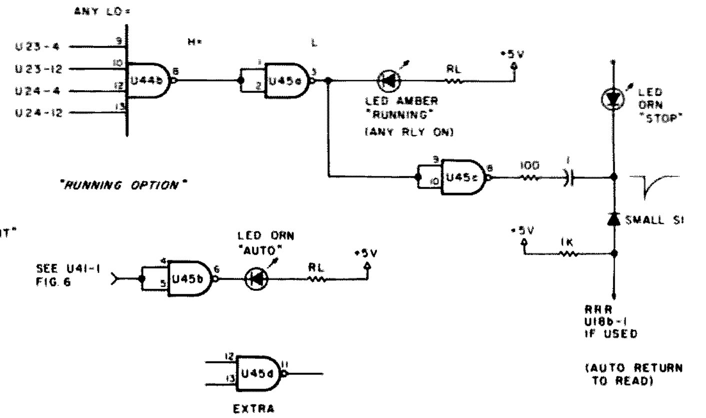


Fig. 5. Mechanical stops handle 350° stop, but, in automatic, the detector U44a-b also shuts off rotor ac via the CW relay and U24 off ($\overline{Q}$s). Handles false calculation data or error in SW entry, e.g., 400°.

grees. So either build the circuits, or watch your entries. If you don't build them, be sure to connect the RRe and RRa points of U23 and U24 (Fig. 2) to +5 volts.

If you add all the extra goodies, a suggested panel layout for a quick look and understanding is shown in Fig. 5. It is neat and quite usable in this fashion. I would include at least the LEDs of Fig. 2 for direction running, U45b if the auto entry of Fig. 6 is used, and the U44b and U45a "running" pair of IC parts.

U45c is nice if you want to automatically return to read mode when both antenna rotators reach their desired location. This isn't important in full automatic, because you won't be looking at the readouts at all except as a check if something suddenly goes afoul. U45c just puts a small reset pulse on the read/track line in place of your finger when all the U44b inputs return high. This drives U44b-8 low, U45a-1 and -2 low, U45a-3 high, the "running" LED off, U45c-9 and -10 high, and U45c-8 low. This causes a small negative-going pulse at the junction of the LED, the general-purpose silicon diode, and the .1 uF capacitor. This blinks the "stop" light (LED) and pulses the read/track line back to read via U18b-1. This allows the counter and readout to update to the new location in degrees.

Fig. 6 covers another option—a very, very useful one that started all of this automation. The 2-line to 1-line IC switches shown allow the preload entry to come from two separate places, depending on the position of the manual/auto switch controlling the select lines U37 to U41, pins 1. When grounded, pin 1 allows the ICs to pass the BCD data from S1 to S5 to SW1 to SW5, respectively. In other words, you have direct entry by manual thumbwheel switches. If you don't want anything else, follow the notes of Fig. 6 and delete U37 to U41.

When pin 1 is high, it allows data to pass to the preload lines from a second source. This may be interesting to some just as a way to run one antenna from two "control heads," both of which would be thumbwheel switches. In my case, the data comes from other 7475 latches. At first, these were the entries like those used with Autotrak I. Now they are entries from a calculator device I put together and called a Calcuputer, for lack of a more descriptive term. It starts as a basic hand-held-type of RPN calculator by APF called a Mark 55. The calculator set of ICs is by Mostek, as are the MK50075N, MK50103N, and 50104N. I wrote a program (sequence) to follow OSCAR by punching in sequential keys on this calculator and cranking out answers. That then led to automating the whole thing with a few more ICs. For the sake of explanation here, it boiled down to the answers for elevation (2 digits) and azimuth (3 digits) being dumped out on command to (5) latches, where they are held until needed.

I use a timer IC that outputs two control pulses 1 minute apart and staggered by 30 seconds. The sequence of operation is as follows: Pulse 1 (P1) occurs when I push a button exactly when OSCAR crosses the Equator (from published data). The Calcuputer has been given the Eqx longitude prior to this, been allowed to calculate the El-Az for T1 (Eqx plus 1 minute), and has outputted to the (5) latches. When the next pulse comes along 30 seconds later, it strobes this information into the preload lines and then triggers the read/track to track mode. Then, 30 seconds later at T2, the Calcuputer is started again and uses the new T = 2 minutes input for new answers which are dumped out into the latches. This sequence is repeated over and over through the T maximum you choose.

I want to explain the other inputs as well. They can also be used to return the antennas to a preferred storage position when you are through operating (into the wind, toward town or a favorite DX direction, etc.) or even tied into the digital wind indicator, as I mentioned earlier in an article on digital wind instruments (*73 Magazine*, Nov., 1976, page 84).

For our small group of EME enthusiasts around the Indianapolis area, this dedicated input control method puts our repeater idea one step closer to remote control of my station antennas very accurately from a remote Indianapolis user's location.

The whole EME station at my QTH was designed around digital remote control, mainly because analog information is a bear to convey or compare. Speak-

IC	Pin Vcc	Pin Gnd
U37-41	16	8

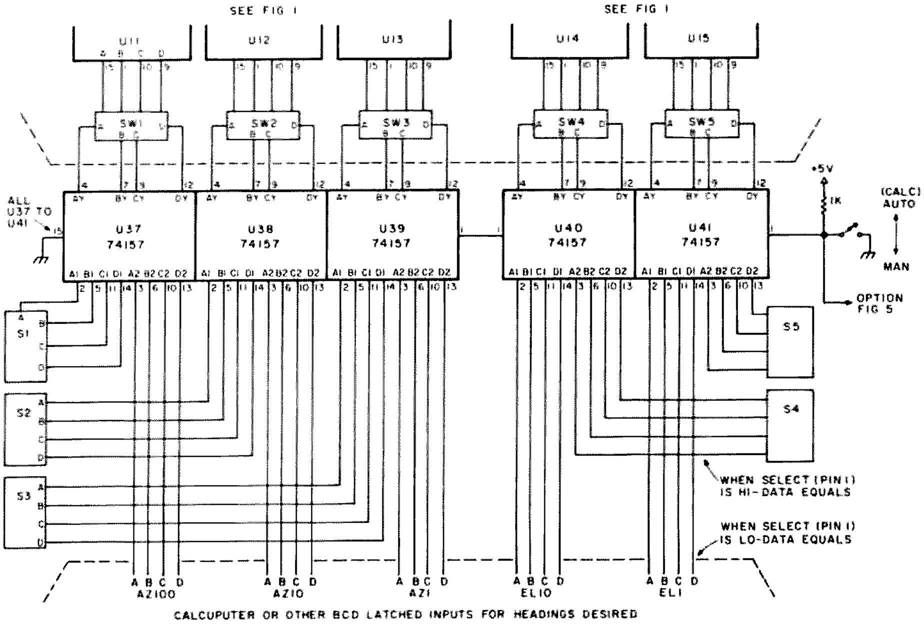


Fig. 6. S1 to S5 are read 0 to 9, BCD output T.W. switches. If manual SW only is desired, connect S1 to SW1, S2 to SW2, etc., and S1a to SW1a, S1b to SW1b, etc., and delete U37 to U41.

ing of digital, I fully believe EME should really pick up soon. Between the narrowband SSB article in a recent *QST* issue and another article on coherent CW which I was already working on (but confess I was not nearly so far along with), the modes of the future all point to narrower bandwidths and are almost always digital in nature. I give as my witness the above NBSSB and CCW examples, backed up by (digital) frequency synthesized receivers so you know exactly what frequency you are on, the (digital) very narrow tracking filters tuned by just adjusting a variable oscillator into them, and the forms of afc tracking receivers such as that on which my hardware is based.

To close this article, may I issue a small challenge to all you dedicated remaining builders—especially the digital IC types? How about the feasibility (and it would seem to be very inexpensive even at TTL prices) of a fully digital transmit and receive system for weak signal work? (1) It should include a synthesis scheme for all the transmitter and receiver (transceive) operations. (2) All of the filters and bandpass (i-fs, bfo, etc.) devices should be digital tracking types. (3) It should have a lock or afc mode such as the one I started with here. (4) It should be locked to, traceable to, or have a countdown scheme involving a reliable master oscillator determining the operating frequency (i.e., WWV, CHU, etc.). (5) The digital readout and display should go down to cycles or, at the very least, 10s of cycles is a must. (6) It should use coherent CW and very narrowband SSB or FM as modes, and the FM detector should be a digital pulse counting type (the FM for inherent AM noise immunity which even improves in a digital system as all transitions are saturating, eliminating AM just as a limiter does). (7) The transmitter should run class D (digital) switching for fairly high power output out of low power devices (they are on or off and therefore dissipate little power themselves). (8) The class D goes for the audio outputs in the receiver as well. (9) Readout must employ mixing of hfo, lfo, and bfo oscillators to give an exact frequency out reading. (10) Oscillators should be vco's so that a dial input can be used.

Is this ten times an impossibility? Not on your life! All the above is available now and at a TTL-type of expense. Now who is going to be the first to build one? (P.S. If you think I'm just kidding, mine is half done!) ■

Table 2. Calibration/setup.

Use a well regulated +6 volts on vco sections and good quality parts. Vco elevation :: Rough set R1 = 8100 Ohms.

1. With RL rough set to around 400 Ohms, run elev. rotor and antennas to 00 degrees elev. This will be a mechanical rotor stop, so set it accurately using a level.
2. Measure X to ground and Y to ground and insert jumper between Z and the X or Y terminal that reads zero (0) Ohms to ground.
3. When Z to ground is zero Ohms, V5 is 0 volts, and the vco runs at its highest frequency (100 Hz), determined by the setting of R1. (This is the shortest gate period, thus 00 degrees—100 cnts.)
4. Use R1 to set the vco output frequency at TP U32d-11 to as accurate a setting as possible of 100 Hz, by method a or b. Elevation switches should be set to 00 degrees.
   a. A counter hooked to U32d-11 and set for frequency should read 100.00000 Hz or, for period, .01000000 seconds.
   b. In the read mode, the readout should display 00 degrees (100 counts). Check the two extreme settings that get the 00 readout, and set R1 midway between these points. Going to track mode should produce no relay pull-in.
5. After successful completion of (4.), set elevation switches to 99 degrees.
6. Run the elev. rotor to 99 degrees (preferably using a level or plumb bob and protractor). This should place the 500-Ohm rotor pot in the R max position from Z to ground.
7. Using RL to set frequency and method a or b, set the low frequency limit. Pot RL preset to 400 Ohms to start.
   a. A counter hooked to U32d-11 and set for frequency should read 50.00000 Hz or, for period, .02000000 seconds.
   b. In the read mode, the readout should display 99 or 00 degrees (199 to 200 counts). Again, check the two extremes of RL setting to get a 99 readout and set midway between these points. Going to track should produce no relay pull-in on elevation.
8. Return to read mode, and set the elev. switches to 90 degrees. Push to track mode and check antennas for pointing straight up after the rotor stop.

This completes calibration of the elevation portion of the antenna control. The antennas can be checked against a protractor or other mechanical device, weather permitting, at other settings. If the relays are mounted on a separate board and the board is mechanically "floated" (rubber grommets), then the pots should hold accuracy. If in doubt, a drop of nail polish or glue from the shaft to case will fix things up after calibration. Just be careful to use something that can be removed later if need be, and get none down inside the pots.

The calibration of the azimuth portion follows the same general procedure. Set the Az switches to 000 degrees and R1 = 8100 Ohms.

1. With RL rough set at 1290 Ohms, run the azim. rotor and antennas to north through east (CCW). This is one of two mechanical stops and should be done accurately.
2. Measure X to ground and Y to ground and insert a jumper between Z and the X or Y terminal that reads zero Ohms to ground.
3. Same as elev. (shortest gate period).
4. Use R1 to set the vco output frequency at TP U32c-8 to as accurate a setting as possible of 10 Hz, by method a or b.
   a. A counter hooked to U32c-8 and set for frequency should read 10.00000 Hz or, for period, .1000000 sec.
   b. In the read mode, the readout should display 000 degrees (1000 counts). Check the two extremes of R1 setting that produce this readout and set R1 midway between these points. Going to track should produce no relay pull-in.
5. After successful completion of (4.), set azimuth switches to 360 degrees.
6. Run azim. rotor and antennas to 360 degrees (north through west) and the mechanical stop. Check for true north, and, if not, run to true north (some rotors allow 360 + a few degrees). This should place the rotor pot in maximum Ohms to ground position at Z.
7. Using RL to set frequency and method a or b, set the low frequency limit. Pot RL preset to 1290 Ohms to start.
   a. A counter hooked to U32c-8 and set for frequency should read 7.3529412 Hz, but few digital counters can handle the low frequencies accurately, so use period and set RL for a period of .13600000 seconds.
   b. In the read mode, the readout should display 360 degrees (1360 counts). Check the two extreme settings that produce a 360 degree readout and set R midway between these points. Going to track should produce no relay pull-in.
8. Return to read mode, and set azim. switches to 180 degrees. Push to track mode, and check antennas for pointing due south after rotor stop.

This completes the calibration of the azimuth portion of the antenna control. The antennas can be checked at the cardinal compass points N, E, S, W, N, weather permitting, by compass. The view from the ground is really accurate enough for most amateur work, anyway.

Social Events

OAK PARK MI
JAN 7

The Oak Park Amateur Radio Club will hold its 10th annual swap & shop on Sunday, January 7, 1979, from 8:00 am to 3:00 pm, at Oak Park High School, Coolidge at 9½ Mile Road, Oak Park, Michigan. There will be expanded table space, parking and prizes. Talk-in on .52. For information, contact Dave Lefko WB8RGQ, 32252 12 Mile Road, Farmington Hills MI 48018.

SOUTH BEND IN
JAN 7

The Repeater Valley Hamfest Swap & Shop will be held on Sunday, January 7, 1979, at the New Century Center on US 31 in South Bend, Indiana. This event will be held indoors with food service available. An automobile museum and art center are in the same building. Tables are $3.00. Talk-in on 146.13/.73, .34/.94, and .52/.52; 147.99/.39, .93/.33, .84/.24, and .69/.09. For information, contact Wayne Werts K9IXU, 1889 Riverside Drive, South Bend IN 46616; (219)-233-5307.

RICHMOND VA
JAN 14

The Richmond Amateur Telecommunications Society will hold its Frostfest-II on January 14, 1979, at the Bon Air Community Center in Richmond, Virginia. Talk-in on .28/.88, .34/.94, and .52. There will be a technical symposium, a drawing, and a home-brewers' contest with two divisions, over 18 and under. FCC exams will be administered starting at 10:00 am. To take the exam, mail Form 610 at least five days prior to the Fest to the address below. Commercial exhibitors are by invitation only. There will be an indoor flea market with one table for $2.50 and outdoor tailgate space for $1.00. Admission is $2.50. For information, contact the Richmond Amateur Telecommunications Society, PO Box 1070, Richmond VA 23208.

WAUKESHA WI
JAN 20

The West Allis Radio Amateur Club, Inc., will hold its 7th annual midwinter swapfest on Saturday, January 20, 1979, starting at 8:00 am, at the Waukesha County Expo Center, Waukesha, Wisconsin. There will be food, beer, and prizes. Directions are as follows: I-94 to Waukesha Co. F, south to FT, west to Expo. Admission is $1.50 in advance and $2.50 at the door. Reserved tables are $3.00 (until January 12). For information, send an SASE to WARAC, PO Box 1072, Milwaukee WI 53201.

SOUTHFIELD MI
JAN 21

The Southfield High School Amateur Radio Club will hold its 14th annual Swap & Shop on Sunday, January 21, 1979, at Southfield High School, Southfield, Michigan, at 10 Mile and

Reader Service—see page 227

Lasher. Admission is $2.00. For information, send an SASE to Robert Younkers, 24675 Lasher Rd., Southfield MI 48034, or call (313)-354-8210.

MIAMI FL
JAN 27-28

The Dade Radio Club presents the 19th annual Tropical Hamboree and ARRL South Florida Convention on January 27-28, 1979, in Miami, Florida. Over one hundred exhibitor booths, a giant flea market, and several technical and group sessions will operate simultaneously in completely separate areas of the Flagler Dog Track Auditorium building. With the Convention immediately following the Miami Board Meeting, most Division Directors and HQ officials will be present for the ARRL general session. Extensive free parking, including overnight space for RVs, is available on the grounds. Preregistration is $3.00; $4.00 at the door. For up-to-date information, booth space, flea market table space, RV parking space reservations, and hotel rates, write DRC Hamboree, PO Box 350045, Riverside, Miami FL 33135.

MANCHESTER NH
FEB 10

The Interstate Repeater Society will hold its 3rd annual auction and hamfest on February 10, 1979, beginning at 9:00 am, at the Manchester Armory, across the Amoskeag Bridge from I-93, in Manchester, New Hampshire. There will be commercial exhibits, and the auction will be held rain or shine. Admission and parking are free. Talk-in on 146.52, 146.25/.85, and 224.86/223.46. For information, contact Gary A. Delong WB7NOH/KA1BCA, Interstate Repeater Society, PO Box 94, Nashua NH 03061.

MANSFIELD OH
FEB 11

The Mansfield midwinter hamfest/auction will be held on February 11, 1979, in a heated building at the Richland County Fairgrounds in Mansfield, Ohio. There will be prizes and a flea market. Doors will open to the public at 8:00 am. Talk-in on 146.34/.94. Advance tickets are $1.50; $2.00 at the door. For information, contact Harry Frietchen K8HF, 120 Homewood, Mansfield OH 44906, or phone (419)-529-2801 or (419)-524-1441.

LANCASTER PA
FEB 18

The 7th annual Lancaster hamfest will be held on Sunday, February 18, 1979, at the Guernsey Sales Pavilion, US Rt. 30 & PA Rt. 896, Lancaster, Pennsylvania. Doors will open at 8:00 am and there will be a prize drawing at 2:00 pm. Admission is $3.00, and table reservations are $2.00 in advance. There is a new, larger indoor flea market area. Food and soft drinks will be available. Talk-in on 146.01/.61. For further information, contact SERCOM, PO Box 6082, Rohrerstown PA 17603.

MARLBORO MA
FEB 24

The Algonquin Amateur Radio Club will hold its annual electronic flea market on Saturday, February 24, 1979, from 10:00 am to 4:00 pm, at St. Mary's School Hall on Broad Street in Marlboro, Massachusetts. There is easy access to the Hall from I-149 via Rt. 20 east. Seller setup is from 9:00 am to 10:00 am. Talk-in on .52. Sellers should contact Charlie W1BK at (617)-562-5622.

Continued on page 176

The Twofer

—double-duty IDer logic

This circuit selects your CW IDer when a repeater is in use, and voice when it isn't.

C. A. Kollar K3JML
1202 Gemini Street
Nanticoke PA 18634

There is much to be said about the advantages and disadvantages of either a voice or CW ID. The best of two worlds would be to have both, with the right one selected automatically according to conditions on the repeater. For example, a CW-only ID is standard in this area, but this approach quickly becomes ordinary and, after a while, no one listens to it anyway. This is demonstrated by the frequent calls on the repeater from transients asking if someone could tell them where it's located. This can be remedied by going to a voice ID which gives the repeater call, QTH, and any other pertinent information. The disadvantage to this approach is the disruptive effect a voice ID has on a QSO. It can get very confusing listening to two voices at the same time. The solution to this problem is the circuit shown in Fig. 1. It has been in use at WR3AGU at Mehoopany PA for about eighteen months and has worked fine.

This circuit gives your repeater "memory" capabilities. While a QSO is in progress, an enable signal is applied to your CW IDer

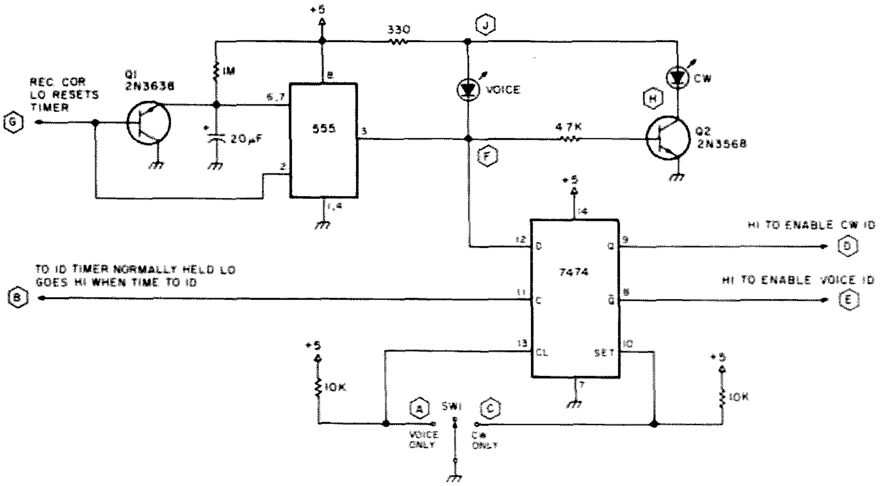


Fig. 1. Dual-ID logic schematic diagram.

which causes the ID to be given in CW only. When the repeater is not in use, when it is kerchunked, or when the last ID after a series of transmissions is given, the circuit will enable the voice IDer.

Operation

Referring to Fig. 1, the 555 timer chip and Q1 are set up as a retriggerable monostable. The 7474 is a dual-D flip-flop. In operation, point A is connected to the repeater COR line at a point that is normally high and goes low when a signal is received. If this is not possible (i.e., the only point easily accessible is a point which is normally low and goes high when a signal is received), a transistor or IC inverter can be used between point A and the base of Q1 and pin 2 of the 555 timer to give you the necessary inversion. Every time a signal is received, the 20 uF timing capacitor is discharged by Q1 and the 555 is reset. During this time, the 555's output (pin 3) goes high and will stay there for 20 seconds unless retriggered. Every time the receiver's COR indicates a received signal, the 555 is reset and retriggered for 20 more seconds. This high is applied to the base of Q2 through a limiting resistor making its collector go low. This lights the "CW" LED to let you know that this ID will come up next. The "voice" LED on pin 3 of the 555 will light only when it times out. This occurs only after about 20 seconds of repeater inactivity.

The information on pin 3 of the 555 is also presented to the D input of the 7474 flip-flop. The C (clock) input of the 7474 is connected to your repeater ID timer at a point which is normally low and goes high when it's time to ID. Again, if this is not possible or inconvenient, an inverter will have to be used to provide the necessary inversion between the repeater timer and point B.

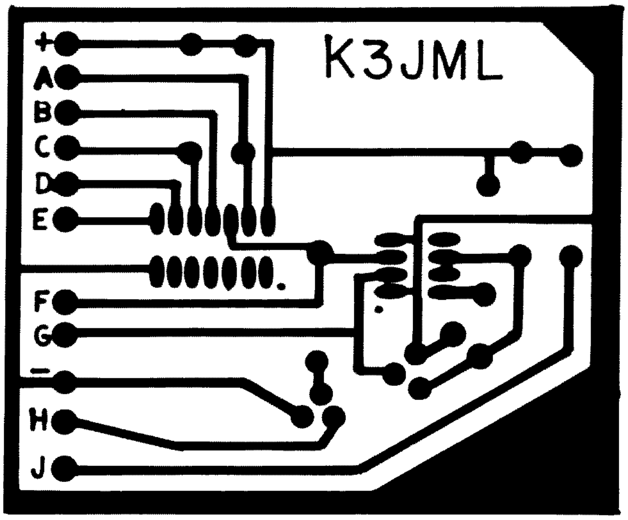
The 7474 works as follows: The info presented at the D input goes on to the Q output whenever the clock changes from low to high. The only time the output can change is when the clock goes positive. Changes on the D input are not passed on if the clock is *held* high or low. Information on the D input can be changed at any time. It is only its value at the instant of the positive clock edge (time to ID) that matters. This is what is entered into the flip-flop.

So, when it becomes time to ID, point B should go high. At this instant, the flip-flop checks its D input. If it is low (the 555 has timed out because of no repeater activity in the last 20 seconds), the low is passed on to the Q output and the Q output goes high enabling the voice ID. If your voice ID requires a low to enable, an inverter can be used after the Q output or the $\overline{Q}$ output can be used to enable the voice ID and the Q output for the CW ID.

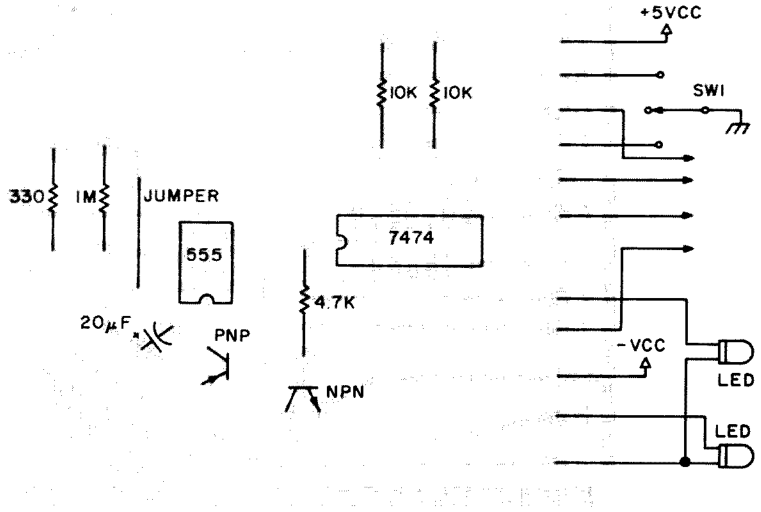
The last feature of this ID selector is the use of S1, an SPDT switch with a center off position. With the switch in the off position, ID selection is completely automatic as described above. However, when put in the position where the clear input (pin 13) is grounded, the Q output goes low and the $\overline{Q}$ output goes high and they both stay that way as long as the switch is in that position for a voice-only ID. Conversely, when in the position where pin 10 (set) is grounded, the flip-flop immediately goes into the state with Q high and $\overline{Q}$ low. This gives you a CW-only ID. This becomes very handy if it is necessary to remove either of the IDers for maintenance.

This ID selector will add a bit of "intelligence" and courtesy to your repeater's automatic operation and provide variety and relief from monotony to the ops who monitor your repeater consistently.

I'll be happy to help with any questions you may have regarding connection to your repeater if you will supply the necessary information and include an SASE.■



PC board (artwork by K3ETN).



Component layout.

James D. Powell II N8AMR/4
6400 J Terrace View
Blacksburg VA 24060

Adam-12 Revisited

—a scanner unscrambler

This simple circuit will decode the most common scramblers used, and is small enough to fit inside hand-held units.

After buying a new VHF high-low scanner and adding all the necessary options such as crystals, flexible antenna, and rechargeable batteries, I found that it was still lacking one useful option, an unscrambler. Many police departments use a scrambler on some transmissions for one reason or another.

Although there are several schemes for scrambling or encoding audio, by far the most common method is to feed the audio signal along with a carrier into a balanced modulator before transmission. Typically, a 2-3.5 kHz carrier is injected along with the audio, producing a DSB signal centered about the carrier frequency. This signal then modulates the transmitter in the normal manner.

When a scanner that is not equipped with a demodulator like the one at the transmitter receives the scrambled signal, it produces the same sort of garbled (and unintelligible) audio you hear from an AM receiver tuned to a DSB or SSB signal. The fact that I could not receive the scrambled transmissions was enough to prompt me to construct a circuit to recover the audio. I would like to remind anyone who builds one of these decoders, that, as with any other information you might obtain over your scanner, you cannot divulge the content of the transmissions.

The Circuit

I designed the circuit with the following conditions in mind:

1. The circuit must operate on the scanner's 6-volt battery supply.
2. The circuit must fit in the scanner with no external components.
3. The change from normal to decode operation must be simple and quick.

The final demodulator uses a Signetics N5596 balanced modulator/demodulator. The pin designations in Fig. 1 refer to the 14-pin DIP package. The National Semiconductor LM1496 or an HEP6050G is also usable with no circuit modifications, but the pinouts are different. The carrier signal is supplied by IC2, a 555 timer. Potentiometer R1 is used to balance the demodulator (null out the carrier), with no audio input to the IC. R2 adjusts the frequency of

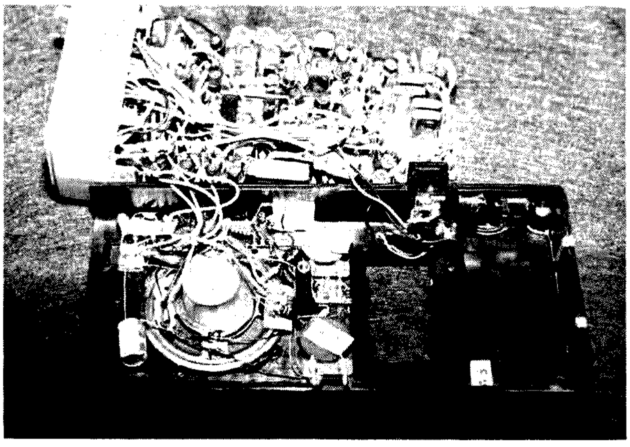


Photo A. View of the inside of the Pro-6 scanner with the decoder installed. Major components are secured to the case with glue.

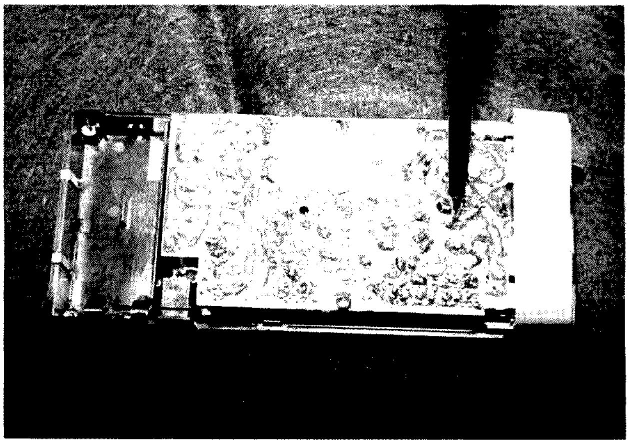


Photo B. View of the foil side of the Pro-6 PC board. The pen points to the point on the board where the volume control wire is disconnected and the decoder input and outputs are inserted.

the carrier generator. R2 must be set so that the frequency of the carrier matches the frequency of the carrier that was introduced at the transmitter. C1 must be selected to give the proper range of carrier frequencies in your use. Since most systems use a carrier frequency of from 2.0-3.5 kHz, C1 = .1 uF is a good choice in most cases (see Table 1). Use a good quality 5% capacitor for C1, as it basically determines the stability of the carrier generator.

Some systems use more than one carrier frequency. Usually these will be designated as Code 1, Code 2, Code Black, Code Yellow, etc. If this is the case in your area, you can add more than one R2 pot, as shown in Fig. 1. A slide switch can then select the proper frequency. If only one frequency is used, S2 may be eliminated, with pin 5 of the 555 connected directly to the wiper terminal of R2. S1 turns the demodulator on and off. I used one of the channel lockout switches on my scanner for S1 and thus did not have to mount any extra switches on the radio. Any general-purpose silicon NPN transistor will work for Q1. The audio input to the demodulator should be about 100 mV rms. This is available at the input to the volume control of most scanners.

Construction

My scanner is a Realistic Pro-6 VHF high-low by Radio Shack, so the photographs and details of the text apply to this particular radio. The circuit itself will work with any scanner or monitor, but the component placement may have to be modified due to space considerations.

I originally planned to build the demodulator on a small printed circuit, but, after seeing how little space was available in the scanner, I had to resort to the less elegant point-to-point wiring method. Owners of the Pro-6 can see where to mount the major components by referring to Photo A.

To disassemble the scanner, remove the two screws at the bottom of the radio just below the battery pack. Now remove the back by squeezing the sides of the front half of the case about 3 inches from the bottom of the case. Once you have removed the back, take out the one screw in the middle of the printed circuit board and remove the front half of the case.

All parts of the demodulator mount in the front half of the case. The ICs are mounted by turning them upside down and securing them with a drop of glue. Be sure to identify lead number one on each IC before gluing it down. The ICs will be hard to remove once glued down, so I strongly suggest that you first construct the circuit on a protoboard if you have one.

Trimpots R1 and R2 should be mounted so that they can be adjusted with the scanner operating. I drilled out two of the "fake" holes in my scanner and mounted the pots behind them, so I could adjust them once the scanner

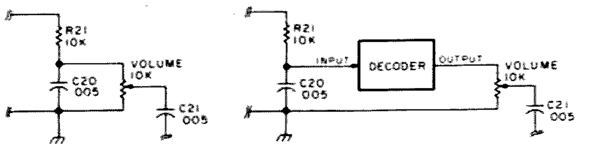


Fig. 2. Details of decoder input and output connections to the Pro-6 scanner. Other brands of scanners will have similar configurations.

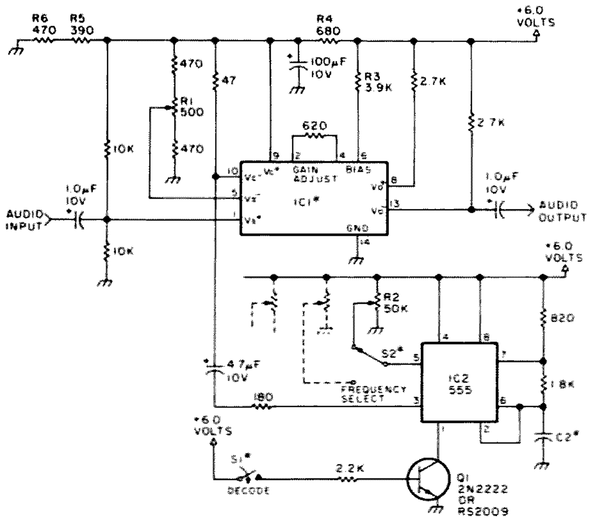


*Fig. 1. Unscrambler schematic. IC1—N5596 14-pin DIP; LM 1496 or HEP6050G also suitable; see text. IC2—555 timer, 8-pin DIP. Q1—2N2222 or RS2009, NPN silicon general purpose. All fixed resistors ¼ W, 10%. * = see text.*

was assembled. After operating the scanner for a few weeks, I found the circuit to be stable enough so that adjusting the pots again was not necessary. Make the needed tie points by gluing small pieces of printed circuit board to the case. Be careful to mount the parts so that they do not interfere with the reassembly of the case.

I used one of the channel lockout switches for S1. If you elect to do the same, refer to Fig. 3.

Testing and Adjustment

Once the circuit is complete, but before connecting the audio input and output to the scanner, you should balance the demodulator. Connect an oscilloscope or high-impedance headphones to the output of the circuit, apply power, and turn the decode switch on. You should have a square wave on the oscilloscope or a tone on the headphones. Adjust R1 to null the carrier output.

If all was well in the previous step, you are ready to connect the demodulator. Unsolder the wire on the PC board going to the volume control. This is a green wire on the Pro-6. See Photo B for the proper location. Solder this wire to the output of the demodulator. Now connect a short wire from the point

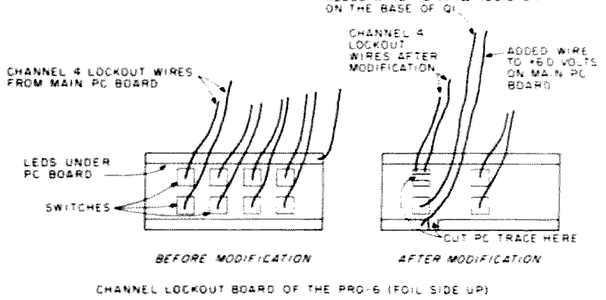


Fig. 3. Modifications to the channel lockout board of the Pro-6 to allow the channel 4 switch to be used as S1 of the decoder. Channel 4 of the scanner will always be active after the modification.

on the PC board where you removed the previous wire to the input of the demodulator.

When S1 is in the off position, the scanner will work normally. When you hear a scrambled message, turn the demodulator on and adjust R2 for a readable output. If you cannot get a low enough frequency for your needs, simply add some capacitance to C1, as in Table 1.

Comments and Conclusions

In operation, the decoder has been totally stable and performed well. When the decoder is switched off, it draws about 3 mA. When it is switched on, it typically draws 15 mA and has little effect on battery life.

If your scanner operates on a higher voltage, scale up R4, R5, and R6 by the % voltage increase (approximately) that you have above 6 volts; also adjust R3 to give 1.0 mA current into pin 6.

I will be glad to answer any questions if an SASE is enclosed. ■

Value of C1 (uF)	Carrier frequencies obtained (Hz) Lowest	Center	Highest
0.10	1650	3500	6000
0.15	1000	2500	4000
0.20	800	2000	3000

Table 1. Selection guide for C1. Lowest, highest, and center frequencies of each range obtainable by adjusting R2 are given.

LETTERS

from page 11

reason, the BS that the ARRL has dished out to Mary has frustrated me.

Mary, as far as I know, started having trouble when she ran against W7PGY in the last director election. I don't know that Thurston was responsible for the mudslinging that Mary got, but he certainly benefited the most from it. If enough people had read between the lines, just maybe the election would have come out differently.

When the election for SCM came up, two people were nominated: W7QGP and W7IEU. The results of the election are obvious; Mary was disqualified. I have proof that Mary was disqualified after the fact. It seems that the people charged with looking after our best interests took it upon themselves to change the rules or by-laws so as to disqualify W7QGP; this caused W7IEU to win by acclamation.

After the fiasco of the SCM election, Mary filed suit in the court system out here. This brings me to the next point of interest.

A few months ago, notice was given in *QST* that elections were to be held for Northwest Division Director and Vice-Director. When after the deadline for nomination petitions had expired and only W7QGP and W7PGY had been nominated, the election was set aside until the litigation concerning the SCM election was settled. Meanwhile, the executive board (minus W7PGY) voted to have W7PGY, his highness and not so exalted ruler of the Northwest Division, Mr. Thurston, act as a caretaker director until such time as the aforementioned litigation is resolved. So far, the litigation has gone on for almost 2 years now, and, by the looks of it, probably a couple more years.

Well, fellow members of the Northwest Division, it seems we are enslaved to the junta in Newington under direct command of Field Marshal Thurston. Heil! Heil! Long live the regime!!

I must close for now and pay homage to his excellency, W7PGY, on my knees bowing down towards Seattle.

Phillip J. Kelly, Sr. WA7DKA
Vancouver WA

P.S. I have remained a member of the ARRL for the sole reason that if any reasonable facsimile of a fair election is run, I want to be able to vote W7PGY out.

HR-13015

You are generally on top of things coming out of Washington which affect amateur radio, so I am somewhat surprised that I've read nothing in *73* (or in any other amateur publication) about a bill currently in Congress which could have an impact every bit as great as WARC. The bill is HR-13015, which was introduced last June by Lionel Van Deerlin (D-Cal.) and Lou Frey (R-Fla.). It is titled "The Communications Act of 1978" and is now moving through the Committee on Interstate and Foreign Commerce, of which Van Deerlin is chairman.

The Van Deerlin-Frey bill has received a great deal of press among broadcasters because of the sweeping changes it would make in regulation of the radio/television broadcast industry. The point is to deregulate the broadcasters, and let free enterprise take its course. The bill also seeks to break up the Ma Bell/AT&T monopoly.

But HR-13015 would also affect amateurs. Amateur radio is not specifically mentioned in the bill, and that in itself is disturbing, since it would affect us so directly. The act, if passed, would repeal the Communications Act of 1934 entirely. It would eliminate the FCC, setting up a 5-member Communications Regulatory Commission in its place. There would also be an independent, policy-making arm of the executive branch known as the National Telecommunications Agency. The duties of the Commission and the Agency, as outlined in the bill, are primarily concerned with broadcasting, although the Commission would also regulate some "non-broadcast services" such as common carriers. Again, the Amateur Service is not mentioned. (Do they know something we don't?)

One interesting change in the bill would be the charging of license fees according to the amount of spectrum allocated. A TV broadcaster would be charged for his 6 MHz, while an AM broadcast station would only have to pay for 10 kHz, etc. In reading the bill, I can't determine if this same system would be applied to the "non-broadcast services," but can you imagine what a ham license would cost if it were? Our 420-450 MHz band alone would cost the same as five TV broadcast permits!

I think this legislation bears looking into by amateurs, and I'll be interested in reading further comments on it.

Mark D. Johns WA0RGV
Iowa Falls IA

DELETE THE DOWNLINK

I would like to express my opinion about the OSCAR-type ham satellites with downlinks into 10 meters now that the band is fully open for worldwide communications direct. It would seem that the time has come to turn off the OSCAR 10 meter downlink.

The reason for my position is that even 100 kHz is a lot to take out of the usable spectrum. Now that the Soviets have put up their two satellites, this has increased to 200 kHz, which seems to be forbidden territory for those wishing to make direct contacts.

The pass time over any given area may be good for only 15 to 20 minutes of acquisition, but now that near-normal direct skip prevails over such a wide area in all directions, it means that interference chances are many times greater because of the wider area a direct skip signal may cover.

There are several other factors that make OSCAR-type satellites unethical at this time, one being the large number of Civil Emergency Preparedness Stations which have been established on these frequencies since shortly after WWII, another being the many QRP stations which have been squeezed out of the lower portions of the band by high-powered activities there.

It is unfortunate that the Soviets chose to make their major output in the 10 meter band at this time of increasing good skip conditions.

I have suggested to AMSAT that if they lead the way now by

Continued on page 93

Larry Griffin WB5NYX
306 East Key Blvd.
Midwest City OK 73110

Digital RTTY Is Simple

—easy as 01, 10, 11

Copy wide- or narrow-shift RTTY with this digital converter.

Lately, I have become interested in getting on a local 2 meter repeater and working some radioteletype (RTTY). I have a 2 meter rig and an old Teletype™ unit, but getting the audio from the speaker to the Teletype print magnet in a language it could understand was a problem. While doing some research and trying to decide on one of the inexpensive RTTY converters described in different magazine articles, I thought how nice it would be to connect my digital frequency counter to the speaker of my receiver, display the frequency, and tell my Teletype unit, "When this display changes from 2125 to 2295, disconnect the power from the print magnet." Of course, there is no way that my counter was going to keep up with the rapid frequency shifts of radioteletype, but the idea stuck with me. It resulted in an inexpensive RTTY converter that is easy to build and operate.

The main element in getting a good copy on a Teletype is to turn the print magnet off and on at a

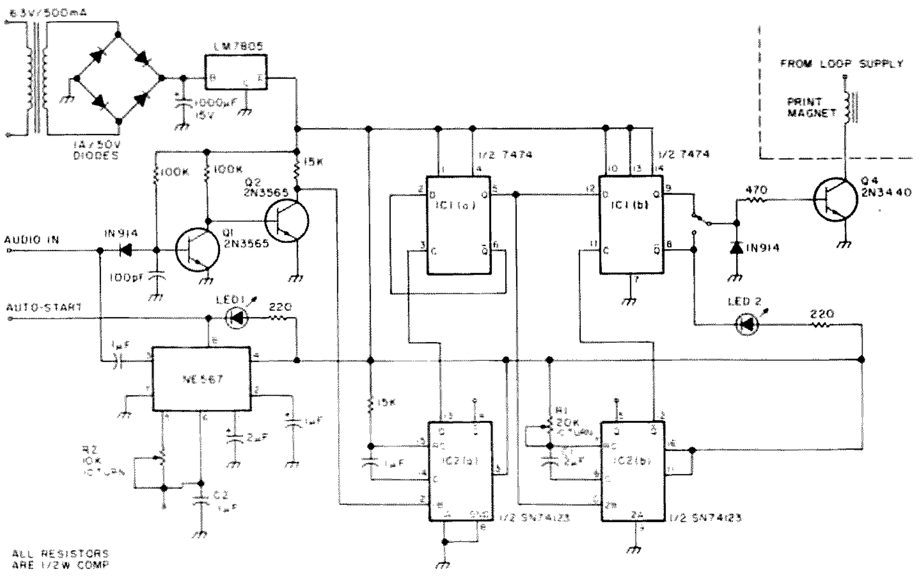


Fig. 1.

precise timing rate. A "mark" turns the magnet on; a "space" turns it off. At 60 wpm, the number of marks and/or spaces that occur during a 163 ms period tells the machine which character to print. A "space" is not the character you get when you hit the space bar, but it signifies that no current is being drawn by the loop.

I knew the first thing I needed was a square audio wave to clock the digital circuitry. After a few hours of building different squaring circuits, Q1, Q2 (Fig. 1) turned out to be the one with the best waveshape with the minimum output voltage required to obtain a square wave output.

Rather than use a method of counting the audio frequency, I decided that it would be easier and require less parts to measure the time between cycles. In order to do this, the first cycle has to turn on a timer and the next one turns it off. I used the popular divide-by-2 method using the SN7474 dual D-type flip-flop. The SN7474 can be used as a place to store data, also. When the SN7474 is clocked by a low-to-high voltage transition at its clock input, the voltage value of its data input (D) is moved to the "Q" output. The "$\overline{Q}$" output is always the opposite of "Q". Data is referred to as a "1" being the higher voltage (4 V typically) and "0" being the lower voltage (.2 V typically). If the "$\overline{Q}$" is connected to the "D" input, the "Q" output will be high on every other clock cycle because "$\overline{Q}$" is always the opposite of "Q". This divides the clock frequency by two.

Now that "Q" is a "1" for one complete cycle of the input frequency, a reference pulse is needed to compare this time with. The SN74123 provides this pulse. The output of the SN74123 can be triggered and the output pulse width can be set by an RC network. It also has a "$\overline{Q}$" opposite of "Q".

There are two one-shots in an SN74123. One of them is used to help square the audio input. The RC time constant of this half is set for approximately 150 µs.

The input circuit was designed to work with the speaker connected to the audio output used. Only 300 mV p-p is required to get a square audio wave out.

The audio input is squared and conditioned by Q1, Q2, and IC2(A). The "Q" output of IC2(A) is connected to the clock input of IC1(A). IC1(A) divides the input frequency by two. The high logic level at the "Q" of IC1(A) is now equal in time to the time it takes the input frequency to complete one cycle. With 2000 Hz at the input, the "Q" output of IC1(A) will be high for 500 µs; at 2170 Hz, "Q" will be high for 460.8 µs.

When "Q" of IC1(A) goes high, this clocks IC2(B), causing "$\overline{Q}$" of IC2(B) to go low at the same time. The output pulse length of IC2(B) can be adjusted to a desired length by R1.

If the output pulse length of IC2(B) is set to 480 µs and input frequencies of 2000 Hz for mark and 2170 Hz for space are used, the "$\overline{Q}$" output of IC2(B) will be low for 480 µs and will go high while "Q" of IC1(A), on mark, is still high. But it will go high after "Q" of IC1(A), on space, goes low. The low-to-high transition of "$\overline{Q}$", IC2(B), clocks the "Q" of IC1(A) into "Q" of IC1(B). A "1" will always be clocked in for a mark and a "0" will be clocked in for a space, as shown by Fig. 2.

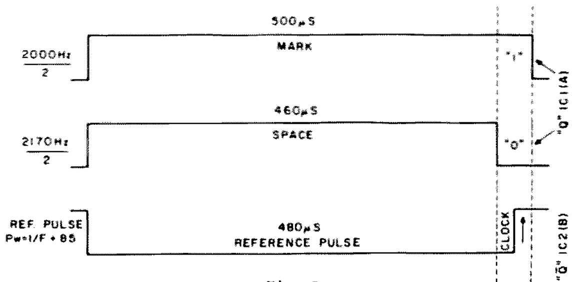


Fig. 2.

The "Q" or "$\overline{Q}$" of IC1(B) can be selected for upshift (Q) or downshift ($\overline{Q}$) and used to drive the loop switch, Q4. This output could also be used to drive a UART.

The converter should be set to convert narrow shift. Then it will decode both wide and narrow shifts.

To adjust the converter, apply a 300-500 mV p-p audio signal at the desired mark frequency to the audio input. Connect a scope to "Q" of IC1(A), pin 5. This output should be a clean square wave at half the input frequency. Disconnect the scope and connect it to "$\overline{Q}$" of IC2(B), pin 12. Adjust R1 until the low-level pulse width is equal to Pw. Pw = 1/F + 85, where Pw is the pulse width in seconds and F is the input mark frequency.

Disconnect the scope and connect it to the "Q" output of IC1(B). This output should be high. Adjust the input to the frequency of the space signal (mark frequency + 170 Hz for narrow shift). "Q" should be low. Shift the audio frequency from mark to space and back. The "Q" output should now shift with the input; 1 equals mark, 0 equals space. If the PLL tuning indicator is used, adjust the audio input to the mark frequency and then adjust R2 until LED1 turns on. Adjust R2 and find the center of the bandwidth of the PLL. The converter is now ready to convert up-, down-, narrow-, and wide-shift radioteletype.

Tuning is done by adjusting the bfo of the receiver and is not difficult. If the converter is to be used on 2 meters, it should be aligned for the standard audio frequencies used in your area. LED2 will blink as a shift in frequency occurs and, if the PLL circuit is used, will also "unlock" randomly, especially on wide shift.

Some other input circuits could be used, such as an FET or Schmitt trigger, and some noise limiters and audio filters added, but they are not at all necessary to get a good copy from a good signal.

I built the converter with VHF RTTY in mind, but have used it to receive Teletype on the HF bands where noise and fading did cause problems. As long as the audio was decent and noise was at a minimum, the converter didn't miss a character.

The phase locked loop circuit using the NE567 was built as an autostart circuit, but makes a great aid for tuning.

For more information on the NE567 PLL, see the November, 1977, issue of *73 Magazine*. For more information on one-shots, see the February, 1977, issue of *73*. If you need to do some reading about radioteletype in general, read the September, 1977, issue of *73*.

I etched a 3" x 5" circuit board and had plenty of room on the board for the power supply. A breadboard or hand-wired circuit will work just as well.

The converter was housed in a Radio Shack cabinet no. 270-252. The LEDs are Radio Shack no. 276-026. ■

James R. Avoli K3MPJ
1261 Brinton Road
Pittsburgh PA 15221

Take the Pledge

—a no-compromise console

This simple approach to building your final equipment features two-tiered, sloped construction.

Following a long history of futile attempts at misusing desks, adding tabletop extenders, building shelves, and the like, I finally decided upon the pictured design for my amateur radio equipment console. Photo A illustrates the unit, complete with the following features:

1. a sloped top to aim the upper equipment down;
2. a sloped bottom to aim the lower equipment up;
3. a storage shelf for books, logs, parts, meters, etc.;
4. an inexpensive woodgrain contact paper finish; and
5. portability to sit atop any existing table or desk.

After estimating the costs to have it built from particle board covered with Formica™ by an acquaintance who is a part-time cabinet maker ($350), or simply to purchase a metal workbench of similar style but less capacity ($150), I made myself an offer that I couldn't refuse: "Do it yourself, but take your time and do it right, and the XYL will be on your side forever!"

Photo A.

The total construction costs will be variable, mostly dependent upon your current supply of scrap lumber and hardware as follows:

1. two aluminum angles @ $4.95
2. four T-braces @ 50¢
3. twenty feet woodgrain contact paper @ 59¢
4. screws, nails, glue, etc., for $5.00
5. optional electrical outlets and lamp(s)
6. one and one-half sheets of plywood (4' x 8' x ½")

Begin to get the overall construction details clear in your mind by referring to Photo B and Fig. 1. The unit is four feet wide, by all the dimensions shown in Fig. 1. The dotted lines represent an internal barrier to keep things from getting lost in the very least accessible nooks and crannies. The shaded areas represent the internal supports needed for strength and stability.

I stress the use of plywood instead of particle board because of its lighter weight and ease of maneuverability, its ability to accept screws and nails without fracturing, and its esthetic wood grain if you elect to give it a natural wood finish instead of using the contact paper option.

If you are not an experienced cabinetmaker, I recommend that you acquire and read the following literature before commencing the actual construction:

"How to Buy Plywood," *Popular Science*, Feb., 1977, page 122; "How to Work With Plywood," *Popular Science*, Mar., 1977, page 124; *NBS Voluntary Product Standard PS51-71, Hardwood and Decorative Plywood*, SD Catalog number C13.20/2:51-71, Government Printing Office, Washington DC 20402.

The first step towards construction is to precut the following sizes of plywood. They can be cut most efficiently according to the diagrams in Fig. 2: 48" x 30" bottom plate, 48" x 18" bottom shelf, 48" x 12¾" bottom slope (20° cut), 48" x 24" top plate, 48 x 11¾" top shelf, 48" x 11" top slope (20° cut).

The slope pieces require angled edges if you don't want to use up all of your Plastic Wood™! The specified lengths include the extended edges of those angled cuts.

Next, precut the internal supports and sides from plywood, or from one-inch pine (the latter is recommended if it is available): 30" x 4½" bottom sides (two pieces), 22" x 5" top sides (two pieces), 6" x 4½" internal support (for bottom), 6" x 5" internal support (for top).

Refer to the details illustrated in Fig. 1 to make the angle of slope on the side pieces, and the 20° cut angle on the slope pieces.

Then, precut the miscellaneous parts as follows: 48" x 1" bottom rear ledge, 48" x 1¾" top front ledge, 47" x 4½" internal barrier (for the bottom). This internal barrier can be made of any material from plywood to plasterboard because it doesn't have to support any weight, it is not usually visible, and you're trying to build this console for next to nothing, aren't you?

Finally, you can go to your local building supply center to acquire the following items:

1. four-penny finishing nails (½ pound)
2. white glue (large bottle)
3. four 3-inch T-braces with mounting screws
4. two 8-foot lengths of ¾" angles of 1/8-inch aluminum
5. six #8 x 1" aluminum screws, bevel-head
6. six #6 x ½" aluminum screws, flat-head
7. miscellaneous electrical fixtures if you aren't reusing whatever you were using before you decided to build this project (I used two outlet strips with six outlets each, one for the top and one for the bottom); you may also want to install a small fluorescent lamp fixture

You are now ready to assemble the console. Remember to use an abundant application of glue at every point of contact. Then remember to wipe away the excess glue after the nails have been driven and countersunk. Since the glue is typically water soluable, all you need is a wet rag for this cleanup procedure.

Begin by building the structural portion of the top and bottom, by referring to Fig. 3. Attach the sides to the top and bottom plates by seating all pieces *atop the plates.* Then attach the internal supports in a similar manner, centered left to right, but secured three inches from the open edge. Now attach the internal barrier for the bottom section; its back side should be flush with the beginning of the downslope cut of the side pieces.

Complete the main sections by affixing the shelf pieces to the top and bottom. As you may have figured out by now, I've saved the best for last. The angle cuts of the slope pieces may have to be "fine tuned" for an acceptable fit due to your manufacturing tolerances. The best way to implement those adjustments is by eyeballing the fit and adjusting the angle of the cut until you're satisfied with your own craftsmanship. Now apply the front and rear ledges, and all the hard work is over. The tedious work now begins!

Take a few moments to smooth the edges and joints, to countersink all the nails, and to fill and sand all those countersunk nail holes, joint gaps, and surface imperfections. If it doesn't look and feel smooth at this point, you'll be disappointed later, especially if you opt for a natural finish.

It is now time to apply the finish of your choice. I decided to use contact paper because the scrap lumber I used didn't consist of all unfinished lumber. Also, I wanted to match the finish of the low-boy filing cabinet, as well as other items already in the shack. Modern adhesives work well on a clean surface, so be sure you have removed all the sawdust possible with a tacky cloth before you start to apply the contact paper.

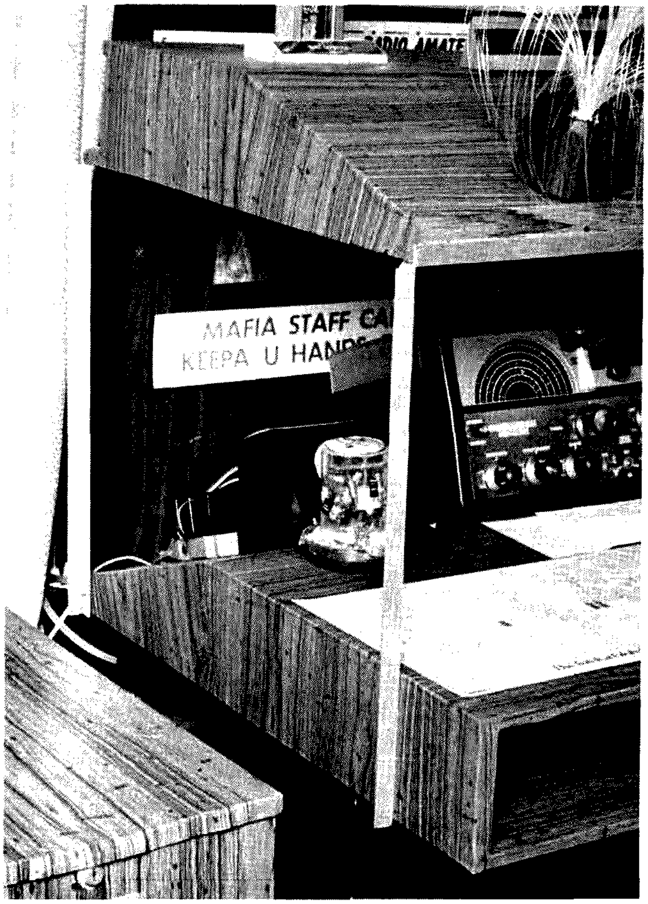


Photo B.

As alternatives, however, you may choose to stain it, then finish it with varnish or shellac, or to paint it, or to apply a veneer or a laminate, depending upon your needs, skills, and finances.

Once that finish is com-

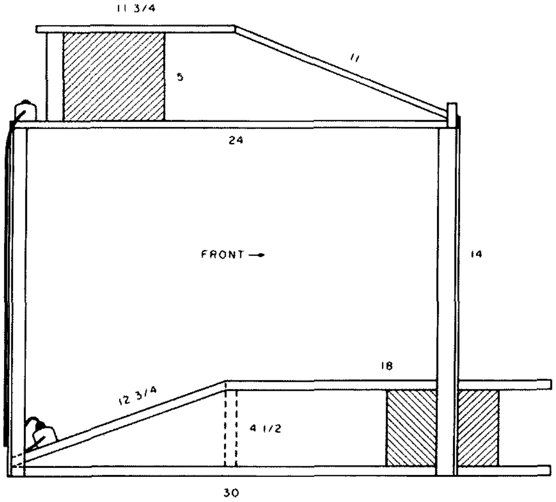


Fig. 1.

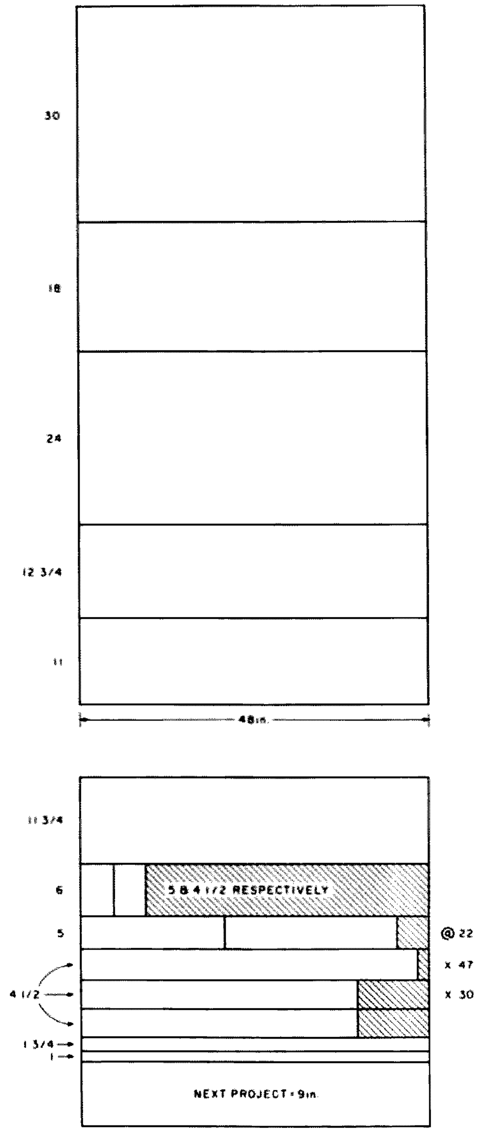


Fig. 2.

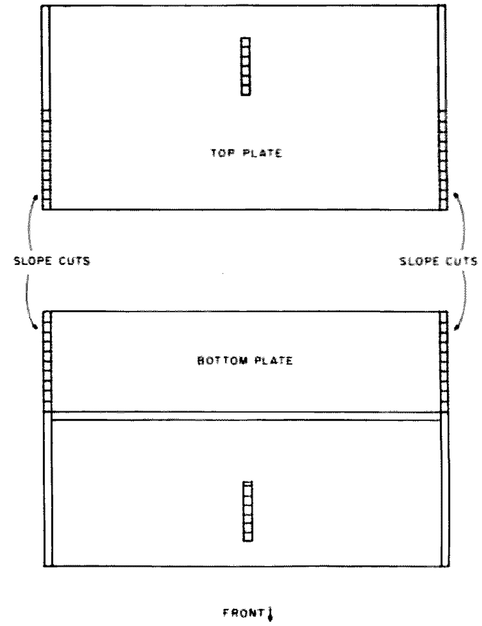


Fig. 3.

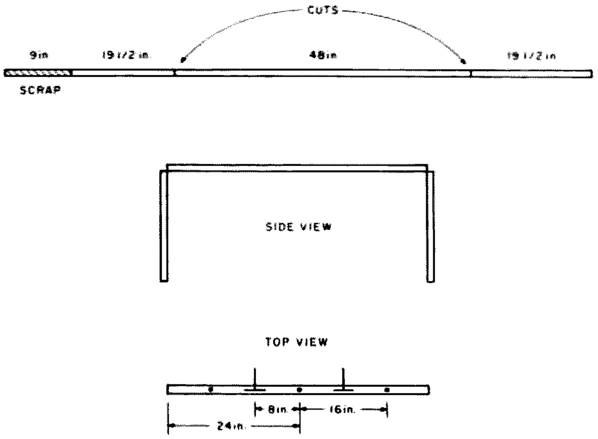


Fig. 4.

plete, the legs can be constructed. The top is supported by, and separated from, the bottom by two aluminum angles reinforced by four T-braces. To fabricate the aluminum supports, first make two cuts on the same edge of both pieces of angle as illustrated in Fig. 4, then scrap the nine-inch cutoff. At the point of each cut, secure the uncut side in a vise (or between two pieces of scrap lumber held together by two C-clamps). Heat the area thoroughly with a propane torch, then slowly and carefully bend the metal to form a right angle, taking special care not to crack the metal on the bend. On each piece of metal, the edges of the two cuts that are now opened 90° should be filed smooth, as should the newly created corners. Drill three holes in the forty-eight inch section, one centered with the other two located sixteen inches each side of center. Countersink these holes to accommodate your flat-head screws; they will hold the top section to the angle pieces.

Turn the top section upside down to drill pilot holes for these flat-head screws and for the T-braces. Secure the aluminum supports with the flat-head screws, then install the T-braces for additional strength, centered eight inches each side of center, as illustrated in Fig. 4.

Right side up, this assembly will wobble easily on these legs, but once secured to the bottom with three screws on each side, it will be sturdy enough to support a human being, let alone your kilowatt amplifier! That task is easily accomplished with two bevel-head screws in each front leg, and one in each rear leg.

Install your outlets at the rear of each section, and secure the feeder cable for the top strip to the back of a rear leg to hide it. If you opted for a lamp, install it now, too.

Finally, sucker an accomplice ... er, ahem .. convince an able-bodied acquaintance to help you carry your creation from the woodshop to the ham shack, and lift it atop your old desk or table. If you used the contact paper finish, remember to be careful not to snag or to tear the plastic when you finally move in, connect, and check out your equipment. Now you may call in the boss for her approval.

Say, have you given any thought to building another console for your test equipment at the service bench? ■

Two Meter Tone Alert

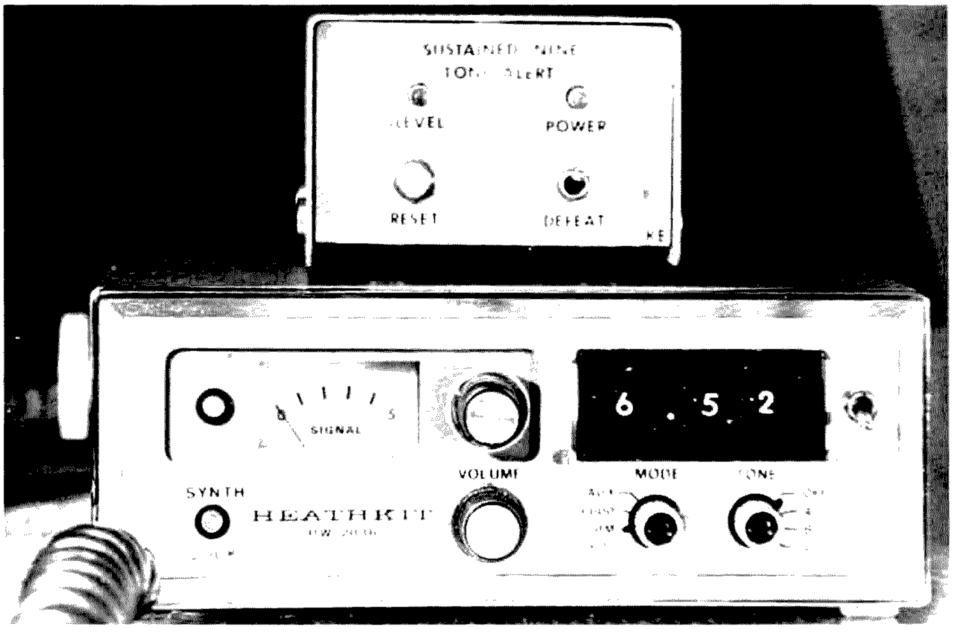
—keep everyone on call

This system can provide emergency help at the dial of a "9".

Rodney A. Kreuter WA3ENK
R.D. #1, Box 27G
New Stanton PA 15672

Here in southwestern Pennsylvania, we have had our share of emergencies lately. The Johnstown flood and two hard winters have kept the local two meter repeaters from gathering dust. However, many hams, myself included, do not monitor these repeaters as much as we should because, many times, we are busy doing something and don't want to be interrupted by local rag chewing or routine traffic. Of course, I'm sure that there isn't a ham in our area who wouldn't drop whatever he was doing and man his station if he was needed.

The morning after Frank WB3HIY had found some stranded motorists in need of first aid for frostbite, Larry WA3YIR and I were discussing the use of the local repeater during times of emergency. Larry, who is the emergency coordinator for Westmoreland County, suggested that it would be very useful to have a type of tone alert similar to those used by fire companies and ambulance services. Two meters is ideal for this, with its local coverage and fixed frequencies for repeaters. Since a great many hams now have touchtone™ pads for autopatch, it wouldn't be very difficult to use these to activate two meter monitors. All a person needs to do is access a repeater and touchtone in a certain code.



The system ready for operation.

Since a fair number of repeaters now have autopatch, the tone alert decoders would have to be designed to ignore the tones used in making phone calls. The easiest and most reliable system of accomplishing this was to delay the output of the decoders so that the tones would have to be present for at least 4-6 seconds to trip the monitors. This doesn't mean that it can never trip during routine autopatch use, but anyone who holds a key down for that long needs help anyway.

The number 911 is the most often used telephone number for emergency service, so we decided to make our tone alert system activate when the number

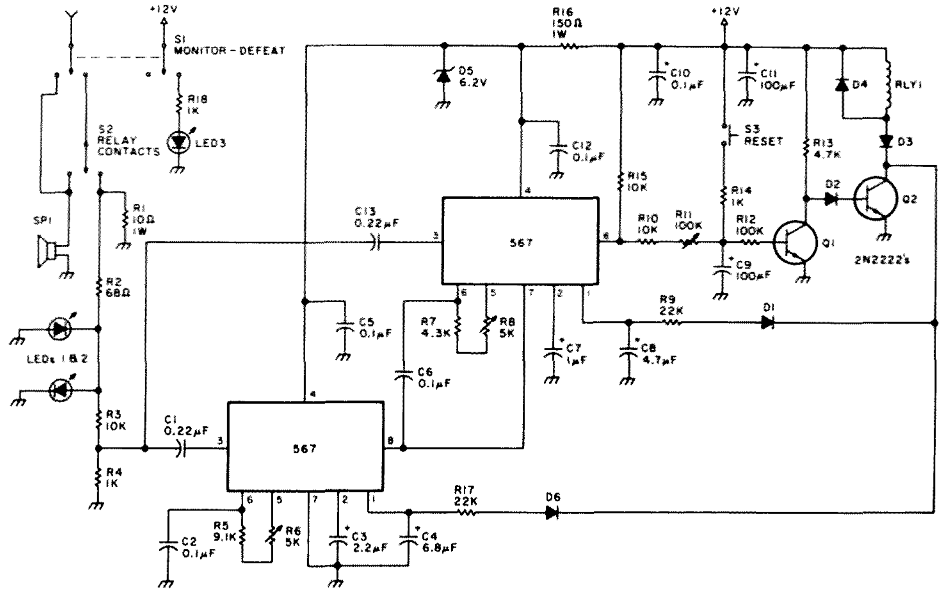


Fig. 1. S1 — monitor, defeat; S2 — relay contacts; S3 — reset.

9 is transmitted for longer than about 8 seconds.

Circuit Operation

In the monitor mode, audio is fed from the receiver to the 10-Ohm resistor, R1. R1 acts as a load for the audio amplifier and should match its impedance. If you don't know what the load impedance should be, use 10 Ohms.

The volume control on the receiver should be adjusted so that the LEDs light dimly when a set of tones is received. Since most LEDs have a turn-on threshold of about 1.7 volts, the audio voltage will be about 1.2 volts rms when the LEDs light. Resistors R3 and R4 divide this voltage down to about 100 mV, which is a voltage that the 567s seem to be happy with.

One more note on the volume control setting on the receiver: With the receiver pumping out 1.2 volts rms, the audio power delivered to the speaker when the tone alert activates will be about 200 mW. This is plenty for my ears. If your ears are different, do this:

1) Choose the audio power that you want;

2) Calculate the rms voltage for this power rating from $E = \sqrt{P*8}$ (assuming 8-Ohm speakers);

3) The new R2 = [(1.4*E) − 1.7]/0.01 (R2 in Ohms); and

4) If you choose to use less than 200 mW, forget the above three steps. The LEDs won't light, so leave them out. Instead, adjust the volume controls so that you get 100 mV at the junction of R3 and R4. A scope or VTVM will suffice.

Since the LEDs limit the voltage to 1.7 volts peak, it won't be necessary to change R3 and R4 unless you opt for lower power. If you do want to use less than 200 mV, calculate the new R3 from:

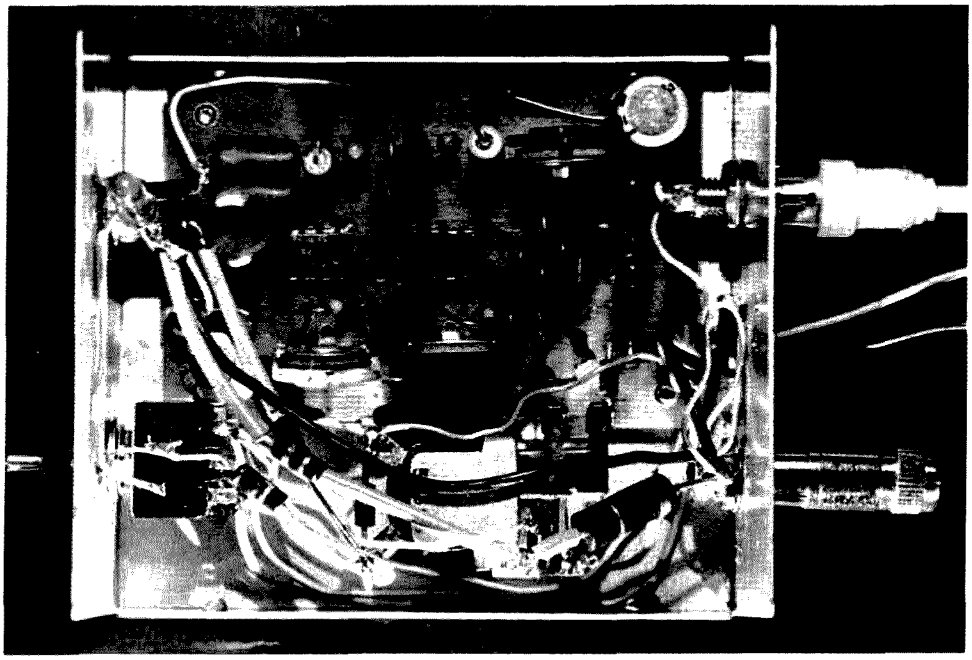
R3 = (10*E) −1
(R3 in k Ohms)

Now that you have 100 mV feeding the 567s, you can proceed to more important matters.

As everyone knows, the tone for the number 9 consists of two tones, 852 and 1477 Hz. The load of IC1 is IC2. Therefore, IC1 is always drawing current from the power supply and "listening" for that 852 Hz tone. IC2, on the other hand, isn't doing anything because IC1 controls its power supply and it won't have any source of current until IC1 "hears" 852 Hz. This saves current and provides the means of producing an output only when both tones are present.

When the tones representing the number 9 are received by the monitor, the output (pin 9) of IC1 saturates (goes from about 5 volts to 0.5 volts). Now IC2 has power and it "listens" for 1477 Hz. If 1477 is present, IC2's output also saturates and energizes the delay circuit, Q1 and Q2.

Capacitors C4 and C7 slow down the action of the tone decoders a little (0.5 to 1 second), but Q1 and Q2 provide most of the time delay. Additional time delay could be obtained by making C4 and



Inside view of the tone alert.

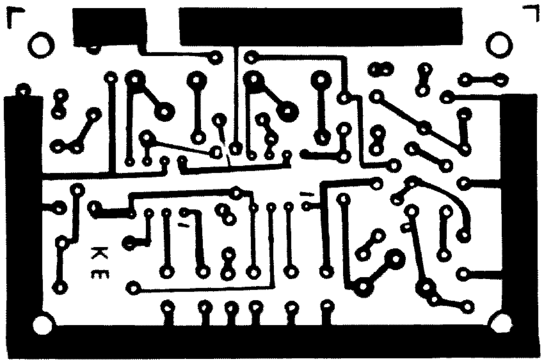


Fig. 2. PC board.

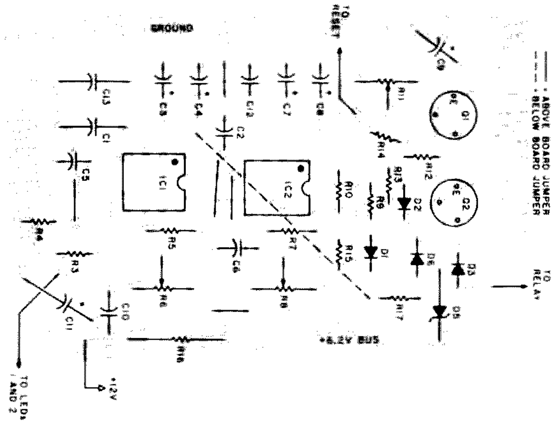


Fig. 3. Component layout.

C7 much larger, but the decoders would be very sluggish and it would be more expensive to do it in that manner.

The time delay operates as follows. Initially, capacitor C8 charges to about 12 volts through resistors R10, R11, and R15. This causes Q1 to turn on and Q2 to turn off. When pin 8 of IC2 goes low, capacitor C8 begins to discharge through R10, R11, and R12. When it has almôst completely discharged, Q1 turns off and Q2 turns on. This pulls in the relay and latches the circuit. Time delay is controlled by R11.

Resistor R9 and diode D1 provide the latching function for IC2. When Q2 finally saturates, pin 1 of IC2 is low. The voltage at pin 1 is then kept low by the diode and resistor. By applying a positive voltage to pin 1, the circuit is reset.

If the tones should end before the time delay times out, as in the case of a routine autopatch, nothing will happen because Q2 never saturates. C8 will be partially discharged, but it will recharge in a few seconds and be ready for an alert.

Construction

The easiest method of construction is to use the artwork in Fig. 2 and make a printed circuit board. This would be especially useful if a club were to photographically produce a lot of boards. Perfboard construction could be used, since the circuit isn't very complex and layout is not critical.

Some components, such as the LEDs, relay, and speaker, were left off the board so that you can use any size components you might have. The relay should not draw any more than 150 mA. Mount the LEDs somewhere where you can see that the device is receiving the proper audio voltage.

A bypass switch (S1) can be used to defeat the tone alert, or you can simply switch to the internal speaker of your rig.

Use the highest quality components that you can afford for this project. This device by its very nature might be called to work for months at a time without any testing. I would suggest that, if your local repeater group has nets every week, the monitors be tested before each net.

Use at least ½-Watt resistors unless otherwise marked. Capacitors should be at least 10-volt unless otherwise marked. Total cost of the tone alert should not be any more than about $15 — junk box to the rescue!

Adjustment

Adjustment is not difficult, but it will take some time, mostly due to the fact that the decoders are a little broad and a little slow to react.

Tune IC1 first. Turn R6 fully counterclockwise. Have someone transmit the tones for the number 9 (simplex, please). Apply power to the board, wait about 15 seconds, and then reset IC2. Adjust the volume on your receiver so that the LEDs just light.

Connect a voltmeter from pin 8 of IC1 to ground. Slowly turn R6 until the voltage falls from 5 volts to about 0.5 volts. Mark this point on the pot. Repeat the tuning with the pot initially in the clockwise position. The final setting of the pot will be midway between these two points. Have your friend pulse his pad — about 2 seconds on, 2 seconds off — and make sure the decoder falls each time.

Now proceed to IC2. Remember that IC1 must

Parts List

C1, C13	0.22 uF	R2	68Ω ½ W
C2, C5, C6, C10, C12	0.1 uF	R3, R10, R15	10k
C3	2.2 uF/16 V	R4, R14, R18	1k
C4	6.8 uF/16 V	R5	9.1k
C7	1 uF/16 V	R6, R8	5k trimpot vertical mount
C8	4.7 uF/16 V	R7	4.3k
C9, C11	100 uF/25 V	R9, R17	22k
D1, D2	1N914	R11	100k trimpot vertical mount
D3, D4	1N4001	R13	4.7k
D5	6.2-volt, 1-Watt zener	R16	150Ω 1 Watt
IC1, IC2	567 tone decoders	RLY1	12 volt SPDT relay 150 mA or less (see text)
LED1, LED2	red LEDs	S1	DPDT switch (power-defeat)
LED3	green LED	S2	relay contacts
Q1, Q2	2N2222 or similar	S3	N.O. push-button (reset)
R1	10Ω 1 Watt	SP1	8Ω speaker

be working before IC2 will operate. Perform the same type of adjustment using R8.

After you are certain that the pots are set correctly, epoxy, glue, wax, or nail polish them so that they cannot move. Adjust R11 for the proper amount of time delay. Six or seven seconds is okay.

One warning about the tones you use for adjustment. Be sure that your friend has a good touch-tone pad.

Depending on what type of relay you might have available, you might do more than just switch in a speaker. A flashing light or tone, for example, might be switched in by an extra set of contacts.

Use

It comes to mind that a device such as this could be misused out of existence rather quickly. We are fortunate here in our area that we don't seem to have that problem.

To be really effective, as many hams as possible should know that a group of people in your area have these devices and are monitoring a certain repeater with them. It would be best if at least a few people on each repeater frequency have the tone alerts.

Another possibility that should not be overlooked is that alerts built for other tones could be used as a private line with friends or the XYL. A club could also have its own to alert members to cancellation of meetings or other business that would affect only those people.

Many thanks to Larry WA3YIR for his help with testing and printed circuit artwork.■

LETTERS

from page 82

deleting the 10 meter downlink, the Soviets may do likewise on their next venture.

AMSAT and associates should be congratulated for providing service into the 10 meter band during the low MUF, but now is the time to stop!

Samuel H. Beverage W1MGP
North Haven ME

MORE GROANING

To K4KI's informative article ("Silence Groaning Refrigerators") in the November, 1978, issue of *73* should be added several additional points to avoid problems he described. In addition to cleaning up bad connections in junction boxes, outlets and switches that show signs of overheating should be replaced. Appliances such as washers, refrigerators, garbage disposals, and air conditioners should be fed by separate circuits directly from the fuse or breaker panel. A common neutral as he describes in his article must be avoided! Balance the current draw on each side of the 220-volt service if possible; for example, if you operate 4 window air conditioners drawing 7 Amps at 117 volts, arrange separate direct wiring to each unit. At the fuse panel, two units should be connected between one of the 220-volt legs and neutral, and the other two between the opposite leg and neutral. If local building regulations do not permit you to work on your wiring in your own home and if you are otherwise not qualified, find a competent electrician.

William W. Muessig K4FD
Falls Church VA

Mr. Muessig does not support his statement about running appliances directly to a fuse box using separate circuits by referencing the specific requirement of any recognized electrical codes. Three-wire systems have been developed for specific technical reasons. They have been in use for many years and are still being installed. As in any electrical power system, poor connections can be hazardous.

As electrical codes are quite complex and differ in various locations, the best thing to do is to check your code and see if your wiring conforms. One of the problems is that older houses may not conform to the latest codes, as the codes are often being changed and updated in many communities. Before making any changes, I would suggest learning the exact facts applicable to your own situation. A licensed electrical contractor will be able to inspect your wiring and suggest what changes would be desirable or required.

I am in full agreement with Mr. Muessig's excellent suggestion that any overheated items be replaced and bad connections corrected.—K4KI.

OOPS!

Oops! I'm only fifty-six and I certainly wasn't any child wizard with electronics, but "fifty years a ham and long-time member of QCWA" is about the nicest thing anyone could say about me even if it isn't correct (see October, 1978, issue of *73*, page 6)! My letter of July 24th providing you with the original artwork had reference to Larry Harvey N6LY for whom I did the sketch—he fits that description. He's the ham responsible for producing the fine printed program of the San Diego Convention and deserves recognition for a job "well done," most especially in view of the lack of help and cooperation which he had to overcome.

Keep the League's tender spots exposed to the stove, Wayne. The pages of *73 Magazine* certainly give the amateur radio community much to think about and use in every facet of this great hobby. May your tribe increase—also your ad contracts and subscriptions!

Paul Hower WA6GDC
La Mesa CA

WE ASKED

You asked. I copied the 14 wpm tape you sent thirty times besides copying off the air—excuse me, thirty sides, *fifteen times*. Tuesday I got my General and Advanced licenses in one sitting.

So now send me the 21 wpm tape and the 6 wpm tape. Also, subscribe me again to *73*.

Glen Jacobs WB7CMZ
Eagar AZ

GOLD STAR

The good guys still outnumber the bad guys in the mail-order business. In the spring of 1978, I ordered a gear set and service manual for a Lorenz Teletype™ machine over the telephone. I paid $48.00, in advance, for the order. The person accepting the order misunderstood and sent gears for a Model 15. I was advised the manual was not available from the advertiser. Subsequently, the advertiser had a machinist cut a pinion gear and I received my three made-to-order gears. I forgot about the manual. Recently, I received an unsolicited check for $26.00 as refund on the manual not delivered. A *gold star* advertiser—Teletypewriter Communications Specialists, Berkeley Heights, New Jersey.

George D. Louden WB9GMF
Omro WI

COMPUTER USER'S NET

There has been established a 2650 Computer User's Net every Thursday at 2330Z on a frequency of 3.993 MHz. The net is an informal net dedicated to the discussion of the 2650 in particular and personal computing in general. Most of the net participants are using the Central Data 2650 system and they are eager to talk to any and all.

The present net control station is Jerry Johnson WA3WZF, Fort Meade, Maryland, and it is hoped to expand the net to a 20 meter version also.

Vincent Staffo WB2FYZ
Ilion NY

Francis J. Ferrara WB8SWH/W8VL
PO Box 56
Enon OH 45323

Sneaky Car Security System

—an alarming article

The recent visit to my van by an "uninvited guest" gave me the impetus to start construction on a radio-controlled electronic locking and alarm system which I have contemplated building for some time. Most standard automotive alarms have certain disadvantages, such as time-delay units which allow 30 or so seconds for entry. A professional thief can have the door to your car opened, radio out, and be halfway down the block before your siren goes off! Lock-actuated systems possess the negative feature of having to punch a hole in the body of your car. They are also a dead giveaway to the "pro" as to what type of protection you are using. But my particular design utilizes a small battery-powered transmitter to activate and deactivate the alarm/receiver, without any direct connection to your vehicle.

Almost all of the digital circuitry is from the CMOS family, which is a natural for automotive applications because of its wide supply voltage range, excellent thermal character-

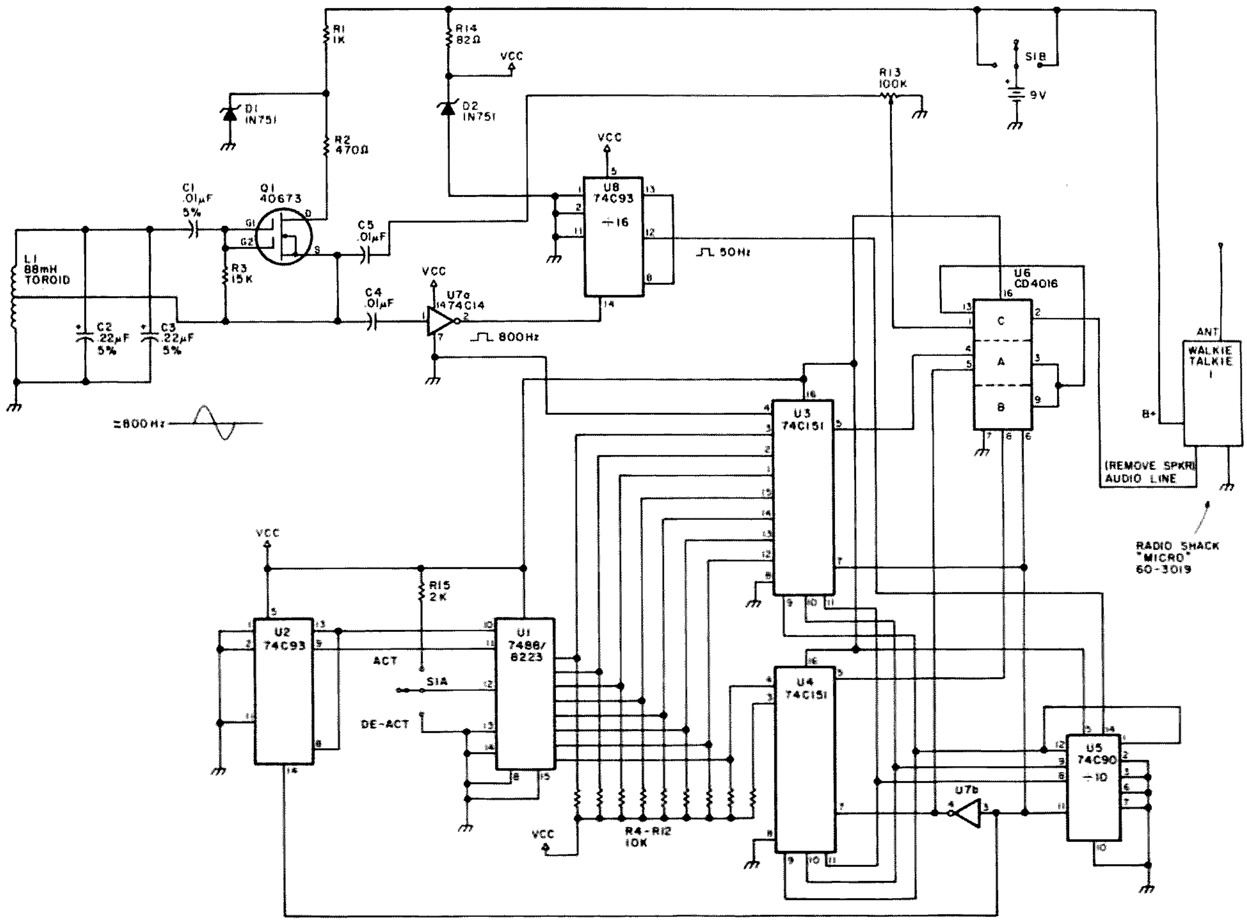
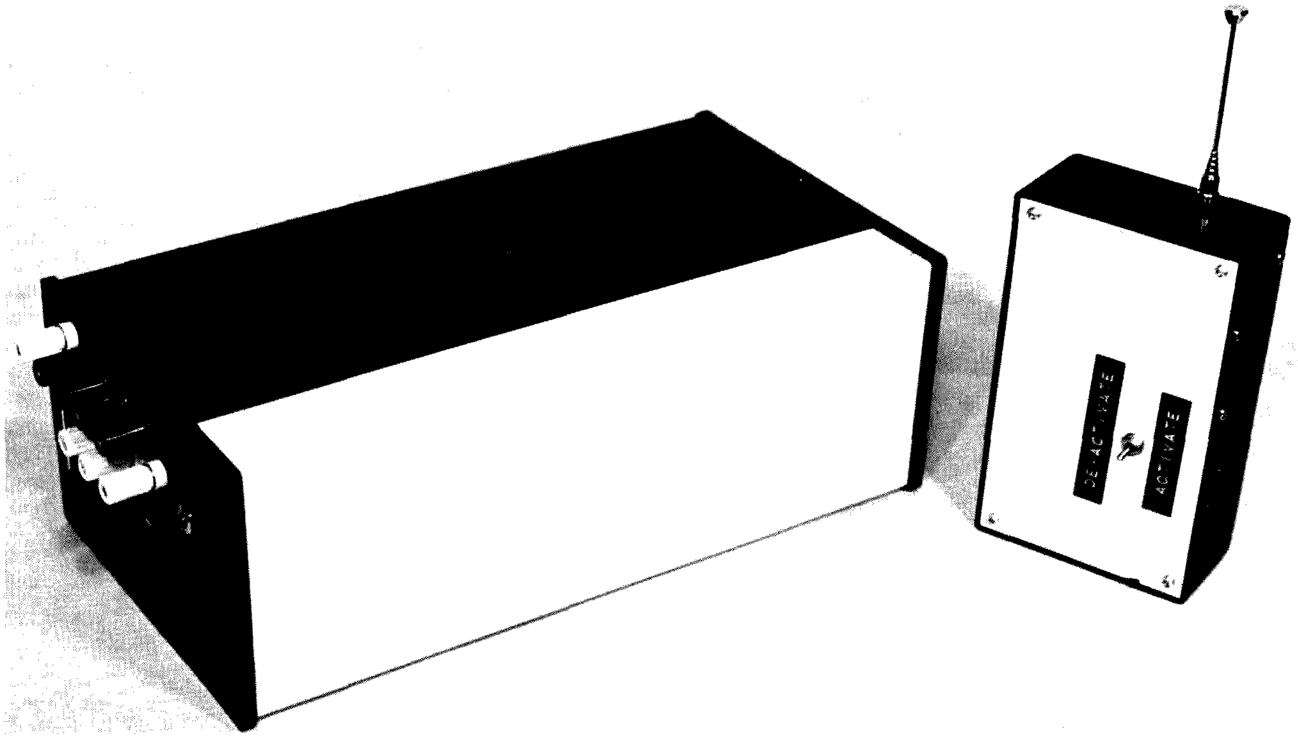


Fig. 1.



Receiver and companion transmitter.

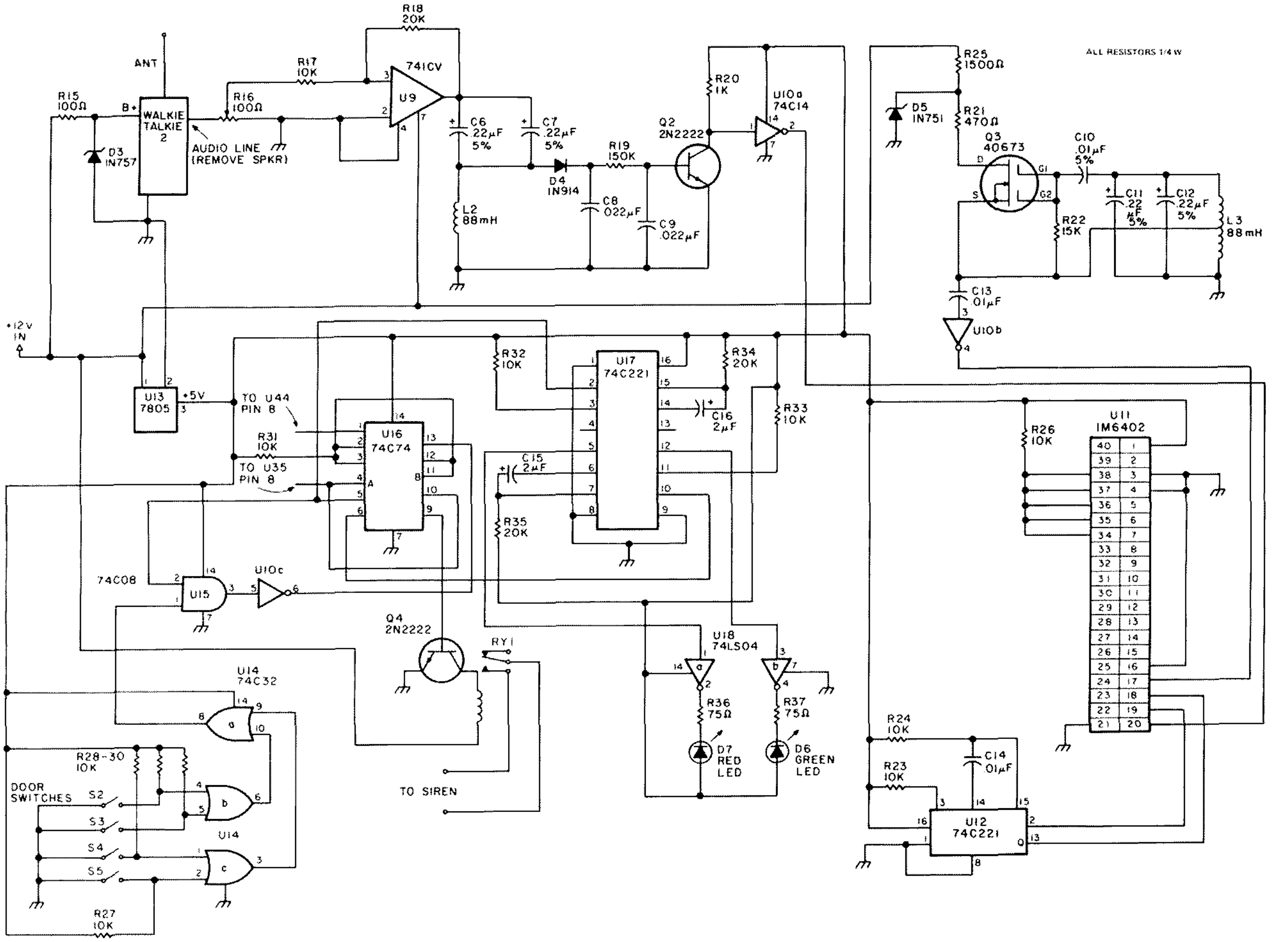


Fig. 2. Rx/logic control. All resistors are ¼ Watt.

istics, and extremely low power consumption. To keep the project as simple as possible, a set of inexpensive walkie-talkies are used as the rf link.

Transmit System Description

Refer to Fig. 1. The transmitter logic centers around U1, a 32 x 8 bit ROM of the 7488 or 8223 variety. These memory chips can be bought, preprogrammed with random bits on the output, through the surplus market for a few dollars each, or they can be purchased new and programmed by the buyer. A four-word address sequence is generated by a 74C93 binary counter, U2, and the activate/deactivate switch, S1. The two remaining address lines are hard-wired to ground. A different eight-bit parallel output is produced each time the address changes. The ROM outputs are then routed to multiplexers U3 and U4. On U3, the first bit is locked low, and, on U4, the second bit is locked high. Since the multiplexers are sequenced with a 74C90 decade counter (U5), the count on U4 will never progress past the second input. The end result is a ten-bit TTY format signal at the output of OR gate U6A/B, with the data changing 1 address each time U5 completes a count of ten. The baud rate is controlled by the MOSFET oscillator and runs at approximately 50 Hz using the components specified. The output is split off at the source of transistor Q1, with one leg passing through the 74C14 Schmitt trigger (U7) and divide-by-16 counter, U8, and drives counter U5 at 50 bits per second. The second leg of the oscillator is the audio source for the data modulator U6C. The TTY signal controls the audio tone by producing ON/OFF keying in direct proportion to the digital data. The output of the analog switch is then used to modulate the transmit walkie-talkie. The unit should be modified by removing the microphone/speaker and connecting the data modulator output directly into the walkie-talkie audio line. Audio level is controlled by potentiometer R13 and should be set for minimum distortion by monitoring it with an oscilloscope at the output of the second walkie-talkie. It is also necessary to lock the TX/RX switch in TX. This is accomplished by removing the PTT button and bending the switch arm around to the foil side of the PC board where it should be soldered in place to the ground pad.

Receive System Description

Refer to Fig. 2. The encoded signal is picked up by walkie-talkie #2 with the audio tone level controlled by R16 and boosted by op amp U9. C6, C7, and L2 comprise a frequency selective network which allows only the 800 Hz tones to pass. D4 detects the signal, and C8, C9, and R19 filter it. Q2 clamps the voltage so that it can fire Schmitt trigger U10A, whose output is the restored digital data. This data is then applied to the serial input port of U11, a 5-volt UART. Clocking to U11 is provided by a second MOSFET oscillator,

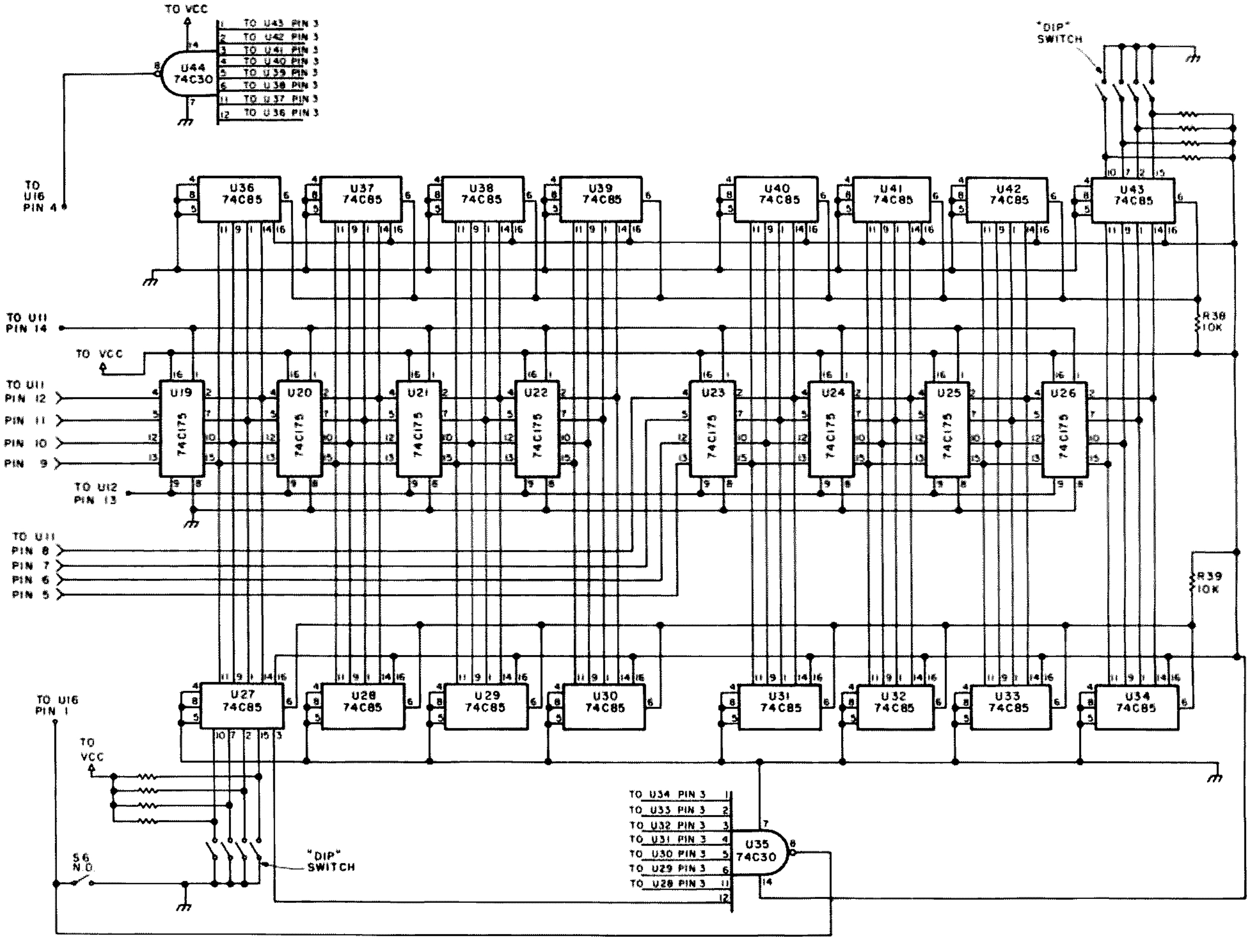


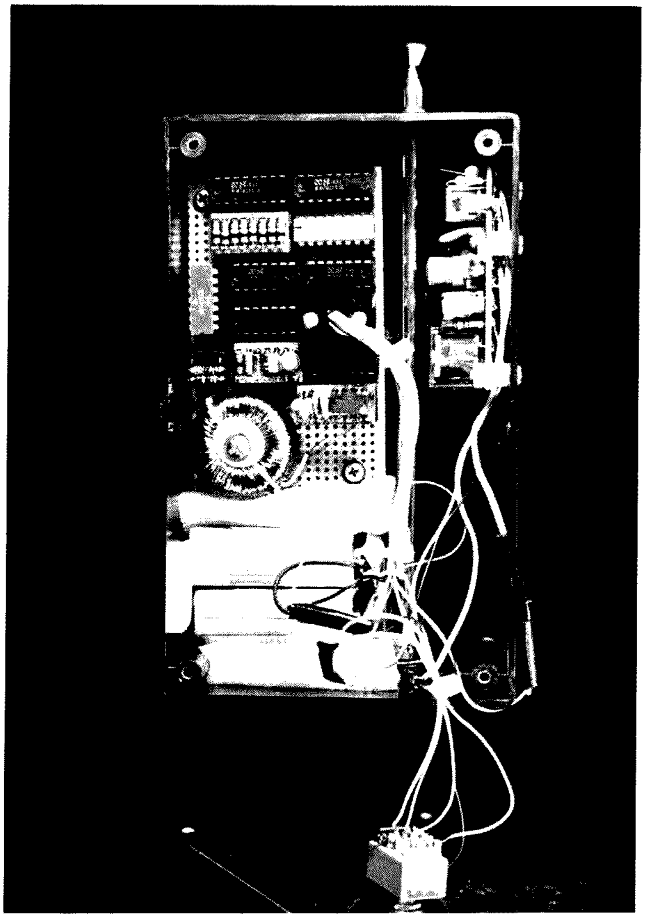
Fig. 3. 10k pull-up resistors and switches on all pins 10, 7, 2, and 15, ICs U36-U34.

 Jan 1979

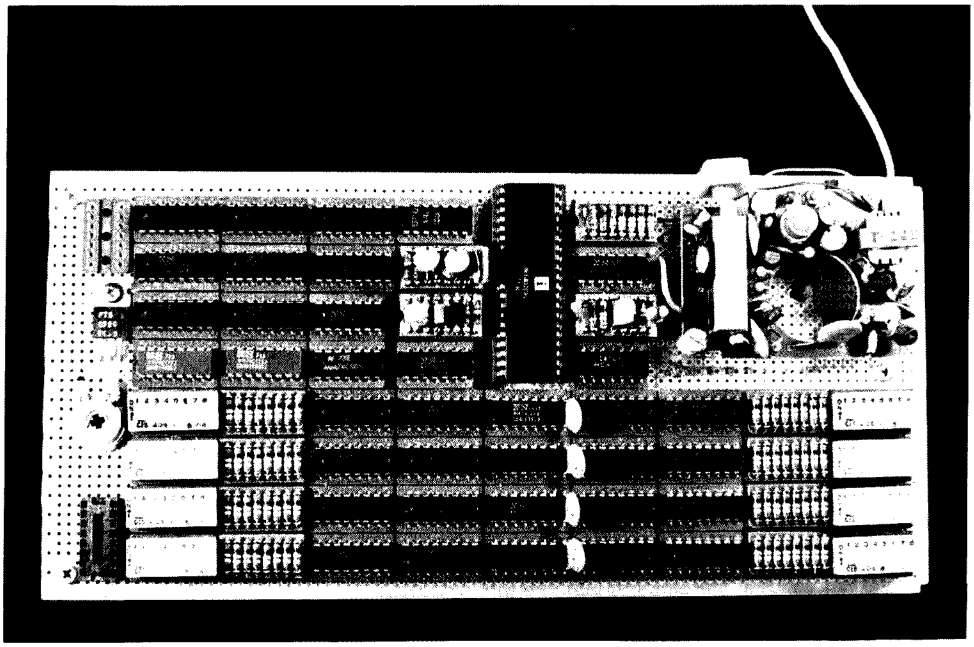
which is essentially the same circuit as the transmit oscillator. The output of the UART is a succession of eight-bit parallel words which are decoded by the circuitry in Fig. 3. The decoder provides a signal when it senses an "activate" command which sets flip-flop U16A. When the Q output (pin 5) goes high, it arms AND gate U15. At this time, if any of the other switches (S2-S5) are opened, the output of U15 will change state, causing U16B to latch, which turns on Q4, trips the relay, and sounds the alarm. Once U16B latches, it is not possible to reset it by merely closing the door. The turn-off command must come from the transmitter or from a reset switch hidden inside the vehicle. To ascertain that the receiver has actually picked up the activate command, a visual indication system is provided. When U16A arms, it triggers one-shot U17, which produces a half-second-wide pulse that blinks red LED D7. When U16A disarms, D6, a green LED, will also blink, indicating that the vehicle can be entered without setting off the alarm. These two LEDs can be mounted in an inconspicuous place near a window to aid visibility.

Decoder

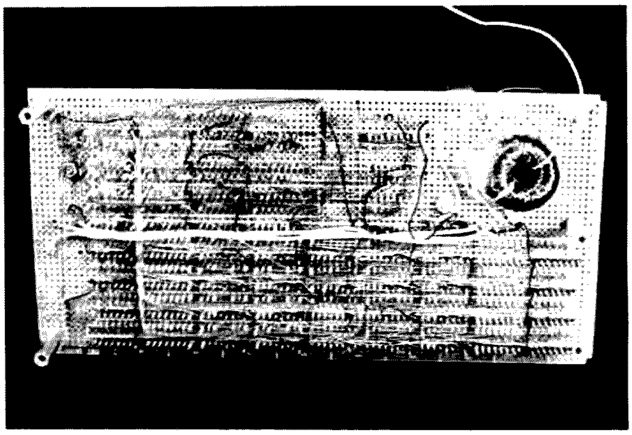
Refer to Fig. 3. The eight-bit codes enter the shift register chain simultaneously through U19 and U23. Here they are clocked down the line by U12, which provides a pulse each time it recognizes that a valid word has been received by U11. U12 also produces the data reset command for U11. At this time, a constant comparison is being made by ICs U36 through U43 and U27 through U34, which comprise the respective activate and deactivate command recognition circuits. Preselected values which match the activate and deactivate codes are set into the comparators by DIP switches. When the data at the shift register outputs is the same as those preselected values, the A = B outputs of the comparators will go high, and, when all eight go high concurrently, their associated NAND gates will go low, causing U16 to either set or reset. If no changes in coding are anticipated after the initial setup, it is not necessary to use the DIP switches. Instead, the codes can be hard-wired into the comparators. It's not even that difficult to change codes with this technique, especially if wire-wrap construction is used. As an added security measure, all the shift register clear lines are tied common and wired to the UART framing error flag output. In the event of noise, quite often the UART will output a random "word," but it also



Interior view of transmitter. Digital section and batteries are on the left. Rf section is mounted on right wall.



Receiver circuit board. Receive rf board is in the upper right-hand corner. To its left are the tone-to-data converter, UART, and shift register chain. The bottom half of the board contains the digital comparator and logic control circuits. I/O connectors are on the extreme left, upper and lower.



Rear view of receive board. Filter coil is in the upper left-hand corner.

recognizes that it was triggered from noise and will pulse the framing error flag high. This pulse will cause the shift registers to dump any erroneous data in them, thus decreasing the possibility of accidental activation or deactivation due to noise. Push-button switch S6 is used to manually reset the alarm by producing a negative-going pulse. The momentary short circuit across U35 will cause no harm to any circuitry.

Operation

It is only a matter of throwing the activate or deactivate switch and observing the receive indicator LEDs for proper operation. The transmitter is designed to send a continuous string of data, for the receiver only has to miss just one data bit for the commands to be ignored. It is better to send the data continuously and then turn the transmitter off after it has been verified that the command has been properly received.

Conclusions

Designed initially as an automotive protection system, the basic circuitry can be adapted to suit a host of other needs, such as home protection or as an automatic garage door opener. Power supply requirements are extremely low. In the arm mode, about only 50 mA of current at 12 V dc is all that is needed. This suggests battery power as a primary or backup source which would sustain protection to, say, a house during a blackout — or if someone cut your ac lines!

There are so many variables present that it would be extremely difficult to try to "crack" the receiver by means other than what it was designed for. Transmission and modulation frequencies, data rate, and code combinations are just a few of the parameters which can be changed. At the other extreme, this particular unit was designed as a prototype, and the coding scheme is more complex that it really has to be. Eight bits per word, multiplied by four words for each command, results in 2^{32} possible code combinations (more than 4 billion)! If this much security is not needed, remove the wire from U2, pin 9 in the transmitter and ground it. This will result in only 2^{16} code possibilities (65536). However, U21, U22, U25, U26, U29, U30, U33, U34, U38, U39, U42, and U43 can all be deleted. Other ways to decrease complexity would be to use only a four-bit data word.■

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Design-a-Notcher

—automated filter values

Personal computers have been around for several years now and it appears that many of them spend most of their time playing games. I think we should start making them do some honest work for us. The following program will compute the variables used in a notch filter. The variables are the R or C terms. The program was written for an SWTP system using 8K Basic.

A notch filter, as its name implies, is used to notch out a certain frequency. The desired frequency will be notched out and certain side frequencies will be attenuated. The number of side frequencies attenuated will depend on the depth of the notch and the sharpness of the notch itself. The notch depth is determined by how well the components are matched. Theoretically, infinite attenuation is possible, but the mismatch of components limits the total attenuation to less than the theoretical limit.

The frequency where the notch occurs is dependent on the values of the RC components in the following equation:

$$F_n = 1/2\pi RC$$

where F_n is the notch frequency.

To use the program, one must know the resistance of the source feeding the filter and the resistance of the load being fed by the filter. The filter works best when working into an open load, which is not practical, but it still does quite well with a load across the output if the load resis-

```
WHAT IS THE DESIRED NOTCH FREQUENCY
1000
WHAT IS THE DRIVING SOURCE RESISTANCE IN OHMS
600
WHAT LOAD (IN OHMS) IS THE FILTER FEEDING
10000

SELECT A VALUE FOR (R)

WHEN SELECTING R THE SOURCE & LOAD RESISTANCE MUST
BE CONSIDERED THE R SHOULD BE AT LEAST => THE SOURCE RESISTANCE
(R=>RS) AND R SHOULD BE 1/10 OR LESS THAN RL.  THE RATIO
SHOULD BE RS<R<RL
1500
IS THIS A STANDARD VALUE OF (C)
YES
THE VALUE OF (R) IS 1500
THE VALUE OF 2C IS 2.12314224E-07
THE VALUE OF R/2 IS 750

THESE VALUES SHOULD BE ROUNDED TO THE NEAREST STANDARD
VALUES

WHAT IS THE DESIRED NOTCH FREQUENCY
6000
WHAT IS THE DRIVING SOURCE RESISTANCE IN OHMS
600
WHAT LOAD (IN OHMS) IS THE FILTER FEEDING
10000

SELECT A VALUE FOR (R)

WHEN SELECTING R THE SOURCE & LOAD RESISTANCE MUST
BE CONSIDERED THE R SHOULD BE AT LEAST => THE SOURCE RESISTANCE
(R=>RS) AND R SHOULD BE 1/10 OR LESS THAN RL.  THE RATIO
SHOULD BE RS<R<RL
1500
THE VALUE OF C IS 1.7692852E-08

IS THIS A STANDARD VALUE (YES,NO)
NO

THE NOTCH VALUE DEPENDS ON THE ACTUAL VALUES OF
THE COMPONENTS IT IS DESIRABLE TO GET AS CLOSE AS
POSSIBLE TO THE ACTUAL VALUE OF C

TO CORRECT THIS WHAT IS THE NEAREST STANDARD VALUE
OF C
0.02
THE VALUE OF (R) IS 1326
THE VALUE OF 2C IS 0.04
THE VALUE OF R/2 IS 663

THESE VALUES SHOULD BE ROUNDED TO THE NEAREST STANDARD
VALUES
```

Sample runs.

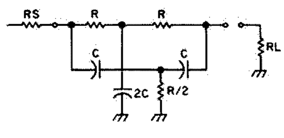


Fig. 1. Twin-T notch filter.

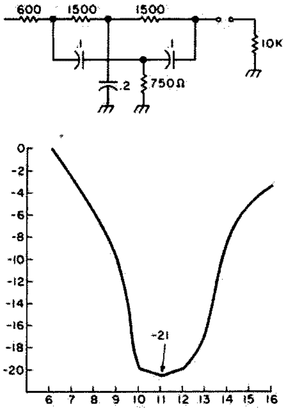
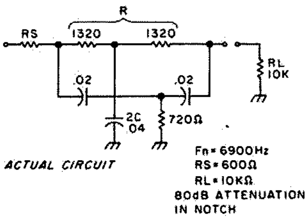
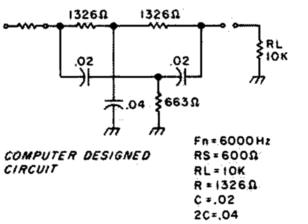


Fig. 2.





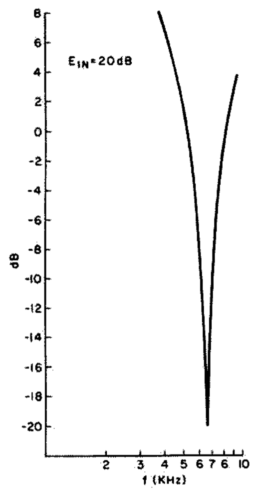


Fig. 3. A graph of a computer-designed notch filter. Note the closeness of the computer values and the values used in the actual circuit.

```
*
0100 PRINT "WHAT IS THE DESIRED "
0105 PRINT "NOTCH FREQUENCY ?"
0110 INPUT N
0111 IF N>450000 GOTO 600
0120 PRINT "WHAT IS THE DRIVING SOURCE "
0125 PRINT "RESISTANCE IN OHMS ?"
0130 INPUT R1
0140 PRINT "WHAT LOAD (IN OHMS) IS THE"
0145 PRINT "FILTER FEEDING ?"
0150 INPUT R2
0155 PRINT
0156 PRINT CHR$(16),CHR$(22)
0160 PRINT "SELECT A VALUE FOR (R) "
0161 PRINT
0163 PRINT "WHEN SELECTING (R),THE SOURCE "
0165 PRINT "AND LOAD RESISTANCE MUST BE "
0167 PRINT "CONSIDERED . THE(R) "
0168 PRINT "SHOULD BE AT LEAST"
0170 PRINT " =>THE SOURCE RESISTANCE (R=>RS) "
0172 PRINT " AND R SHOULD BE 1/10"
0175 PRINT "OR LESS THAN RL"
0180 PRINT "THE RATIO SHOULD BE RS<R<RL"
0185 INPUT R
0190 LET C=1/(6.28*N*R)
0194 PRINT CHR$(16),CHR$(22)
0195 PRINT "THE VALUE OF (C) IS ";C
0196 PRINT "IS THIS A STANDARD VALUE (YES,NO)"
0197 INPUT A$
0198 IF A$="YES" THEN 400
0220 PRINT "THE NOTCH DEPTH DEPENDS ON THE"
0230 PRINT "ACTUAL VALUES OF THE COMPONENTS"
0240 PRINT "IT IS DESIRABLE TO GET AS CLOSE AS POSSIBLE "
0245 PRINT "TO THE ACTUAL VALUE OF (C) "
0250 PRINT
0255 GOSUB 800
0260 PRINT CHR$(16),CHR$(22)
0270 PRINT "TO CORRECT THIS, WHAT IS THE "
0275 PRINT "NEAREST STANDARD VALUE OF (C) "
0280 INPUT C
0285 LET R3=1/(6.28*N*C*(1E-6))
0290 PRINT "THE VALUE OF (R) IS ";INT(R3)
0295 LET C2=2*C
0300 PRINT "THE VALUE OF 2C IS ";C2
0310 LET R4=R3/2
0320 PRINT "THE VALUE OF R/2 IS ";INT(R4)
0330 PRINT
0340 PRINT "THESE VALUES SHOULD BE ROUNDED TO THE NEAREST STANDARD VALUES"
0350 END
0400 LET R3=1/(6.28*N*C)
0410 GOTO 290
0600 PRINT "BE ADVISED THAT THE NOTCH"
0605 PRINT "FILTER IS NOT EFFECTIVE AT THE"
0610 PRINT " HIGHER FREQUENCIES "
0620 PRINT "DO YOU STILL WANT THIS HIGH A FREQUENCY (1=YES,0=NO)"
0630 INPUT Z
0640 IF Z=1 THEN 120
0650 GOTO 100
0800 FOR I=1 TO 500
0803 NEXT I
0805 RETURN
```

Program listing.

tance is high compared to the source resistance and the resistance in the notch circuit. For best results, the following ratio should be adhered to: RS < R < RL.

Notch filters are popular, but their use is limited to frequencies below approximately 400 kHz, and they tend to have high attenuation and low selectivity. But, because of their simplicity, low cost, and ease of design, they are widely used.

The sample run of the program uses RS equal to 600 Ohms, RL equal to 10k Ohms, and a desired notch of 1 kHz.

Fig. 2 shows the circuit that the program developed. Note that it does not notch out at exactly 1 kHz. The reason for this is that with the values of .1 uF for C vice 1.0615 · · ·, the value of R should be 1592 Ohms and R/2 should be 796 Ohms. I am reasonably sure that the notch would have been nearer 1 kHz if more exact values of R were used.

If you have need for a notch filter and use a computer that speaks BASIC, this program will allow you to play with different values and see how they affect the depth and sides of the notch.■

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The Cosmac Connection: Part 1

—computerized CW

With a few ICs and this program, your Cosmac microcomputer can imitate the best automatic keyers available.

A simple 90-byte program can turn your Cosmac microcomputer into an excellent automatic keyer for sending Morse code. It features automatic dash and dot completion, dash and dot memories, adjustable dash:dot ratio, automatic letter spacing, iambic or squeeze keying, and adjustable speed from 5 wpm to 80 wpm.

Equipment Required

You will need the Cosmac microcomputer fashioned around the CDP1802CD CPU by RCA. The program requires 90 bytes of memory. My computer was constructed according to the article which appeared in *Popular Electronics*, September, 1976. In addition, you will need some ICs and perhaps a transistor or relay in order to interface the computer with your transmitter. The program was written for a clock frequency of 1 MHz, but it can be modified for other clock frequencies quite easily.

How the Program Works

After setting subroutine counters and memory pointers, the first thing the program does is convert the code speed entered via the keyboard into hexadecimal form. The program assumes the code speed will be less than 100 wpm. An example will illustrate the method best. Suppose you enter 35 as your desired speed. The program converts this to base 16 by repeatedly subtracting 10_{16} from it until the remainder is less than 10_{16}. In this case,

$35_{16} - 10_{16} = 25_{16}$
$25_{16} - 10_{16} = 15_{16}$
$15_{16} - 10_{16} = 05_{16}$

Each time a subtraction is performed, OA is added to R1, and, finally, the remainder is added to R1. In this case R1 = 0A + 0A + 0A + 05 = 23_{16}. This completes the conversion, 35 wpm = 23_{16}.

Next, I derive a number which is proportional to the length of one dot. Since the length of a dot is inversely proportional to the code speed, I calculate 00F7/code speed in hex form and store the quotient in M(000A). This number sets the length of a timing loop in making a dot. Two times this number is used for letter spacing, and three times this number is used for the dash length. Actually, during execution of the program, a dot or dash is automatically followed by a space of one dot, and, if a letter space of two dots is added to this, you get effectively a letter space equal to the length of three dots.

Spaces were left at M(0048) and M(0049) to enable you to increase the length of the dashes. By inserting the instruction F4 at M(0048), the dashes will be 4 times the dot length. If you also put F4 at M(0049), the dashes will be 5 times the dot length. This will change the speed of the code, of course.

The dash length is stored in M(000C), and, since it cannot exceed FF, this restricts the maximum dot length at M(000A) to 1/5 of FF if you use a 1:5 dot-to-dash ratio. This, in turn, places a maximum value on the numerator of the formula quoted earlier, 00F7/code speed in hex form. So, summing up, the number 00F7 was chosen to allow code speeds as low as 5 wpm without exceeding a dash time of FF at M(000C). At M(0036), provision is made for changing this numerator to 01F7 or 02F7, if desired. This is useful when operation will consistently be at high code speeds and when finer resolution is required in the code speed. For example, with the program as

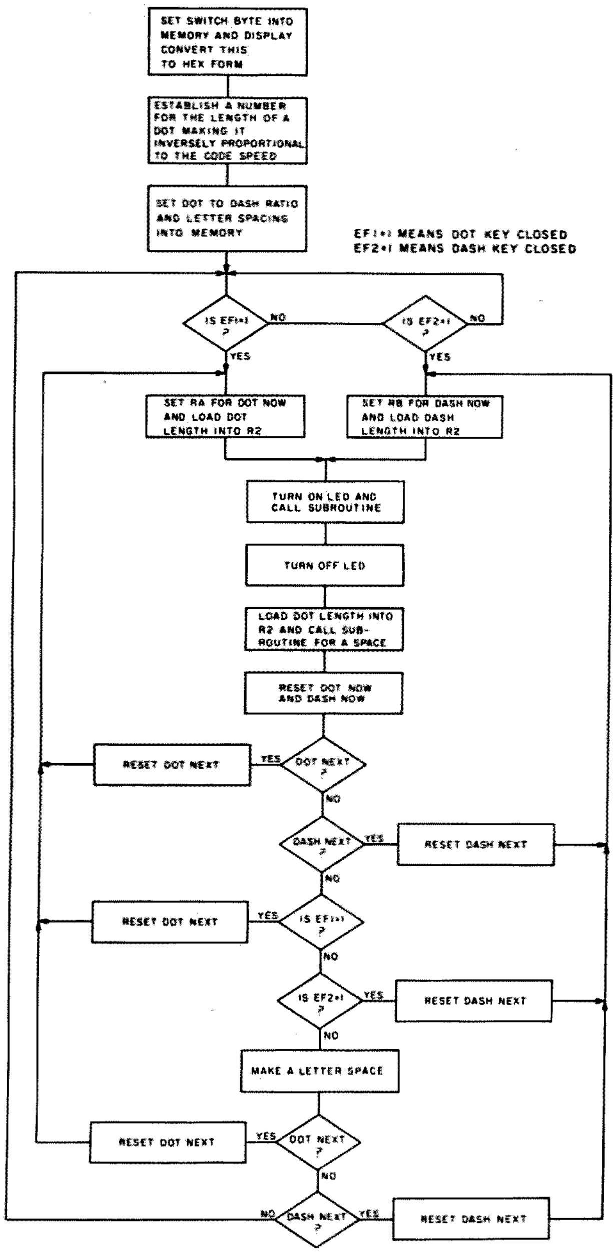


Fig. 1. Flowchart for automatic keyer.

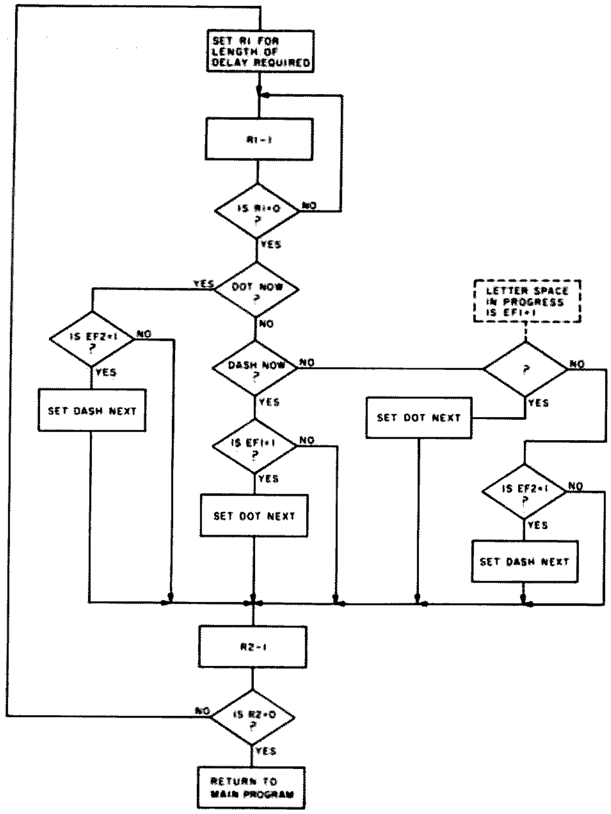


Fig. 2. Timed subroutine flowchart.

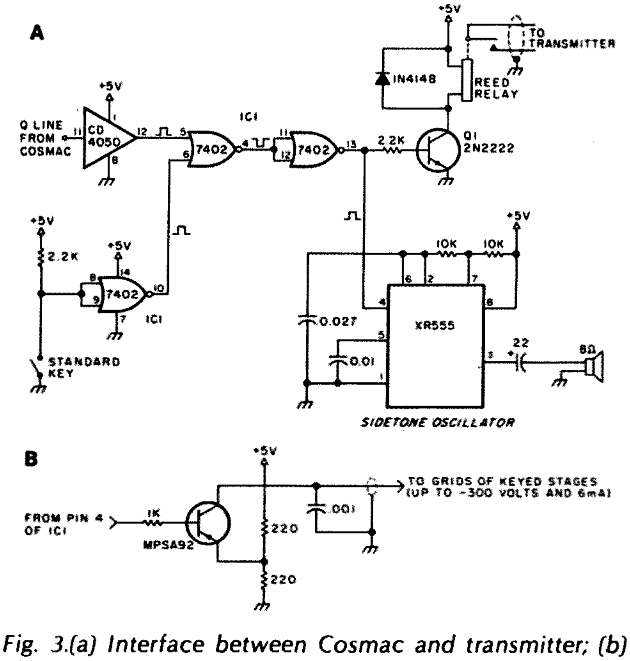


Fig. 3.(a) Interface between Cosmac and transmitter; (b) alternate circuit for rigs with grid-blocked keying eliminates relay and Q1.

is, you get the same speed of code whether you enter 25, 26, or 27 wpm. The speed changes at 28 wpm, but remains at this new speed whether you enter 28, 29, or 30. The problem is accentuated at very high speeds. For example, you get the same speed of code for all entries between 62 and 81 wpm.

The rest of the program is straightforward and is understood best by looking at the flowchart. The key is connected to $\overline{EF1}$ and $\overline{EF2}$. Closing the dot side makes EF1 = 1. Closing the dash side makes EF2 = 1. The program periodically checks the status of these inputs, and the dots and dashes come out on the Q-line, which is interfaced with the transmitter as described later.

The subroutine in the program is simply a timed loop using registers R1 and R2. The initial value of R2 is set before entering the subroutine according to the length of delay required, whether a dot, dash, or letter space is being generated. At a code speed of 24 wpm, you should get 10 dots per second. For a 1:3 dot:dash ratio, the length of a dot at 24 wpm should be 50 ms. Accordingly, the values of R1.1 and R1.0 were set at M(009C) and M(009F) so that the dots are the cor-

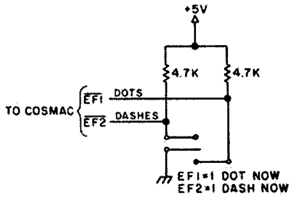


Fig. 4. Key connections.

rect length at this speed. They will automatically be the correct length at other speeds because the number in R2 is proportional to the code speed. The values chosen for R1.0 and R1.1 assumed a clock frequency of 1 MHz. It should be a simple matter to adjust these figures for different clock frequencies, although I have not tried anything but a 1 MHz clock.

Interface Circuitry

The connection of the computer to the transmitter is shown in Fig. 3. It includes a sidetone oscillator for monitoring your code and also an input for a hand key which I like to use when tuning up the transmitter or when the computer is programmed

Fig. 5. Program listing. Title: Automatic keyer.

Address	Bytes	Comment
0000	F8	0D→D set main program counter
0001	0D	
0002	A3	D→R3·0
0003	F8	9B→D set subroutine counter
0004	9B	
0005	A4	D→R4·0
0006	C4	no operation; leaves space for setting up
0007	C4	additional subroutine counter
0008	C4	
0009	D3	3→P go to main program
000A		dot time
000B		letter space time
000C		dash time
000D	F8	0A→D
000E	0A	
000F	A5	D→R5·0 R5·0 = 0A
0010	F8	0B→D
0011	0B	
0012	A6	D→R6·0 R6·0 = 0B
0013	F8	0C→D
0014	0C	
0015	A7	D→R7·0 R7·0 = 0C
0016	F8	01→D
0017	01	
0018	AA	D→RA·0
0019	AB	D→RB·0
001A	AC	D→RC·0
001B	AD	D→RD·0
001C	E7	7→X
001D	6C	input switch byte → MX, D
001E	64	MX→display, RX + 1
001F	27	R7-1
0020	F8	00→D start decimal to hex conversion
0021	00	
0022	A1	D→R1·0 sets R1·0 = 00
0023	F0	MX→D
0024	FF	D-10→D, carry→DF
0025	10	
0026	3B	Go to 2F if DF = 0
0027	2F	(if number is less than 10)
0028	57	D→M7 place remainder in M7
0029	81	R1·0→D
002A	FC	0A + D→D
002B	0A	ADD 0A to R1
002C	A1	D→R1·0
002D	30	Go to 23
002E	23	
002F	81	R1·0→D
0030	F4	MX + D→D
0031	55	D→M5 conversion complete
0032	E5	5→X
0033	F8	00→D routine to set dot timing
0034	00	
0035	A2	D→R2·0
0036	F8	01→D
0037	01	
0038	A1	D→R1·0
0039	F8	F5→D limits minimum speed to 5 wpm
003A	F5	
003B	F7	D-MX→D, carry→DF
003C	12	R2 + 1 R2 accumulates quotient
003D	33	go to 3B if DF = 1
003E	3B	
003F	21	R1-1
0040	81	R1·0→D
0041	3A	go to 39 if D ≠ 00
0042	39	
0043	82	R2·0→D
0044	55	D→M5
0045	F4	MX + D→D
0046	56	D→M6
0047	F4	D + MX→D
0048	C4	no operation
0049	C4	no operation
004A	57	D→M7 conversion complete
004B	34	go to 57 if EF1 = 1 (dot now)
004C	57	
004D	3D	go to 4B if EF2 = 0 (no dash either)
004E	4B	
004F	F8	00→D dash now
0050	00	
0051	AB	D→RB·0
0052	47	M7→D R7 + 1
0053	27	R7-1
0054	A2	D→R2·0
0055	30	go to 5D and make dash
0056	5D	
0057	F8	00→D dot now
0058	00	
0059	AA	D→RA·0
005A	45	M5→D R5 + 1
005B	25	R5-1
005C	A2	D→R2·0
005D	7B	1→Q light on
005E	D4	4→P call subroutine for a delay
005F	7A	0→Q light off
0060	45	M5→D R5 + 1
0061	25	R5-1
0062	A2	D→R2·0
0063	D4	4→P call subroutine for delay = 1 dot
0064	F8	01→D

0065	01	
0066	AA	D→RA·0 reset dot now
0067	AB	D→RB·0 reset dash now
0068	8C	RC·0→D
0069	3A	go to 70 if D ≠ 00
006A	70	(no dot next)
006B	F8	01→D
006C	01	
006D	AC	D→RC·0 reset dot next
006E	30	go to 57 and make dot
006F	57	
0070	8D	RD·0→D dash next?
0071	3A	go to 78 if D ≠ 00
0072	78	(no dash next either)
0073	F8	01→D
0074	01	reset dash next
0075	AD	D→RD·0
0076	30	go to 4F and make a dash
0077	4F	
0078	34	go to 90 if EF1 = 1 and make a dot
0079	90	
007A	35	go to 95 if EF2 = 1 and make a dash
007B	95	
007C	46	M6→D, M6 + 1 no dot or dash now
007D	26	R6-1
007E	A2	D→R2·0
007F	D4	call subroutine for letter space
0080	8C	RC·0→D dot next?
0081	3A	go to 88 if D ≠ 00
0082	88	no dot next
0083	F8	01→D
0084	01	
0085	AC	D→RC·0 reset dot next
0086	30	go to 57 and make dot
0087	57	
0088	8D	RD·0→D dash next?
0089	3A	go to 4B if D ≠ 00
008A	4B	no dash either
008B	F8	01→D
008C	01	
008D	AD	D→RD·0 reset dash next
008E	30	go to 4F and make dash
008F	4F	
0900	F8	01→D
0091	01	
0092	AC	D→RC·0
0093	30	go to 57 and make a dot
0094	57	
0095	F8	01→D
0096	01	
0097	AD	D→RD·0
0098	30	go to 4F and make a dash
0099	4F	
009A	D3	3→P return to main program
009B	F8	01→D start subroutine
009C	01	
009D	B1	D→R1·1
009E	F8	58→D fine adjustment of dot length
009F	58	
00A0	A1	D→R1·0
00A1	21	R1-1
00A2	91	R1·1→D
00A3	3A	go to A1 if D ≠ 00
00A4	A1	
00A5	8A	RA·0→D dot now?
00A6	3A	go to AF if D ≠ 00
00A7	AF	
00A8	3D	go to BD if EF2 = 0
00A9	BD	(no dash next)
00AA	F8	00→D
00AB	00	
00AC	AD	D→RD·0 set dash next
00AD	30	
00AE	BD	
00AF	8B	RB·0→D dash now?
00B0	3A	go to B9 if D ≠ 00
00B1	B9	(if no dash now either)
00B2	3C	go to BD if EF1 = 0
00B3	BD	
00B4	F8	00→D
00B5	00	
00B6	AC	D→RC·0 set dot next
00B7	30	go to BD
00B8	BD	
00B9	34	go to B4 if EF1 = 1
00BA	B4	
00BB	35	go to AA if EF2 = 1
00BC	AA	
00BD	22	R2-1
00BE	82	R2·0→D
00BF	3A	go to 9B if D ≠ 00
00C0	9B	
00C1	30	go to 9A
00C2	9A	end of subroutine

R1, R2—part of timing loop and used for decimal to hex conversion
R3—main program counter
R4—subroutine counter
R5—memory pointer for dot length
R6—memory pointer for letter space
R7—memory pointer for dash length

RA = 00 if dot now	RC = 00 if dot next
RB = 00 if dash now	RD = 00 if dash next

Table 1. Register assignments.

as an automatic message generator instead of an automatic keyer. Fig. 4 shows the method used to connect the key to the computer.

If your transmitter is running more than a few Watts, you must be careful that your wiring does not pick up rf in the shack. If it does, it may upset the logic gates, and you'll find that, once the first dot or dash is sent, the transmitter might not shut off. This rules out any long dangling wires running across your desk in front of your transmitter! For best results, use a shielded enclosure and bypass the leads to the transmitter and key with 0.001 uF ceramic capacitors.

Using the Keyer

Enter the program shown and, before setting the computer to "run," enter the desired code speed from the front panel. Set the computer to "run," and your speed will be displayed on the hex display. To change the speed, just set the switches on the front panel to the new speed and flick the run switch off and then on. Some people find the automatic letter space a bit awkward at first, probably because their fist, like mine, has become a little sloppy over the years. To eliminate automatic letter spacing, enter the instruction C4 at M(007F). C4 means no operation, and the subroutine normally called at that location does not get called.

So, for your next QSO, try out this nifty keyer and tell the operator at the other end that he's talking to a computer! He'll have no excuse for not being able to read your fist. ■

W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

from page 4

were running thousands of Watts in order to win the Sweepstakes contest and then taking the 100-Watt multiplier.

The saying that an antenna is not big enough unless the winter brings it down came from Sam. His Medfield home was surrounded by enormous towers with beams for all bands. Sam was one of the first to consistently get his signals back from the moon on 144 MHz. This activity progressed to a couple of big dishes, and eventually were his ticket to working as an engineer at the world's largest dish at Arecibo, Puerto Rico.

Sam would never actually admit it, but I think my own activities in New Hampshire helped drive him out of the country. I mentioned his deep need to have the loudest signal on a band. Was it a coincidence that shortly after I put up 336 elements on 2m on a mountain not far from *73* HQ that Sam moved to Arecibo?

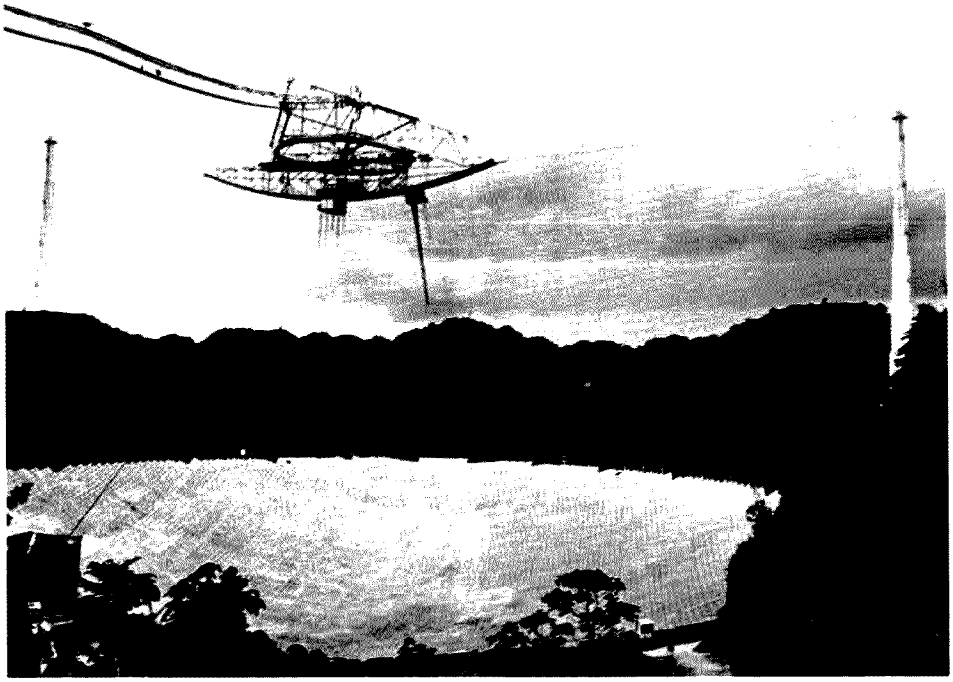
At the time, Sam had been working for Microwave Associates, helping them sell his parametric amplifiers. Sam called me one day to say that he had been fooling with a very high gain amplifier on six meters and had gotten it working. Before this there had been some articles predicting that something like that might work but no one had ever built one. It not only worked, but it was so powerful that they were soon being added to virtually every US radar installation in the world.

Sam wrote an article for me on it, and it happened to be published in an April issue of the magazine. Many readers thought the concept so outrageous that the article must be an April Fool.

After Sam moved to Arecibo, he got the laboratory there interested in amateur radio moonbounce. I made a trip down to participate in the 1296 MHz moonbounce experiments. The dish had so much gain that the band sounded like 20 meters during a contest. That was an experience which will never be forgotten.

Getting time allocated on the big dish was so difficult that Sam started building his own fixed dish with a movable antenna pointing into it, a small replica of the big one. After he got this dish working well, he was loaded with so many laboratory uses for it that he seldom had time to get set up for ham moonbounce work.

We have so few pioneers such as Sam that we can ill afford to lose them. I would be hard put to name one other amateur who has done as much for amateur radio as Sam.



W1FZJ's dish at Arecibo.

SEPTEMBER WINNER

Our readers religiously voted for Thomas R. Sundstrom W2XQ's article, "The SWL Bible," as the most popular in our September issue, so he will be receiving *73*'s $100 bonus check for that month. Don't forget to use *your* Reader Service card ballot!

WRIST RADIOS

For those of you who have not been reading the more obscure technical journals, be advised that there is a strong move afoot to augment the present telephone system with a wrist radio which would work on about 5 GHz. This would run about 25 mW and would work through a series of satellites.

The radio would have an LED which would tell you when you were within working range of the satellite. This would be accomplished by the reception of

Continued on page 110

Noise Bridge BASICs

—computer-optimized radiation

This program makes sense out of those funny readings on your noise bridge.

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One of the most useful tools that the antenna experimenter can have is an antenna noise impedance bridge. This handy device allows you to find not only the resonant frequency and swr of an antenna, but it also lets you find the actual impedance at the antenna, which is decidedly handy when adjusting matching networks. It is portable and does not require you to operate your transmitter to make measurements, which helps to reduce the already ridiculous QRM levels on the bands.

The only thing that is particularly inconvenient about a noise bridge is making use of the indications that it gives. Unless you use a feedline which is a multiple of a half wavelength, the reading on the bridge is not the impedance at the antenna. It isn't very convenient to find the swr, either. The Smith chart is a very usable graphical tool which will allow you to find both the impedance at the antenna and the swr. There is a learning period on the Smith chart, and, even after you understand its use, it is still easy to make silly errors and get the wrong answer. And, since it is a graphical method, there are small errors due to "eyeballing" the lines and circles. This isn't a serious problem, however, considering the accuracy of the bridges available to most amateurs.

The BASIC program given here does all of the dirty work for you. It will accept readings from any of three different types of antenna noise bridges and output the antenna impedance in series form (R + jX). It also gives the swr on the feedline. The only

A	Angle of complex antenna impedance in radians
B*	Z tan (P) + W
C	Reactance or capacitance dial reading
D	Resistance dial reading
E	Range extension resistor value
F	Frequency in MHz
G*	U tan (P)
H*	Z − W tan (P)
K	Reflection coefficient
L	Feedline length in feet
M	Magnitude of complex antenna impedance
P	Electrical length of feedline in radians
Q*	$1/[(1/D^2) + (1/Y^2)]$
R	Series resistive component of antenna impedance
S	Swr
T*	tan (P)
U	Series resistive component of impedance at bridge
V	Velocity factor of feedline
W	Series reactive component of impedance at bridge
X	Series reactive component of antenna impedance
Y	Parallel reactance at bridge
Z	Characteristic impedance of feedline

* Intermediate variable used for convenience

Table 1. List of variables used.

Bridge type	All	All	P & B
Char impedance	50 ohms	50 ohms	50 ohms
Line length	83.6961'	68.4471'	157.89'
Velocity factor	0.69	0.79	0.66
Frequency	14.2	7.1	3.6
Omega-t			
resistance dial	20	100	---
Palomar			
resistance dial	20	100	60
reactance dial	0	0	3.49089
W6BXI/W6NKU			
resistance dial	20	100	165.625
capacitance dial	0	0	−50.0487
range extn. resistor	0	0	100
Antenna resistance	125	40	75
Antenna reactance	0	30	−25
Swr	2.5	2	1.76759

Table 2.

```
ANTBRG    OMSI BASIC-1.870X

  10 IFINDS REAL AND IMAGINARY PART OF ANTENNA IMPEDANCE
  20 !AND SWR, GIVEN FEEDLINE DATA, MEASUREMENT FREQUENCY,
  30 !AND READINGS FROM POPULAR NOISE BRIDGES.
  40 !VERSION 3.02                 2001 CHARACTERS
  50 !07 MAR 1978               TERRY CONBOY  N6RY
  60 !
 100 FRINT "TYPE O FOR OMEGA-T, P FOR PALOMAR,"
 110 FRINT "  OR B FOR W6BXI/W6NKU BRIDGE ";:INPUT A$
 120 IF A$="O" THEN 200
 130 IF A$="P" THEN 200
 140 IF A$="B" THEN 200
 150 GOTO 100
 160 !
 200 PRINT
 210 PRINT "CHARACTERISTIC Z=";:INPUT Z
 220 PRINT "LINE LENGTH (FT)=";:INPUT L
 230 PRINT "VELOCITY  FACTOR=";:INPUT V
 240 IF V>1.0 THEN 230
 250 !
 300 PRINT
 310 PRINT "FREQUENCY  (MHZ)=";:INPUT F
 320 IF F=0 THEN 1200
 330 PRINT "RESISTANCE  DIAL=";:INPUT D
 340 IF D=0 THEN D=0.00001
 350 !
 400 IF A$="O" THEN GOSUB 800
 410 IF A$="P" THEN GOSUB 900
 420 IF A$="B" THEN GOSUB 1000
 430 IF U>0 THEN 500
 440 PRINT "NEGATIVE RESISTANCE!"
 450 GOTO 300
 460 !
 500 P=(-6.38372E-3)*L*F/V
 510 IF ABS(P)=PI/2 THEN P=P+0.0001
 520 T=SIN(P)/COS(P)
 530 B=(Z*T)+W
 540 G=Z-(W*T)
 550 H=U*T
 560 M=Z*SQR(((U↑2)+(B↑2))/((G↑2)+(H↑2)))
 570 A=ATN(B/U)-ATN(H/G)
 580 IF G<0 THEN A=A+PI
 590 R=M*COS(A)
 600 X=M*SIN(A)
 610 PRINT "ANTENNA RESISTANCE=";R
 620 PRINT "ANTENNA  REACTANCE=";X
 630 !
 700 K=SQR((((R-Z)↑2)+(X↑2))/(((R+Z)↑2)+(X↑2)))
 710 IF K=1 THEN K=0.999999
 720 S=(1+K)/(1-K)
 730 PRINT "FEEDLINE  V S W R =";S
 740 GOTO 300
 750 !
 800 !SUBR FOR OMEGA-T BRIDGE
 810 U=D
 820 RETURN
 830 !
 900 !SUBR FOR PALOMAR BRIDGE
 910 U=D
 920 PRINT "XL(+)  OR  XC(-)=";:INPUT C
 930 IF C>70 THEN C=140-C
 940 IF C<=-70 THEN C=-C-139.999
 950 W=(2273.64/F)*C/(C+70)
 960 RETURN
 970 !
1000 !SUBR FOR W6BXI/W6NKU BRIDGE
1010 PRINT "CAPACITANCE DIAL=";:INPUT C
1020 IF C=0 THEN C=0.00001
1030 Y=(-159155)/(F*C)
1040 Q=1/(1/(D↑2)+1/(Y↑2))
1050 PRINT "RANGE EXTN RESIS=";:INPUT E
1060 U=(Q/D)-E
1070 IF U=0 THEN U=0.00001
1080 W=Q/Y
1090 RETURN
1100 !
1200 END
```

Fig. 1. Program listing.

assumption is that the feedline is lossless, which works out well in practice. Most feedlines used in the frequency range where the bridges are most useful do not have significant loss.

Of the three types of bridge which may be used with this program, the simplest is the resistance-only bridge, such as an Omega-t unit. These are very popular, but they will only give a deep null when the unknown impedance has a nearly zero reactive component. Often you can find only one or two nulls in a band. More nulls may be obtained if you add another chunk of feedline to the normal feeder. The nulls will then move to different frequencies. Be sure that you have a good null, or the output from the program will be in error.

Another popular commercial bridge is the one sold by Palomar Engineers. This bridge has a "reactance" dial in addition to the resistance dial. This dial varies a small series capacitance in the bridge circuit. (In fact, the dial is really calibrated in picofarads, even though it is labeled "XC" and "XL".) Use of this dial should let you find a null for almost any impedance at any frequency. This wide range is a liability at times, though. A small error in reading the dial can give a fair amount of error, especially at lower frequencies. Notice that the program considers "XL" readings to be positive and "XC" readings negative.

The third type of bridge we'll call the W6BXI—W6NKU bridge, after the two hams who brought this circuit to a state of perfection.[1] It, too, has a variable capacitance, but the capacitor is connected in parallel in the bridge. The dial is calibrated in positive and negative picofarads. (A negative picofarad is what resonates the inductive reactance at the measuring port of the bridge.) These parallel-type bridges have a somewhat restricted range of reactances for which they will provide a null, particularly at lower frequencies. To extend the measurement range, a coaxially-mounted resistor is placed in series with the feedline connection at the bridge. This improves the ratio of resistance to reactance and often permits nulling the bridge. The value of this range extension resistor must be input to the computer (zero Ohms if not used).

The program is broken up into nine sections. The "100" section lets you specify the type of bridge you are using. In the "200" part, you input the parameter of the feedline. Velocity factors greater than 1 are not allowed. (If you find a feedline with this characteristic, sell me part of it!) In section "300", the measurement frequency and resistance dial reading are input. If you input a zero frequency, it terminates the program run. If the resistance dial reading is zero (doubtful), the program substitutes 10 milliohms to avoid division by zero later.

Section "400" calls the subroutines needed for the type of bridge that you have specified. These three subroutines input any other readings needed, make allowances for out-of-range values, and convert the readings to the series-equivalent impedance seen at the bridge end of the feedline. If a negative resistive component is present, the program bails out to prevent meaningless results.

In sections "500" and "600", the equivalent length of the feedline in radians is found and is used to transform the impedance at the bridge to the impedance at the antenna. This impedance is then printed. The last section of the main program, "700", computes the magnitude of the reflection coefficient and uses that to calculate the swr.

Table 1 lists the variables used and indicates what they represent. This may help you adapt to other languages or make modifications. If you are only interested in one of the three types of noise bridges, you can de-

lete the branches to the subroutines for the undesired types of bridges to shorten the program.

The only thing that might be a bit different about the Quodata BASIC compiler used on the PDP-8/e is that it doesn't allow for prompts as part of an "INPUT" statement. This was circumvented by using a "PRINT" statement followed by a semicolon to suppress the line feed.

To check for proper operation of the program, Table 2 shows three different sets of input data which will give nice round answers for most of the outputs. The inputs simulate feedline lengths at multiples of one-eighth wavelength. The six-digit input values should give outputs within one-tenth of an Ohm. Obviously you can't measure your antenna this accurately, but at least you'll know the program won't interfere with your answers.

In actual use, don't be surprised if the swr that your noise bridge indicates is somewhat higher than your trusty old swr meter. The normal reflectometer-type swr meter usually reads optimistically, especially when it is not driven with a great deal of power. This is probably due to detector diode nonlinearity at low power levels.

With this program you can speedily optimize your radiating system. Take care that the switching noise from your CPU doesn't interfere with the noise nulls, or you might have to go back to the Smith chart! ■

Reference

1. R.A. Hubbs W6BXI and A.F. Doting W6NKU, "Improvements to the RX Noise Bridge," *Ham Radio*, February, 1977, p. 10.

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editorial by Wayne Green

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a guide signal from the satellite. In order to get the antenna gain needed to pick up these low-powered radios, the satellites would use 68 dB gain antennas, with about 7000 of them covering the country.

A study of the project has been made by NASA and their estimates of the cost for the use of the system run to about one cent per minute, about one-tenth that of Ma Bell's costs. The watches are estimated to cost about $10. It is hoped that the system will be operational in about ten years.

Illustration courtesy of *Microwave Systems News*; artwork by Hans-J. Wacker, Jr.

YOUR HAM DEALER

If you don't see *HR* and *HRH* magazines at your local dealer in the future, chalk it up to a stupid blunder. Dealers are really upset over this and are not only canceling their monthly copies of the magazines, but also are canceling advertising and even leaning on manufacturers to stop them from advertising.

How come all the uproar? It stemmed from an article which was full of bad advice for ham newcomers on buying rigs. One of the parts that really got to the dealers was the claim that dealers don't service new equipment, they just send it to the factory, so who needs a dealer to back up a new equipment purchase?

It was bad enough that someone wrote this baloney, but for a magazine to publish such rot seems inexcusable. The fact is that any reputable dealer has an enormous investment in test equipment so he can service ham gear and perform warranty service. Most test benches these days run from a minimum of $35,000—and many double that. It takes two or three technicians to keep up with the service situation for most stores. The dealer knows that he *has* to provide this service if he is going to stay in business and keep his customers coming back.

What about factory service? Ask *me* about that, if you want your ears pinned back. I get most of my ham gear directly from the manufacturers or the importers since it is sent to me for evaluation. Obviously, they send me equipment which has been checked out and should be in pretty good shape. Despite this, at least one third of the equipment I get craps out within a few days and has to go back for service. It is a sorry fact of life that few manufacturers of ham gear put their equipment through the burn-in tests which most commercial equipment suffers. This means that early part failure happens *after* you get the rig instead of before.

This is by no means an indictment of the manufacturers. They are forced to cut corners on design, construction, and testing in order to be competitive in the ham market. If you look at almost identical commercial equipment made by the same firms, you'll find that it costs half again as much in most cases. This is not because the manufacturers are making a bigger profit—it's because they are putting out a much better product, one which the customers are willing to pay for.

Few hams are equipped to deal with the aches and pains of modern high-density synthesized equipment . . . and even if we are game to spend a few days chasing some glitch, we feel that, dammit, the rig is under warranty, so why should *we* go through all that trouble.

Now, if you've bought the rig from a reputable dealer, all you have to do is get it back to him. In some cases, if the rig is still brand new and he has another, he may well give you another rig in its place. But at least he has the repair equipment and technicians to tackle the problem, plus the service data from the factory to help him quickly isolate the difficulty.

My own experiences with getting equipment repaired by the factories have occasionally been so bad that it is unbelievable. And if *I* can't get service from a manufacturer, how can *you*? I've had rigs come back to me two and three times either in worse shape than they went out or with no improvement whatsoever. I've had rigs take months to get fixed. There's one piece of equipment which is at the factory right now . . . and has been in and out of there for almost two years, with not one day working right in between. When I call to find out what is happening, I'm sure they put the rig to the back of the line again.

Sure, there are some factory service departments that are wonderful. But, on the other hand, there are some importers who do no service at all. If you can't get your rig fixed by your dealer, it will have to be sent to

Continued on page 181

The Morse Master

—convert your computer friends to hamdom

A novel use of the MID$ function is only one feature of this relentless program.

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There have been a few articles lately in the microcomputer literature concerning the creation of a radio network for the interchange of information. It has been mentioned that the amateur radio service would provide a natural environment in which to implement such a network.

For several years, amateurs all over the globe have been exchanging "files" in the form of slow scan television. These "files" are of a special nature, but they are still streams of data in the long view.

The ability to use radio for information exchange should be easy for the average computerist to develop. However, there are three major hurdles to overcome.

The FCC must approve the use of ASCII in the amateur radio service. This, I hope, is a formality whose time will come. Secondly, there must be a set of hardware/software protocols developed, so we can dance to the same tune when using the system. There are some bright people working on this, and we will surely hear more about this in the future.

Last, but not least, one needs a license to operate a transmitter in the amateur radio service. A ham license is the key that unlocks the door to an entire world of adventure in amateur radio. To get a license, you must pass a written test and a code test. The international Morse code must be mastered at various levels of difficulty, corresponding to the different licenses.

Stop a minute and consider this combination. I am sure serious computerists would be welcomed to the ranks of amateur operators and would find a niche in the amateur structure to enjoy this unique blend of electronic wizardry. I am also sure computerists would enjoy the unique experiences that only amateur radio has to offer. The potential for increased enjoyment is tremendous. Can you imagine discussing and swapping algorithms with a fellow ham computerist in Australia via the 20 meter ham band? How about accessing your computer by using your two meter hand-held radio and touchtone™ pad while cruising down the highway or fishing on some remote river? And, some of the brightest inhabitants of the Silicon Valley can be heard on the ham bands discussing the latest in hardware, software, and techniques. (I hear a lot of computer discussion in the advanced portion of the 20 meter band.) The list of possibilities is endless when you combine these two activities.

I repeat: To be a ham you must get a license; to get a license one must learn the code. The code is not the awesome obstacle that some make it out to be. It can even be a lot of fun. To further learn about the amateur licensing structure, I suggest the *73 Novice Study Guide* and the ham magazines. These can most often be found in the local radio store.

Now that your motivational fires are stirred up, let's look at the program about which this article was written.

This program is a drill which will help you to learn the Morse code. It spits out groups of 5 randomly-selected characters by sounding the proper Morse dit/dah patterns, and it can also print the letters on the video terminal.

My system is all Heathkit. I have the H-8 with 16K

of memory, the H-9 video terminal, the cassette tape recorder and I/O board, and Extended Benton Harbor BASIC.

In the Heath H-8 mainframe, there is a speaker. An audio tone is counted down from one phase of the system clock and applied to the speaker using appropriate control logic which provides a means to turn the "horn" on and off. The H-8 monitor normally uses this feature to provide audio feedback and signaling in conjunction with the front panel.

Placing the number 112_{10} in location 8201_{10} turns on the tone, and a 240_{10} in location 8201_{10} turns it off. This can be accomplished by using the "POKE" command, e.g., "POKE 8201,112" turns it on, and "POKE 8201,240" turns it off. By selectively turning the tone on and off and providing the proper timing and spacing, the Morse code patterns can be formed.

The flowchart in Fig. 1 illustrates the main features of the program logic. Two nested FOR/NEXT loops control the timing between characters and between groups of 5 characters. Statements 131, 132, and 140 do the actual work of tone generation via subroutines. The inner loop and delay return a group of five characters. The outer loop provides a delay between groups of five characters.

A delay is created by a FOR/NEXT loop of the form "FOR I = I TO X: NEXT X". The timing parameter "X" is user-defined and is in arbitrary units of time.

Line 131 generates a pseudorandom number between 650 and 900, which is stored in P3. Please note that P3/10, a number between 65 and 90, corresponds to the ASCII code for the letters of the alphabet. Therefore, the command "PRINT CHR$ (P3/10)" prints the actual letter (line 145).

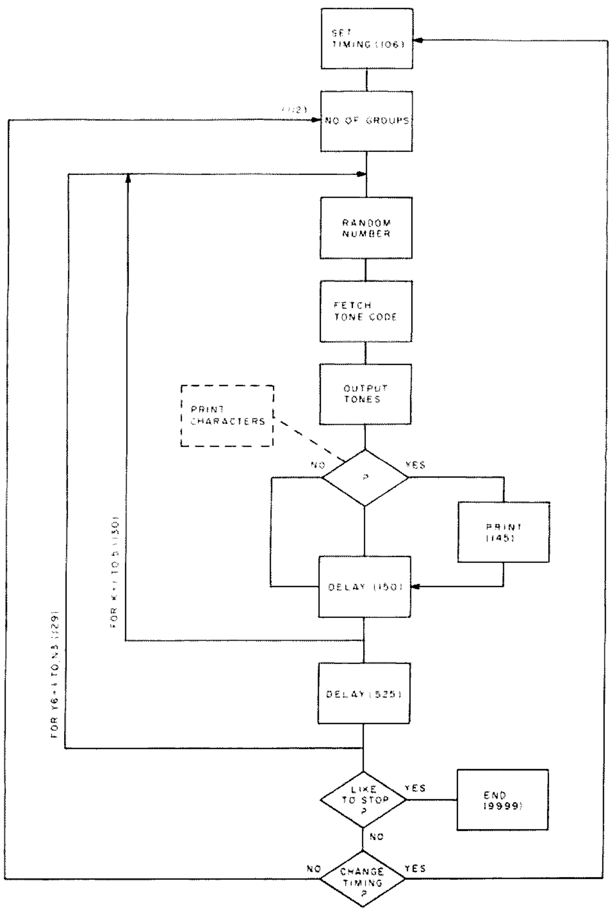

Fig. 1. Flowchart. Statement numbers are in parentheses.

Lines 650 to 900 constitute a conversion table and control is directed here as a function of the variable P3 and statement 132. A string code is placed in the string variable A$. In Morse code, there are two sounds: the short sound "dit" and the long sound "dah". A dit is encoded by a "1" in the string. A dah is encoded by a "3". For example, if P3 comes up "650", A$ is set as "13"; the ASCII code for an "A" is 65, and the Morse code is "dit dah". The letter "C" in Morse is "dah dit dah dit", and a 670 from the random number generator would cause the string "3131" to be placed in the variable A$.

With A$ charged with the proper string code, the subroutine at line 1000 produces the actual sounds. This subroutine examines each element in the string A$ proceeding from left to right. If a "1" is encountered, a sound will be emitted whose duration is governed by the timing parameter "X". If a "3" is encountered, the sound emitted will be of length "T". There is also a delay after each sound governed by "X".

Stepwise examination of the string expression A$ is accomplished by the MID$ function. This is a very handy function, and its power in string or text processing is often needed. Consider the following: R$=MID$(A$, I, J), where A$="HI THERE". If we set I=4 and J=2, then R$ becomes "TH". The string which is placed in R$ starts with the Ith character and continues until there are J characters moved (in a left to right fashion). If we use the construction: "FOR I=1 TO LEN(A$): R$=MID$(A$, I, 1):::NEXT I", then the individual elements of A$ are placed one at a time in R$, allowing action to be taken as a function of the instantaneous value of R$.

Keep in mind that the timing parameters are in arbitrary units, and what is really important is the ratio. Normally, amateurs suggest a dit/dah ratio of 1/3. I have found that a dit length of 10 and a dah length of 35 sounds good to me. As this drill is intended for the beginner, this setup should remain constant. The time between characters should be fairly long at first, say around 300 to 400.

There is another delay provided between groups of five. This is to allow the user to look up at the video terminal and check to see if he has copied the last group correctly. Therefore, if the user has optioned to view the characters, a time longer than 500 should be used. When the user no longer needs this visual feedback, he can set this timing parameter equal to that for the intercharacter delay.

As was noted, this tone is actually a square wave of around 1 kHz that is fed to a tiny little speaker inside the H-8 cabinet. You shouldn't expect it to sound like a clean sine wave coming out of your stereo. The upper limit of speed is naturally set by the operating environment of the equipment and the software.

If you terminate program execution during tone output by the "Control C" command, it is possible that the system "horn" will be left on. To shut it off, issue the command "POKE 8201,240" in "command mode." Or, you could just start the program again.

Program listing.

```
50  REM    ******************************************
51  REM    *                                        *
52  REM    *         CODE PRACTICE PROGRAM          *
53  REM    *    WRITTEN BY WILLIAM A. THORNBURG     *
54  REM    *               2-13-78                  *
55  REM    *                                        *
56  REM    ******************************************
90  PRINT
91  PRINT "THIS PROGRAM SENDS MORSE CODE IN GROUPS OF FIVE."
100 G=8201
102 H=112
104 R=240
106 INPUT "INPUT THE LENGTH OF A DIT"; X
108 INPUT "INPUT THE LENGTH OF A DAH"; T
109 INPUT "THE TIME BETWEEN CHARACTERS"; P7
110 INPUT "INPUT THE TIME BETWEEN GROUPS OF FIVE"; G9
111 LINE INPUT "WOULD YOU LIKE TO SEE THE CHARACTERS?"; A8$
112 INPUT "INPUT THE NUMBER OF GROUPS OF FIVE DESIRED"; N3
113 PRINT
114 REM
115 REM
116 REM     END OF INITIALIZATION CODE
117 REM
118 REM
129 FOR Y6=1 TO N3
130 FOR K=1 TO 5
131 P3=(INT(26*RND(1)+65))*10
132 GOSUB P3
140 GOSUB 1000
145 IF A8$="YES" THEN PRINT CHR$(P3/10);
150 FOR I=1 TO F7:NEXT I

500 NEXT K
501 PRINT
525 FOR M=1 TO G9:NEXT M
550 NEXT Y6
560 PRINT
561 LINE INPUT "WOULD YOU LIKE TO STOP?"; W6$
564 IF W6$="YES" THEN GOTO 9999
565 LINE INPUT "WOULD YOU LIKE TO CHANGE SPEEDS?"; E7$
566 IF E7$="YES" THEN GOTO 106
567 GOTO 112
640 REM     P3 IS A PSEUDO-RANDOM NUMBER BETWEEN 650 AND 900
641 REM     WHICH IS 10 TIMES THE ASCII CODE.
642 REM     THE FOLLOWING ENCODES FOR THE LETTERS.
643 REM     A "1" MEANS A DIT AND A "3" IS A DAH.
644 REM
650 A$="13":RETURN
660 A$="3111":RETURN
670 A$="3131":RETURN
680 A$="311":RETURN
690 A$="1":RETURN
700 A$="1131":RETURN
710 A$="331":RETURN
720 A$="1111":RETURN
730 A$="11":RETURN
740 A$="1333":RETURN
750 A$="313":RETURN
760 A$="1311":RETURN
770 A$="33":RETURN
780 A$="31":RETURN
790 A$="333":RETURN
800 A$="1331":RETURN
810 A$="3313":RETURN
820 A$="131":RETURN
830 A$="111":RETURN
840 A$="3":RETURN
850 A$="113":RETURN
860 A$="1113":RETURN
870 A$="133":RETURN
880 A$="3113":RETURN
890 A$="3133":RETURN
900 A$="3311":RETURN
950 REM
951 REM
952 REM  A$ HOLDS THE LETTER CODE.  THE NEXT ROUTINE GENERATES
953 REM  THE ACTUAL DIT AND DAH SOUNDS.
954 REM
955 REM
1000 L=LEN(A$)
1005 FOR I=1 TO L
1010 R$=MID$(A$,I,1)
1015 IF R$="1" THEN GOSUB 1200
1020 IF R$="3" THEN GOSUB 1300
1025 NEXT I
1030 GOTO 1320
1200 POKE G,H
1205 FOR J=1 TO X:NEXT J
1210 POKE G,R
1215 FOR J=1 TO X: NEXT J
1220 RETURN
1300 POKE G,H
1305 FOR J=1 TO T:NEXT J
1310 POKE G,R
1315 FOR J=1 TO X:NEXT J
1320 RETURN
9999 END
```

As a person passes through the beginner stage, it is best to practice your code copy in a more realistic manner. The method that I found best was a combination of *73's* code practice cassette tapes and listening to the ARRL ham station's (W1AW) code practice sessions.

This article started out focused mainly on the microcomputer software. As I got further into the project, it dawned on me that computer enthusiasts would be very valuable additions to the ham ranks. And, when these two activities are combined, the whole will be greater than the sum of its parts. ■

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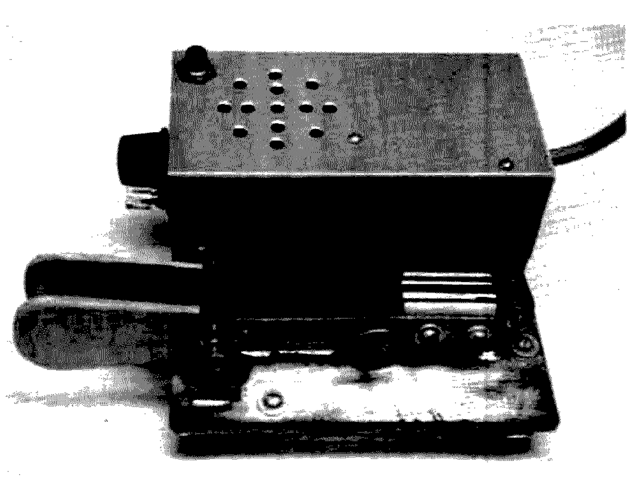
The MINI-MOUSE Key

—perfect companion to the MINI-MOS keyer

WA6EGY reveals the secret ingredients of his funny-looking key.

When my article on the MINI-MOS keyer appeared in the August, 1976, issue of *73*, many readers were puzzled by the funny-looking dual-paddle key that was shown in the photos together with the keyer. Several wrote me and inquired about the key which they thought was "built up from scraps of PC board." So, forthwith, I will reveal the secret ingredients of this mystery key, which, because of its mouse-grey, ear-shaped plastic paddles, may be referred to as the MINI-MOUSE key.

A straight key is actually nothing more than a contact that makes and breaks a keying circuit. If need arises, any contact can be pressed into service for this purpose. Some readers might remember that dramatic scene in the movie classic "Union Pacific" where the hero (was it John Wayne?) taps out the lifesaving code message by hitting his gun barrel against the downed telegraph wire. To build a reliable, easy-to-use dual-paddle key, however, is another story. The necessary low-friction bearings, lockable stops, and tension springs normally make the construction of such a key a project beyond the capabilities of the average ham. While several good dual-paddle keys are available from manufacturers advertising in *73*, none were small enough to be used with the MINI-MOS keyer. For this reason, a matching key was designed. In the design, great care was exercised to use only materials and tools that are readily available to the average ham. A close-up of the key is shown in the photo.



Close-up view of the MINI-MOUSE key mounted with the MINI-MOS keyer on a common base plate.

The material used for the construction of the key was G-10 (fiberglass epoxy) circuit board, single-sided, with a measured thickness of .046 inches. This board, which was surplus material, is somewhat thinner and more flexible than the more common 1/16 inch PC board. One starts by cutting parts 1, 8, 6a, 6b, 4a (twice), and 4b (twice) from the board according to the dimensions shown in Fig. 1. By drilling and filing, or with a fine jigsaw, one then cuts the slot in parts 4a, leaving only about 1/16 of an inch of material at the edge. These sections will later act as a flexible "hinge" around which the paddles pivot and, thus, solve the problem of the bearings. Next, parts 4a-4b and 6a-6b are laminated

together (foil sides out) as indicated by the dotted lines in Fig. 2, using contact cement. As indicated in Figs. 1 and 2, the foil on both sides of part 6 is cut 1/4 of an inch from the edge by removing a narrow strip. This can be done with a router, cross-feed table on a drill press, bit of a high-speed hand tool, or even with the blade of a hacksaw. Then one corner of the part is notched according to the dimensions shown in Fig. 1.

Next, the position for hole "Y" on part 4b and holes "U", "V", and "X" on parts 4b and 8 are marked according to the dimensions shown in Fig. 1. Parts 2 (four each) and 3 (two each) are cut from any kind of suitable plastic of the correct thickness. Next, all parts (with the exception of parts 3) are stacked together in the sequence shown in the "explosion" drawing, Fig. 2. Parts 4 and 6 should line up at the front edge, with all other parts lining up with parts 4 at the rear with part 6 protruding by about 1/4 of an inch. The whole stack is tightly clamped together or, if no suitable clamps are available, it is wrapped tightly with wire or clear plastic adhesive tape. While making sure that the corners of the stack remain lined up, holes "U" and "V" are drilled using a No. 33 drill. After the first hole has been drilled, a 4-40 screw is inserted through the hole, which helps keep the stack from moving while the second hole is drilled. Then hole "Y" is drilled, which serves the purpose of lining up the contact rivets when they are soldered in place. The diameter of hole "Y" should be chosen to center the part of the contacts protruding on the side of the spring opposite the contact surface. Next, part 1 is removed from the stack of parts and, using the screws in holes "U" and "V" to keep everything lined up, hole "X" is drilled using a No. 42 drill. Then the stack is separated and hole "X" enlarged to a diameter of about 1/4 of an inch in parts 4 and 6; but not in part 8. The contacts, part 5, are soldered in place on parts 4 and 6, using the holes to line them up, and the same is done with nut 15 on part 8. Parts 3 are cemented to part 4, as shown in Fig. 2, again using contact cement. Make sure part 3 does not cover part 4 by more than 3/4 of an inch. Parts 4 will later be pulled out by "springs" 1 and 8 respectively, with the help of linkage 10. This linkage, a short piece of flexible stranded wire or copper braid, is soldered to part 4 in the appropriate location; the other end will be connected later. Then part 6 is soldered to the ground plate along its center line, making sure the two parts are positioned perpendicular to each other, with the notch of part 6 lined up with the

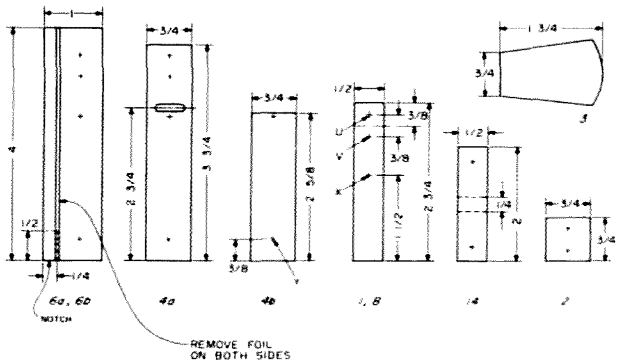


Fig. 1. Dimensions for most parts. For details of the materials to be used, see parts list.

edge of part 4.

Now, everything is ready for the final assembly. If one wants to protect the beauty of the MINI-MOUSE key permanently, however, one has to keep the copper foil on the PC board from tarnishing. First, the contacts and all places where one must solder during assembly will have to be masked with patches of masking tape. Then all parts are sprayed with several coats of a clear plastic lacquer. Before the final assembly, the setscrews 9 are prepared. Knurled discs of exactly the correct size in a handsome copper-nickel alloy are available from the U.S. Mint for the price of 10 cents each. To drill a hole through the center of the dime, however, and to solder the 2-56 screw in place, might be the most difficult task of the construction project.

Using a larger drill bit or a sharp knife, one removes a ring-shaped section of the foil around holes "U" and "V" on both sides of part 6 and on parts 4a and 4b. This prevents the screws from shorting out the foil on the parts. These foil surfaces on part 6 will be connected to the dot and dash terminals of the keyer by lengths of wire which are soldered to the foil at the rear end of part 6. The negative supply voltage, $-V_{ss}$, will be connected to the foil surfaces of parts 4a and 4b which face part 6. This arrangement has the effect that the foil surfaces of parts 4, which, for rf, shield the dot and dash contacts and, thus, reduce the effect of stray rf fields. The connection to the foil of parts 4 can be made by inserting a U-shaped strip of copper foil between parts 4 and 2, which connects both parts 4, and then soldering the $-V_{ss}$ connection to this foil.

All parts can now be stacked as shown in Fig. 2 and, after checking that the contacts line up properly, the compression nuts and screws can be tightened. The thumbscrew inserted through nut 15 should pass through

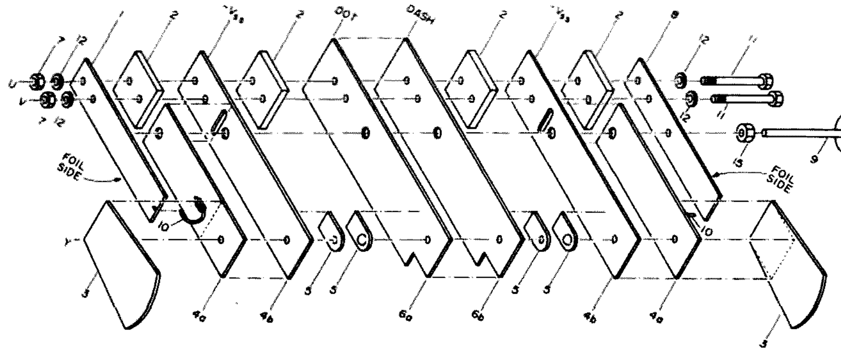


Fig. 2. This "explosion drawing" shows how the many parts fit together.

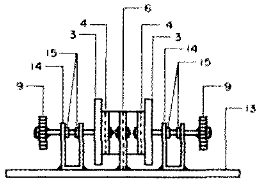


Fig. 3. Front view of the key.

Parts List

Part Number	Description
1	Spring, PC board. See Fig.1.
2	Spacers, 1/16" plastic. Four needed. See Fig. 1.
3	Paddle, 1/8" plastic or wood. Two needed. See Fig. 1.
4a, b	Lever parts, PC board. Two needed. See Fig. 1.
5	Pieces of contact springs with contact rivet, approximately 1/2" long, cut from surplus relay. Four needed.
6a, b	Center part, PC board. See Fig. 1 and assembly instructions.
7	Nuts, 4-40. Two needed.
8	Spring, PC board. See Fig. 1
9	Screw, 2-56 × 3/4" with thumbscrew head made from dime with hole drilled through center and soldered to screw. Three needed.
10	Stranded copper wire or fine braid. Two pieces about 3/4" long needed.
11	Screw 4-40 × 3/4". Two needed.
12	No. 4 washer. Four needed.
13	Base plate, PC board, 2" × 4".
14	Metal strip, brass or tinplate cut from can. See Figs. 1 and 3. Two needed.
15	Nut, 2-56. Five needed.

part 6 and both parts 4 without touching, and should contact only part 1. This screw is tightened slightly until parts 1 and 8 begin to spread. Then the linkages 10 are cut to length and soldered to parts 1 and 8.

Next, the brackets 14 (Fig. 3) for the stop-screws have to be prepared. They are bent according to the dotted lines in Fig. 1, and the locations for the holes are marked so that they line up with the centerline of part 6 when the brackets are soldered to the ground plate. The holes are drilled, and two No. 2 nuts are soldered to the inside of the brackets. With the thumbscrew inserted, the brackets are then soldered to the ground plate in such a way that the setscrews can touch parts 4 without rubbing against parts 3 and 1, or 8, respectively.

Fig. 3 shows the key as viewed from the paddles. This completes the assembly of the key. The ground plate is mounted to some suitable base, either alone or together with the keyer as shown in the photo. The contact clearance can be adjusted separately by the thumbscrews in the U-shaped brackets. If these screws tend to turn on their own, unscrew them from one of the nuts, spread the bracket slightly, and turn the screws back in against the force of the bracket, which acts as a brake. The stiffness of the paddles can be controlled with the screw that spreads parts 1 and 8.

One word of warning for operators who are used to Vibroplex-type semiautomatic keys: The MINI-MOUSE key works best with little contact clearance and minimal stiffness of the paddles, a characteristic it has in common with the FYO-key (now sold by HAL Communications Corporation). If the key is hit hard, as you would do with a Vibroplex key, you can get contact bounce and erroneous code elements. Once you are used to the different feel, however, you can operate the key with nothing more than a very slight finger movement, and you will find that the MINI-MOUSE key, together with the MINI-MOS keyer, greatly reduces operator fatigue and keying errors. ■

✓ Reader Service—see page 227

One Step Further

—PTTR instead of PTT

If you can push to talk, you can push to receive.

There are some amateurs who prefer a leisurely style of operating, even while mobile, instead of machine-gun-like exchanges. In such a case, the old push-to-talk button on a microphone can become a bit of a nuisance to hold down. VOX operation is, of course, a solution, but then, if one pauses to think a bit, the VOX relay will drop out. To hold relays in, one can produce a bunch of "aah"s, but it hardly makes for a pleasant sound.

A better solution was found years ago in the use of latching relays. These relays close (or open) when they are momentarily energized and then perform the opposite operation when they are again momentarily energized. So one achieves a push-to-talk and push-to-receive mode of operation where both "pushes" are just momentary depressions of the microphone button.

All it takes is some simple IC circuitry which can be used with any transceiver to provide push-to-talk, push-to-receive operation. The circuits are made up of low-cost, readily available ICs which I had on hand. Undoubtedly, the circuitry can be made even more simple by those who like to optimize IC circuitry.

The basic solid-state replacement circuit for the old latching relay is shown in Fig. 1. In this case, it is one half of a dual J-K flip-flop IC. The circuit is wired so that each time pin 1 is momentarily grounded, the outputs of pins 14 and 15 change state. Once "set," they hold their state until pin 1 is momentarily grounded again. Pin 15 is shown driving a transistor switch which, in turn, operates a relay. The transistor switch and relay are only necessary if one wants to build the unit so it is universally usable with any transceiver. In a great many cases, the transistor switch and relay may not be necessary. Depending on the voltage present on the PTT line in a given transceiver, it is often possible to tie pin 14 or 15 directly to the PTT line or to use just the transistor switch without the relay.

The 1k resistor and the switch are shown in dotted lines in Fig. 1 because, although theoretically the circuit should be complete as shown, it would prove to be erratic in actual operation. This is due to the fact that the PTT switch exhibits contact bounce. The effect of this bounce is shown in Fig. 2. Both on "make" and "break," the switch will actually cycle on and off for several milliseconds before it comes to rest in its final state. The J-K flip-flop would try to follow these switch changes, and the final outcome would be a random switching action.

Two simple "debouncing" circuits are shown in Fig. 3. These circuits will present positive switching action to the J-K flip-flop, although the switches which activate them exhibit contact bounce.

The circuit of Fig. 3 is extremely simple, has a very positive response, and utilizes a simple 7400 IC. Its disadvantage is that it requires an SPDT-type PTT switch. The leaf-spring switches in many mobile-type microphones do have the necessary contacts and an extra conductor in the microphone cord. So, in this case, the circuit can be easily implemented.

If only a simple PTT switch is available, the circuit of Fig. 3 can be used. In this case, one section of the 7414 is used as a Schmitt trigger. The resistor and capacitor form a time constant that lasts slightly longer than the duration of the contact

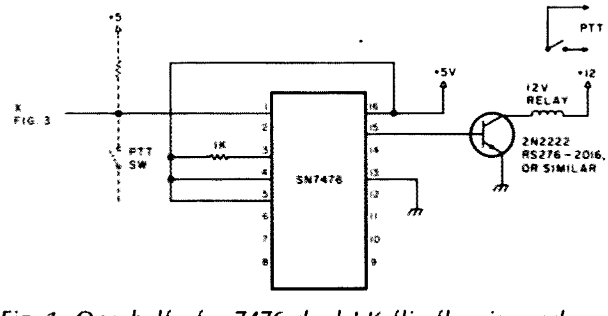


Fig. 1. One half of a 7476 dual J-K flip-flop is used as a latching circuit.

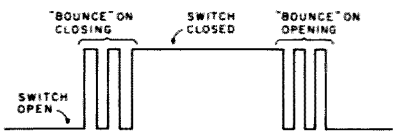


Fig. 2. An illustration of the contact bounce which occurs to some degree with any mechanical switch.

bounce from the switch. Although the values shown should suffice, if the action is not positive with any given PTT switch, one might try lowering the resistance value or using a larger size capacitor.

Depending on the number of conductors available in the microphone cord, it might be possible to place the necessary circuitry in the microphone case. If not, the circuit can be assembled on a piece of small perforated board stock. Simple point-to-point wiring can be used since there is nothing critical about the layout of the components. The voltages to the ICs need not be regulated. The required 5 volts can be obtained by using a series 200-Ohm trim-type potentiometer from a 12-volt source. Adjust the potentiometer from its maximum value until 5 volts is measured at pin 16 on the 7476 IC.

There are two ancillary circuits that one might want to consider. Probably the most important is some positive indicator that the transceiver has been placed in the transmit mode, if this does not already exist on a given transceiver. If the receiver is squelched, there is the danger that one might not notice that the transceiver has been left in, or accidentally placed in, the transmit mode. Any sort of positive indicator will do, such as a lamp operated from some line or circuit that is active during transmit. A nice touch, if one has the necessary conductor available in the microphone cord, is an LED indicator in the microphone case itself.

One might wish to add a bypass switch to the circuit so one can go back to ordinary PTT operation. It is not really necessary, however, since the push-to-talk, push-to-receive circuitry can be activated just as fast as one can momentarily depress the PTT button. But, there might be some circumstances when one is making a particularly long series of very short communications exchanges where the push-to-talk, push-to-receive operation can become tiresome.

The current drawn by the circuitry will be that typical for TTL logic devices. For small handheld transceivers, this current could be a good fraction of that drawn by the transceiver itself in a squelched receive condition. So, one would have to weigh the advantage of putting the circuitry in such a unit against the increased current drain. Of course, for mobile and home station transceivers, the increased current drain should be insignificant as far as the operation of a transceiver is concerned. ■

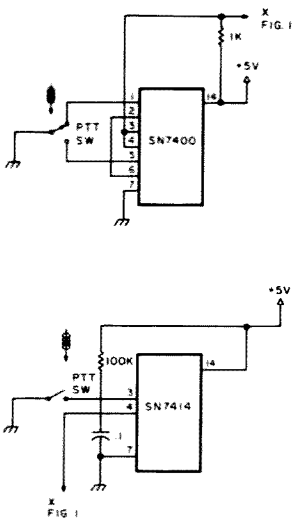


Fig. 3. Two circuits which can be used before the circuit of Fig. 1 to eliminate the effects of contact bounce.

Hooray for LC Filters!

—simplest is sometimes best

Design a simple filter and a useful control circuit to go with it.

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With names like Chebyshev, Butterworth, M-Derived, Maximally Flat, or Minimum Ripple, it is sometimes difficult to decide just how to pick a filter, particularly one that will pass or reject a small band of low frequencies. Well, why not use an LC circuit, since it is quite stable and simple to make?

The difficulty with the tuned LC circuit, of course, is that it is usually too sharp to pass or stop a band of frequencies, and has to be loaded (resistively) to reduce the Q. Fig. 1 shows the series (a) and parallel (b) forms of this circuit, along with a generalized impedance curve (c), which shows how the impedance of the circuit changes with frequency and Q.

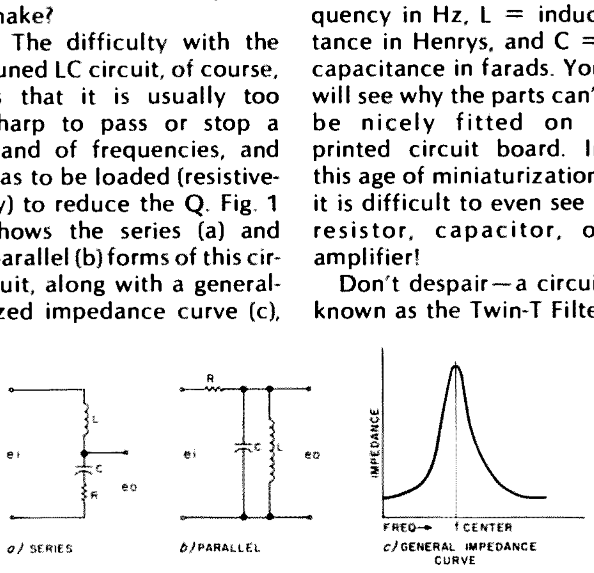


Fig. 1. Series (a) and parallel (b) tuned circuits with generalized impedance curve (c).

Another problem with this network is that as the notch or center frequency of the band of frequencies we would like to pass or stop is lowered, the necessary values of L and C become very large. Just calculate, for a center frequency of 160 Hz, the values of L and C for a series-tuned LC circuit using the following formula: $f = 1/2\pi\sqrt{LC}$, where f = frequency in Hz, L = inductance in Henrys, and C = capacitance in farads. You will see why the parts can't be nicely fitted on a printed circuit board. In this age of miniaturization, it is difficult to even see a resistor, capacitor, or amplifier!

Don't despair—a circuit known as the Twin-T Filter will not only fit on the board, but is extremely simple to design. The circuit layout is shown in Fig. 2.

All you have to know in order to design this network to "stop" or at least attenuate a particular frequency is the following set of relations: C1 = 2C2, R1 = 2R2, and $f = 1/2\pi R1C2$. For example, suppose we want to design the filter to have a center frequency of 160 Hz. By rewriting $f = 1/2\pi R1C2$ as $R1C2 = 1/2\pi f$, we find R1C2 = 1/6.28(160) = 0.000995. Since there are an infinite number of ways to multiply R1 and C2 in order to get the value 0.000995, we have to narrow things down a bit. A simple way to do this is to pick a large value for C that is available in a small physical size, such as a high K (dielectric constant) ceramic-type capacitor. Let's try .01 microfarads ($.01 \times 10^{-6}$ farads). Using this value, we find that $R1 = 9.95 \times 10^{-4}/.01 \times 10^{-6} = 9.95 \times 10^{2}/.01 = 9.95 \times 10^{4} \approx$ 100k Ohms.

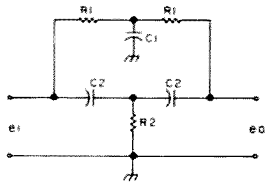
Therefore, with C2 = .01 uF, then C1 = 2C2 = .02 uF and R2 = R1/2 = 50k Ohms. Using these values, with small ceramic capacitors and 1/4-Watt resistors, we can produce a filter that will pass all frequencies except those directly around the center frequency of 160 Hz. This is a notch filter.

Let's assume that we want to stop all frequencies, but we would like to pass the frequency of 160 Hz. The op amp circuit outlined in Fig. 3 does this with good stability.

This is a negative feedback circuit, which means that the output of the amplifier is added to the input such that the input to the amplifier is reduced. The amount of feedback is controlled by the feedback network, which in our case is the Twin-T filter. Since this network passes all frequencies except a small band of frequencies around the design center (160 Hz), the feedback is large at all these frequencies, and the input to the amplifier will, therefore, be very small. This means that the output will be very low. In the region of 160 Hz the feedback is almost zero, so the output becomes large.

In other words, if we attach an audio oscillator to the input of this circuit, and slowly increase the frequency starting at about 10

Hz, we will get no output until the dial reads from about 130 to about 190 Hz, with the signal peaking at 160 Hz. As the frequency is increased further, the output will again drop to zero.



2. Twin-T filter schematic diagram.

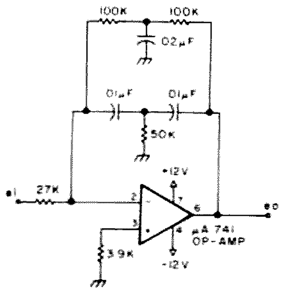


Fig. 3. 160-Hz bandpass filter schematic diagram.

This is similar to the general tuning curve of the LC circuit shown in Fig. 1(c).

This circuit was used in a tone-operated slide viewer that a friend asked me to build for him. The tape recorder that he used to provide the narrative for each slide, as it was shown by the projector, contained a tone of 160 Hz which occurred at the end of each narration. A microphone near the speaker picked up the tone, which was then amplified, and this operated a relay which caused the slide mechanism to insert a new slide. This circuit is shown in Fig. 4, and it should be self-explanatory. With a little ingenuity, many uses can be devised for this simple filter.■

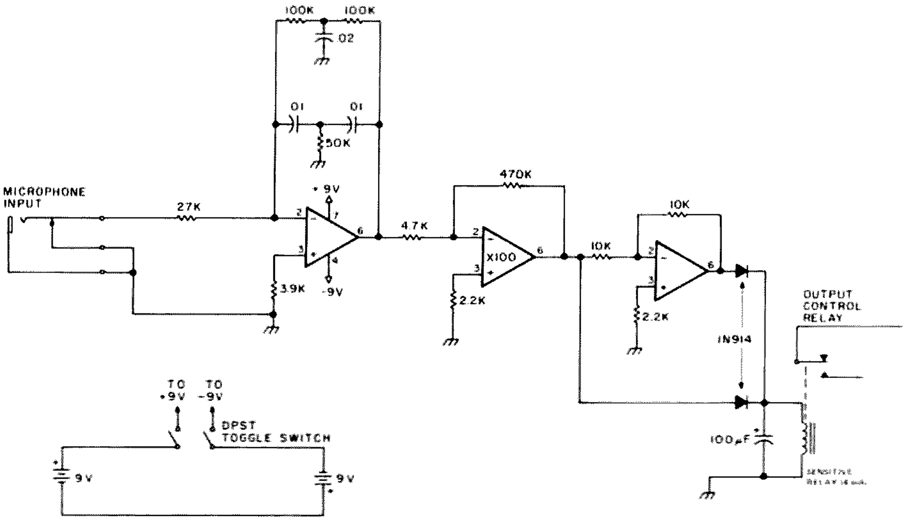


Fig. 4. Automatic slide-advance system using a 160-Hz Twin-T filter for cueing from a tape recorder speaker.

DX

from page 55

and unless some decision is made soon by the Iraqi officials, that may be the end result.

HB9MX reports that he hit bedrock in the mountain of Clipperton QSLs and is now answering QSLs as they come in. As of the end of September, he had answered 19,298 QSLs. 15,812 were returned direct by air mail, with the remainder going via the various bureaus. 852 cards were rejected because they were not in the log. If you still don't have your Clipperton QSL, you can now get an immediate response from Kurt Bindschedler, Strahleggweg 28, 8400 Winterthur, Switzerland.

Australian Novices, recognizable by the letter N immediately following their district number in their callsign, are allowed to run ten Watts on CW and thirty Watts on SSB. They operate in the following subbands: 28100-28550, 21125-21150, and 3525-3625 on CW, and 28100-28600, 21150-21200, and 3525-3625 on SSB.

9V1TT is apparently the only XYL active in Singapore. She is the XYL of 9V1TP.

Ownership of Abu Ail, once considered unclaimed, seems to be a bone of contention between France and Djibouti. If it is owned by Djibouti, then it is just another offshore island. But if Abu Ail belongs to France, then it would be a separate DXCC country.

FH8CY should become a bit more available now that the Northern California DX Foundation has donated an FT-101 and outboard vfo. This was the rig used by K5YY on his recent African swing.

The efforts of the Northern California DX Foundation have put many new ones in the pockets of the deserving DXers. Drop them a line at PO Box 717, Oakland CA 94604, to see how you can get in on the fun.

DJ9ZB is publishing a large, plastic-bound QSL book which lists a large number of QSL Managers. It contains some 50 pages of listings, and is a great aid for the serious DXer. Order from DJ9ZB, Carl-Kistner Str. 19, D-7800 Freiburg, West Germany.

If you still need cards from the SV0WZ stay on Rhodes, try WB3JRL.

Well, that about covers the DX front for this month. We want to again thank the *West Coast DX Bulletin*, the *LIDXA Bulletin*, and *WorldRadio News* for much of the preceding information. We also want to thank all you readers who have sent reports and photos. Keep them coming, and we will see you again next month.

Ham Help

This letter is in regard to the article "Rejuvenate A Pawnee," in the October, 1978, issue. I liked the way K4GRT and W4IEV laid out the modifications and diagrams—even I could follow them. I would like to know if someone else will do the same sort of article on the Hallicrafters SR-42 2 meter AM rig, as that is what I have and I would like to put it on 2 meter FM.

If an article is not possible, is it possible that someone would modify it for me at a reasonable price? Thanks.

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Denham Springs LA 70726

Corrections

Please note the following corrections to my article "The Klassic Kilowatt," which appeared in the November, 1978, issue: On page 226, column 2, line 9, should read: "3 dB weaker than a large,". On page 228, column 2, line 17 should read: "output power is 700 Watts." (It is assumed that the reader realizes that the amplifier is loaded into a dummy load for these measurements.) On page 229, column 1, lines 12 through 14, should read: "are 1500 volts at 700 mA on 20 meters, producing 700 Watts output." (This power was measured using a Drake W4 wattmeter while feeding a nonradiating dummy load.)

Dave Ingram K4TWJ
Birmingham AL

turned off. C2 charges positive through D1 until U1A switches negative once again. The period that C2 is charging positive is the space, and, at the end of the space, the circuit stabilizes unless another dot or dash is triggered.

The speed control provides biasing for U1A (note that this bias is different during a character than during a space because R9 is tied to the output of U1A). R4 determines how fast C2 charges positive during the production of a space following a character. If R17 and R20 are adjusted to make dashes equal to 3 spaces and dots equal to 1 space, then this weight will be true at any speed.

Capacitors are used liberally to bypass rf energy so that there is no interference from the transmitter. Care must be taken to ground the keyer, or problems might still arise with rf feedback, especially at high power levels.

I have been using this keyer for several years and find it very enjoyable. Keying is effortless and is ideal for extended operation such as during contests. This mechanism should also be useful to persons with certain types of handicaps that restrict motion. A 9-volt transistor battery will power the keyer for a long time and makes portable operation practical. With mechanical paddles as expensive as they are, this keyer provides an excellent alternative because it can be built complete with keying mechanism for less than most paddles on the market. Information and PC boards are available from the author. I would like to express my appreciation to Bruce Robinson and John Coken, fellow students at Temple University, for help in preparing this article.■

Parts List

U1	LM339 quad voltage comparator
Q1	2N4888 PNP
D1-D9	silicon small signal diodes (50 piv, 50 mA)
C1, C5, C6, C7	100 pF
C2	0.1 or 0.047 uF
C3, C8, C9	0.001 uF
C4	10 uF
R12, R24	10k
R9	39k
R25	47k
R3, R6, R7, R8, R11, R21, R22, R23	100k
R19	220k
R4	470k
R20	500k
R5, R10, R14, R15, R17, R18	1 megohm
R1, R13	1.8 megohm
R2, R16	5.6 megohm
S1	2-pole, 3-position rotary switch

SOS! Ship in Trouble!

—life and death on 20 meters

When a ship sinks in the Caribbean, it's the U.S. Coast Guard and Air Force to the rescue.

John M. Murray W1BNN
4 Kenwood Circle
Bloomfield CT 06002

Imagine listening in on a real SOS situation involving a ship sinking at sea! Purely by chance, I tuned in on just such an urgent drama in August, 1977, on 20 meters.

With no fanfare, suddenly there was a loud voice at about 14.252 kHz. "This is the U.S. Coast Guard at Portsmouth, Virginia. Emergency . . . Emergency! A clear frequency is requested. A ship has been reported by an amateur operator as sinking in the Caribbean. HP3422—do you read me?"

Of all times for it to happen, my tape recorder was out of order. I could only listen and try to remember, jotting down a few notes.

"HP3422—this is the U.S. Coast Guard. Do you read me?"

Smack on frequency but weakly came the reply, "Yes, here's HP3422. We're sinking. Eleven feet of water in the hold. Thirteen persons aboard. This is a ham operator on the bridge with battery power. Ship's transmitter and electrical power gone. We have 11 life preservers. Again, 13 of us aboard. . ."

"What is your position? Give us your coordinates so we can notify Homestead Air Force Base in Florida. A rescue plane can be sent out, if it's within their range."

"Thank you. It will have to be fast. The captain says we have maybe an hour and a half before going down."

"Roger. This is Portsmouth Coast Guard. Stand by!"

"Hello, HP3422," came another loud voice, "this is Potomac Coast Guard at Washington, D.C. We have notified Homestead Air Force Base in Florida to ready a rescue plane to proceed to your position when we know it. What is your position?"

"The Captain says we're about 17-15 north, 78-58 west, but there may be a discrepancy because the last time we plotted our position was the day before yesterday, and we believe our compass is faulty." He repeated the position coordinates several times at CG request.

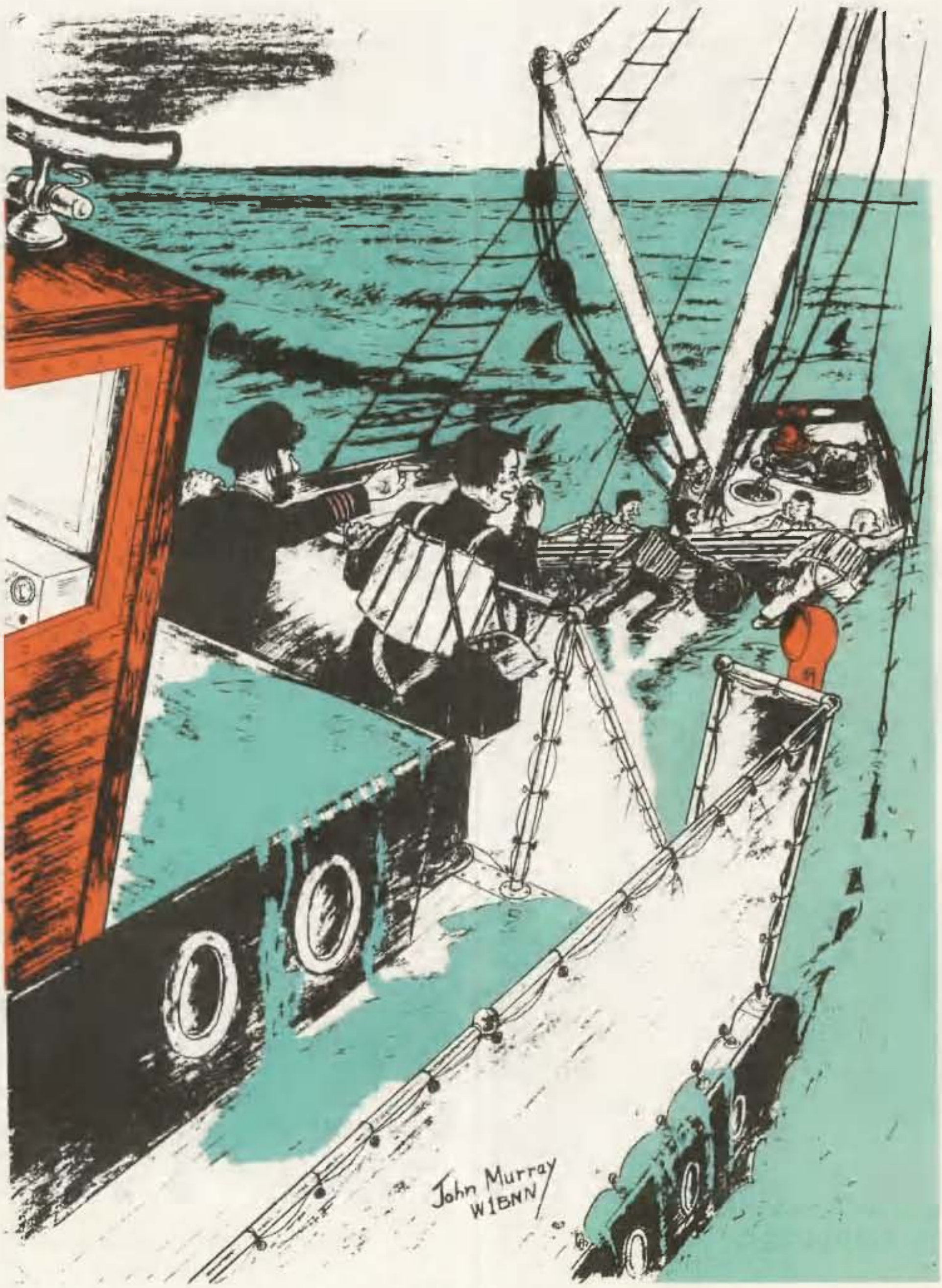
HP3422's signal had dropped way down at this point, probably due to atmospherics. The time was approximately 10:50 am, DST. As could be expected about that moment, with things getting more urgent, a bland voice cut in, "CQ twenty . . . calling twenty for Hoboken, New Jersey. This is WA5 Bing-Bang-Boom (or something like that). Is anyone around there?"

Fortunately, the directional CQ went on for only a few moments, and was quickly followed by the Portsmouth Coast Guard again: "Please QSY off this frequency immediately. This is the U.S. Coast Guard in emergency contact. A clear frequency is requested!"

Again the WA5: "What is the emergency? This is an amateur band."

The CG operator was in no mood to argue. "Please do as I say." He then continued, "HP3422, please give me your vessel's name and type. What other lifesaving gear have you aboard?" The CG signal was enormously strong and would probably override any ham competition. As he stood by, HP3422's very weak signal, fading in and out, was again audible. "Name is *Hippopotamus,* registered in Panama. Cargo vessel, about 200 feet. We're in ballast now. Grey, with much rust." The signal then stopped abruptly.

As close as I could figure it with the National Geographic Mercator Chart and an 18-inch globe, Homestead to the disaster area would be a flight of



some 775 miles, allowing a deviation eastward through the Windward Passage between the eastern end of Cuba and the tip of Haiti. Otherwise, to take the direct Great Circle route would churn up quite a bit of air space over Cuba, possibly blowing sparks from an angry cigar and setting a beard on fire. The ship was foundering in 3,000 feet of shark-infested ocean about 75 miles due south of Cap Carcasse, Haiti.

"This is Air Force rescue plane. I repeat—what lifesaving gear do you have aboard? What color are your life preservers?"

"Hello, Air Force rescue plane. This is HP3422. Thank you for calling." I could hear some other voices in the background of HP3422's signal, one yelling, "This is the captain speaking. All we have is a life raft of planks lashed to four oil drums."

At times there were considerable time lags between transmissions. Well over an hour sped by. Presumably, military direction finders and radar were being used, but so far no mention of them had been made over the air. Also, there was no explanation of how the ship got in such dire straits. No storm reports were given, nor word about why they didn't have at least one lifeboat.

Another voice cut in: "This is Homestead to HP3422. Please give us a long count so we can get a better DF bearing on you. Repeat it several times. OK?"

HP3422 proceeded to give several long counts, then stood by with, "Is that enough? Did you get a reading? Our bow is dropping deeper!"

Before the plane could answer, a new signal appeared on frequency. "This is experimental research ship *Aquarius*. We're some 300 miles from HP3422's approximate position. Can we be of help?"

"Air Force Rescue here. Negative. You're too far away. Thank you. Stand by. HP3422, I say again, what color are your life preservers and oil drums? Over."

"This is HP3422. Preservers, planks, and drums are grey."

"That'll be hard to see. Visibility is very poor, less than a mile at my altitude. I hope I can find you. This is going to be a tough one."

Homestead then gave the rescue plane a DF bearing which altered his course only slightly. Apparently, the sinking ship's position report was not as faulty as had been implied.

Suddenly, HP3422 was on the air again weakly. "The Captain's given the order to abandon ship. Water in hold now at 14 feet. When I go over the side, I'll have to cut loose from my antenna. Visibility here not too bad, maybe three miles. Almost a cloudless sky. Hazy. Oh, yes, there's a single big thunderhead about a mile due west of us. A huge one, only one in sight. Over."

The Air Force plane's signal snapped back on. "Great! I see it . . . about five miles from me. Correcting my course immediately."

"Good! This will be my last transmission. We see your plane. Over and out."

That was the last I heard

of HP3422. But the Air Force plane resumed transmission. "Hello, Homestead. Hard to believe! I've just passed over the spot where the ship went down. Great swirl of water and quite a bit of deck debris. Much bubbling—but have spotted the raft. Will make another pass directly and drop them our rescue craft. Over to you."

That was it. A few minutes later, the plane came on again briefly, reported that his rescue raft, with first aid, food, clothing, radio, etc., had landed with a hell of a splash very close to the shipwrecked mariners. Then, to my utter frustration, the pilot made one final transmission. "OK Homestead, am switching to the military frequency for follow up instructions. Thank you, hams!" And he was gone. I had no way of knowing what that military frequency was. My transceiver was limited in that setting to the 20 meter ham band. Obviously, the rescue craft's radio would be on the new frequency.

It was not clear whether the rescue plane was sent out from Florida, or whether Homestead had notified Guantanamo or one of the NASA activities in the area. Either of the latter might have meant a much shorter flight, and may well have been what happened.

In any event, it will be of much interest to me to learn any further details which some listener, or even the military operators involved, might have on this near-disaster.

The fact that there was a happy ending seems almost certain. However, I failed to hear a single word about it on the radio or on the tube, or even see a tiny item on the subject in newspapers or magazines, let alone in our ham radio publications. ■

Maria Stocking
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Minicontests
—get 'em involved!

A little local competition can be a great source of fun—and new members.

Would your amateur radio club like to have a fun activity that will attract new members? If so, challenge another club to a "minicontest." Such a contest will provide behind-the-mike and contest logging experiences for all participants.

In planning a minicontest, the time and station location should be such that the greatest number of people can observe the station in operation. (A shopping mall, a public park, or a school lobby are possibilities.) As much publicity as possible should precede the contest.

In a recent minicontest between the amateur radio clubs of the Principia College (Elsah, Illinois) and the Principia High School (St. Louis County, Missouri),[1] the following format was devised by the clubs' officers. This information was duplicated and given to the members of both clubs.

Inter-Campus QSO Party

Purpose: To create interest in amateur radio on both of our campuses and to unite the campuses in friendly competition.

Rules: Each campus will operate a portable radio station using a transceiver without a linear amplifier. The contest will be held on November 12th for a period of three hours from the first contact. Starting time will be about 11:00 am. We should encourage as many non-hams as possible to get involved.

Logs need to include the following information: Time of the QSO, call of the station worked, its operator's name, and the state of the station. The name of any unlicensed operator of our station making the contact should also be entered. Only one contact per station per band counts.

Scoring: Count one point per contact by a licensed operator, or two points if the operator is unlicensed. Each unlicensed operator will be permitted to make only five contacts. Each state worked will be used as a multiplier. After the contact points have been multiplied by the number of states, add on bonus points: 2 points when an operator communicates with his home state, and 15 points if a phone patch is completed or a message delivered to a third party.

Observations at the high school station in the November 12 contest illustrate a minicontest in action. The station was located along the route between the dormitories and the dining room. All students would be sure to see it on their way to lunch. A temporary antenna was installed on the roof. Two bamboo fishpoles taped together supported a 32-foot wire for the vertical half of the antenna. The other half of the antenna was another 32-foot wire slanting down towards the roof. The antenna was fed by 60 feet of twinlead connected to an antenna tuner. The antenna loaded beautifully on both 40 and 20 meters. The sponsor of the club, WBØVOE, supplied a Yaesu FT-101E transceiver and lumber to support the fishpoles. An "old-timer" (and long-time field day "supervisor")[2] supplied the antenna, the antenna tuner, and the two-letter call (WØVM). A sign with the station call and its phonetic equivalent, "whiskey zero victor mike," was posted where all participants and visitors could see it.

The first contact was made with the college station WA9NYN (Illinois). The second contact was made with the father of the college club's sponsor (Minnesota). The next two contacts were in Ohio and Tennessee. What a good start! Four contacts in four different states! The first 19 contacts were made on 40 meter SSB. The remaining contacts were made on 20 meter SSB. All in all, the high school club made 32 contacts in 19 states.

Nine unlicensed students made contacts under the supervision of the two licensed operators. In the middle of the contest, a much appreciated contact was made with WA2RBN, the South Queens Boys Club in New York City. The father of one of the participants was in New York City on business. This student sent a message to his dad via the hotel where he was staying. Another student from New York City also sent a message to his family.

During the QSO with the Boys Club station, one of the student operators innocently used the expression "ten four." The club's sponsor immediately took the microphone and apologized for the use of "such language." This incident provided a good opportunity to explain the differences between CB and ham radio. As one student put it, "using CB lingo in an amateur radio QSO is like wearing old patched-up blue jeans to a formal dance."

Circumstances gave the high school club what could be called an "unfair advantage" in the contest. A Missouri QSO contest was on at the time, and "CQ contest, WØVM, St. Louis, Missouri" brought many answers. The two-letter call also helped. Although the high school club made more points than the college club, both clubs really won. All participants (some of whom were YLs) had fun, and each club has new members as a result of the minicontest. One of the new high school members has taken the Novice examination and is eagerly waiting for his license to arrive. When Field Day comes around in June, these two clubs are planning to join forces and enter a class 1-A station in the "big contest."

Your amateur radio club could benefit from a minicontest. Why not challenge another club, have a minicontest, and enjoy the fun? ■

References

1. Private boarding schools managed by a nonprofit organization, the Principia Corporation.
2. See "A Field Day to Remember," *73 Magazine*, June, 1969, page 44.

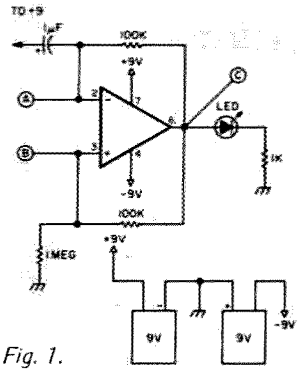

Fig. 1.

Allan S. Joffe W3KBM
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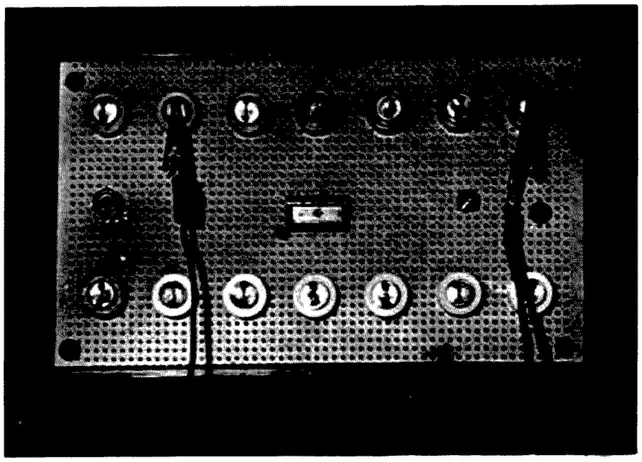
Are Your Op Amps Opping?

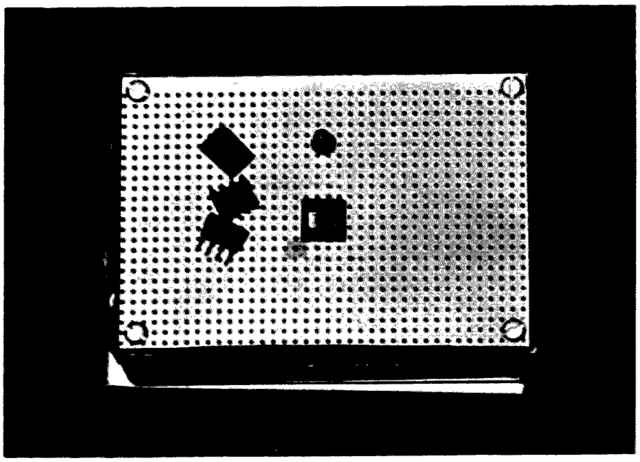
—try this IC helpmate

Here are two small shack helpmates, simple and inexpensive, but very handy. The first one has been around in many forms. Fig. 1 shows it is an astable multivibrator that will blink the LED about one flash per second if a mini-DIP op amp with typical 741 pinouts is plugged into the socket. The self-contained nine-volt batteries should give shelf life, as the drain is both minimal and infrequent. Some of the similar pinout units are the 301, 307, 318, and 844.

A second unit was constructed to allow testing of dual units in mini-DIP packages and 14-pin units, either dual or single.

This is identical electrically but differs physically. Fourteen test point jacks are arranged around a 14-pin socket, and each socket pin is wired to one of the jacks. Five test leads with clips are brought out to connect to the proper pins, depending on the device packaging. Two of these are the plus and minus nine volts. The other three connect to points A, B, and C in the schematic of the mini-DIP tester. Simply determine where the clip leads should go according to the unit to be tested. Clip the leads to the appropriate test point jacks, and insert the IC. If the LED blinks, the device is okay. The mini-DIP version needs no battery switch. The second device only needs a switch if you believe in Murphy's law that says, "When in storage on the shelf, if two leads do touch, they will be the battery leads." ■





Edmund H. Smith, Jr. K3NCL
101 Winterbury Circle
Wilmington DE 19808

Major League TT Controller

—15 digits, 40 devices, 100 bucks

Now's the time for a high-performance control system.

Photos by James Sevast K3IMH

Front view of system. The system is housed in a 5" × 9" × 6" cabinet. The source selector switch selects as input the internal touchtone pad or one of two external sources. The "key" LED is turned on by a key of the pad being depressed.

The radio amateur has been using dual-tone multifrequency (DTMF) touchtone™ signalling to remotely control electrically activated devices for some time. Detection circuitry has evolved from bulky LC tone filters to phase-locked-loop tone detectors to the most recent development, an MOS/LSI integrated circuit that shrinks the size of circuitry, simplifies construction, and yields substantially improved DTMF detection performance.

Since the two meter repeater explosion started, I have had the pleasure, and occasional frustration, of building four 2 meter repeaters, three of which have limited-capability phase-locked-loop-based DTMF supervisory control circuitry. When I saw this new IC, I decided the time was right to develop a general-purpose, flexible, high-performance expandable control system that could be used at a repeater site, or in the shack, to turn

almost anything on or off remotely.

The system that has evolved can be programmed to respond to a user's access code of up to 15 digits and can control up to forty devices. Access code and control codes can easily be changed at any time by changing the system's programmable read only memories (PROMs). Cost is reasonable. Even with an empty junk box, you should be able to reproduce the system for under $100.

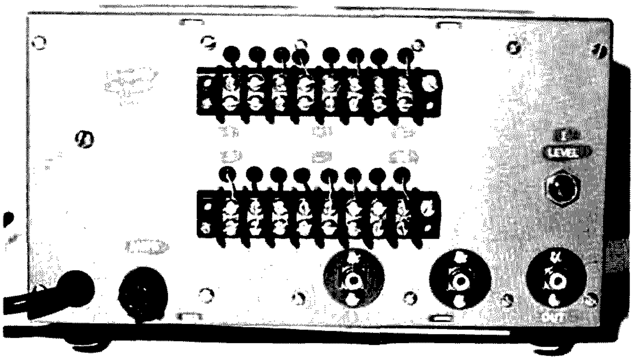
General Description

Referring to Fig. 1, audio from a receiver or other source of DTMF tones is applied to a high-tone group preprocessor and a low-tone group preprocessor. The preprocessors consist of multistage active bandpass filters that provide a minimum of 32 dB separation between the high-tone group (1209 Hz, 1336 Hz, 1477 Hz) and the low-tone group (697 Hz, 770 Hz, 852 Hz, 941 Hz). Included in the preprocessor are digital comparators that change the analog tones into digital pulse trains for input into the DTMF detector.

The DTMF detector consists of a Collins Rockwell CRC-8030 MOS/LSI integrated circuit. Fig. 2 is a block diagram of the 8030. Using a unique (patent pending) digital filter algorithm, the 8030 processes the incoming high and low tones, recognizes when a valid touchtone digit is being sent, and provides a user-selectable two-of-eight output or 4-bit binary output that identifies the digit received. High stability is assured by a crystal-controlled timebase.

The DTMF detector is followed by a sequence detector which determines if the proper access code has been received. The sequence detector, after detecting a valid access code, responds to the next digit as a command to activate or deactivate a particular control function. The sequence detector is capable of being programmed to recognize an access code consisting of as little as one digit up to a maximum of fifteen digits. It can control from one to nineteen on-off functions or up to forty pulsed functions. Circuitry for five on-off functions and one pulsed function will be described in detail.

The output interface has drivers that can power relays or other external dc circuitry. The open collector transistor outputs can sink up to 300 mA and can sustain voltages of up to 30 V dc.



Rear view of the system. Relay contacts are brought out to terminal strips for easy connection to external devices being controlled. Jacks are provided for the two input sources and audio output from the touchtone pad. A level control was included for source #1.

The status display shows if the incoming digit sequence corresponds to the access code, which digit is being received, and which

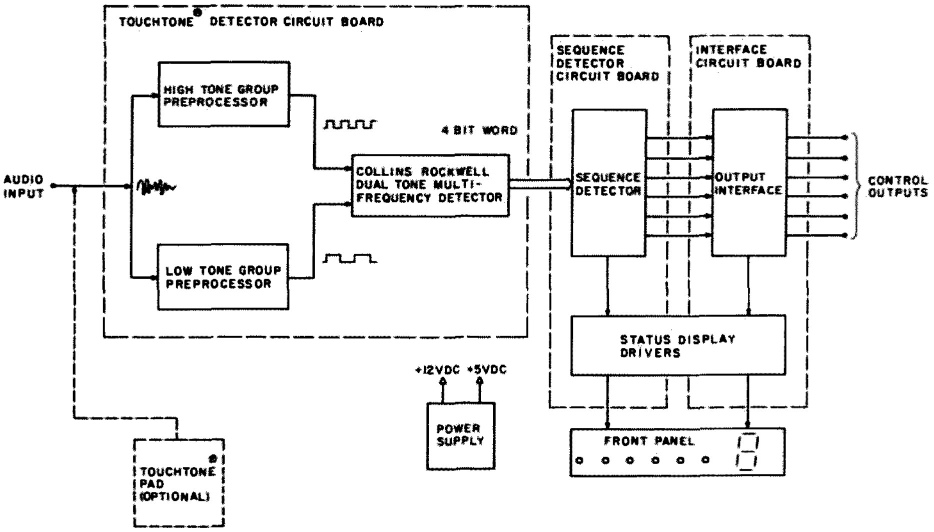
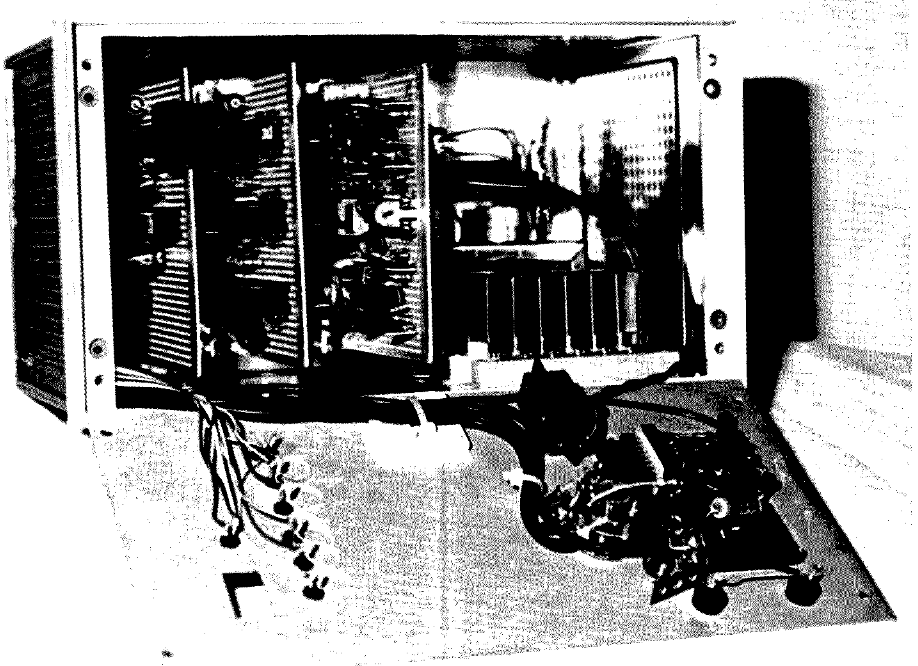


Fig. 1. Block diagram of the touchtone control system.

	Touchtone® Digit	A7 (MSB)	A6	A5	A4	A3	A2	A1	A0 (LSB)	O1	O2	O3	O4	
		DTMF detector word 8	4	2	1	Binary counter 8	4	2	1	PROM output bits (Note 2)				
Access code	2	0	0	1	0	0	0	0	0	1	0	0	0	Valid sequence bit
	7	0	1	1	1	0	0	0	1	1	0	0	0	
	0	1	0	1	0	0	0	1	0	1	0	0	0	
	3	0	0	1	1	0	0	1	1	1	0	0	0	
	1	0	0	0	1	0	1	0	0	1	0	0	0	
Control digits	9	1	0	0	1	0	1	0	1	0	0	0	1	Control bits
	0	1	0	1	0	0	1	0	1	0	0	1	0	
	*	1	0	1	1	0	1	0	1	0	1	0	0	

NOTE 1 (boxed: A7–A4 of access code rows)

Table 1. PROM #1 (U9) programming chart. Notes: 1 — The access code is determined by the addresses within the box. Any access code can be chosen by appropriate address selection when the PROM is programmed. Access code 2-7-0-3-1 is shown. 2 — All other PROM outputs are left unprogrammed (binary 0).



Front view with panel lowered. The three circuit cards plug into sockets attached on standoffs at the rear of the cabinet. The power supply and relays are located in the right portion of the cabinet. The cards are, right to left, the DTMF detector board, the sequence detector board, and the output interface and display driver board.

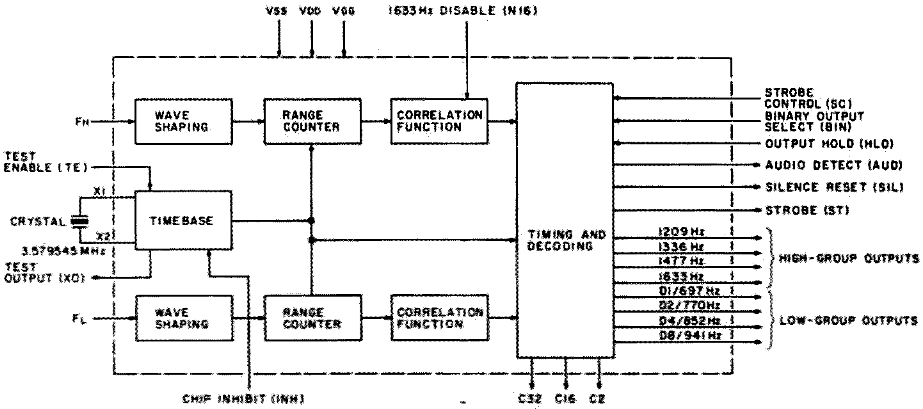


Fig. 2. CRC-8030 block diagram (from CRC-8030 data sheet, pg. 2, Fig. 3).

functions are on or off.

I elected to include an optional touchtone pad in my system for local control. When not in use for local control, the pad drives my two meter transmitter.

Tone Group Preprocessor

The tone group preprocessor circuitry is shown in Fig. 3. 100 millivolts peak-to-peak audio is coupled into the high- and low-tone group bandpass filters through gain control potentiometers. The gain control potentiometers permit individual adjustment of gain of the high-tone group and low-tone group filters to compensate for "twist," which is the term used to describe differences in the level of the high group and low group outputs from the user's receiver. The filters consist of four active bandpass stages. Trimpots are provided for each filter stage so that the stage can be tuned to the proper frequency. In addition to filtering, the active stages provide gain so that an incoming tone is amplified to 6 volts peak-to-peak at the filter output.

An LM339 comparator converts the sinusoidal output from the group filter into a digital pulse train. A trimmer potentiometer, Rc, permits adjustment of the comparator reference voltage so that the comparator output is logic low when DTMF tones are not being received. Note that mylar™ capacitors are used in the bandpass filters to minimize filter drift with temperature.

DTMF Detector

Fig. 4 shows the circuitry for the DTMF detector. The CRC-8030 has numerous inputs and outputs, which give the device great flexibility.

In this application, I have selected the binary output format rather than two of eight and thus have grounded the binary select pin, Bin. Likewise, I am using a 12-digit touchtone pad rather than a 16-digit pad and have, therefore, grounded the "1633" pin which defeats the reception of these additional control digits. The strobe control selection pin, Sc, is also grounded, which ensures that the detector only responds to high quality input signals. This reduces the probability that voice or noise signals from the receiver will cause the chip to falsely identify the presence of a control signal.

Outputs include a 4-bit binary word, a strobe signal that indicates when a valid tone pair has been received, and a silence reset signal that continually pulses when valid tone pairs are not being received.

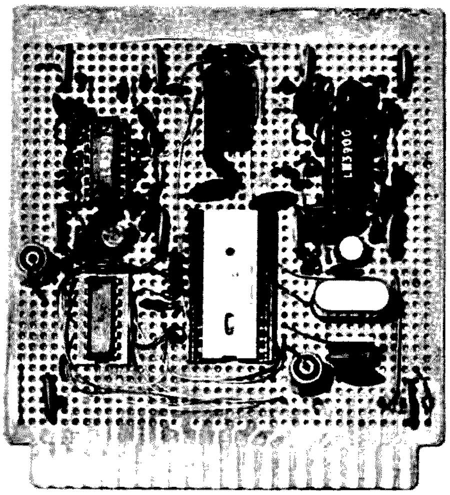
The CRC-8030 can be operated from a single or dual power supply. When operated from a single 5-volt dc power supply, as I have elected to use, the outputs are only capable of driving LPTTL or CMOS.

CD-4049 CMOS-to-TTL buffers interface the detector to the remainder of the circuitry.

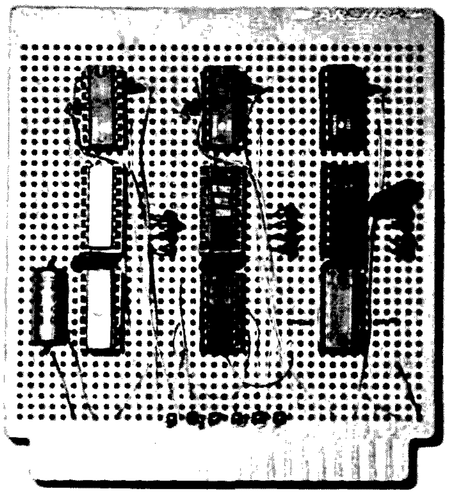
Preprocessor/Detector Construction

As can be seen in the photograph, the high- and low-tone group preprocessor circuitry and the dual-tone multifrequency detector fit nicely on a single 4" × 4½" circuit board. The preprocessor circuitry operates from a +12-volt dc power supply. I have included on the circuit board an LM340-5 voltage regulator that provides the +5 volts dc for the CRC-8030 chip.

If you are fortunate enough to have a microcomputer in your radio shack, you could utilitze this single card to convert DTMF tones into a 4-bit binary word for input to your microcomputer. Sequence decoding and control could be programmed by appropriate software. If you don't have a microcomputer, the following "computer-like" circuitry



DTMF detector circuit board.



Sequence Detector Board.

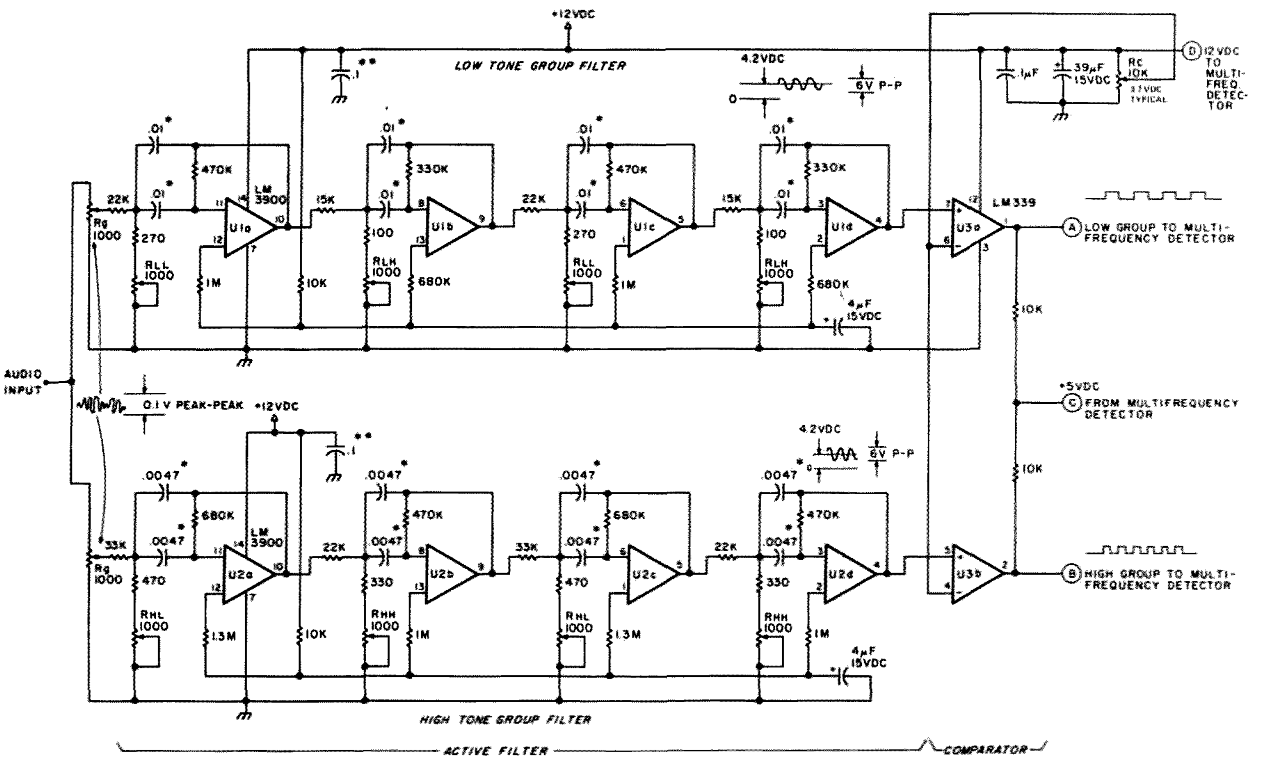


*Fig. 3. High- and low-tone group preprocessor circuitry. * Mylar TM, 10%; ** located close to associated LM3900; all resistors ¼ Watt; all capacitors uF.*

will do the job.

Sequence Detector

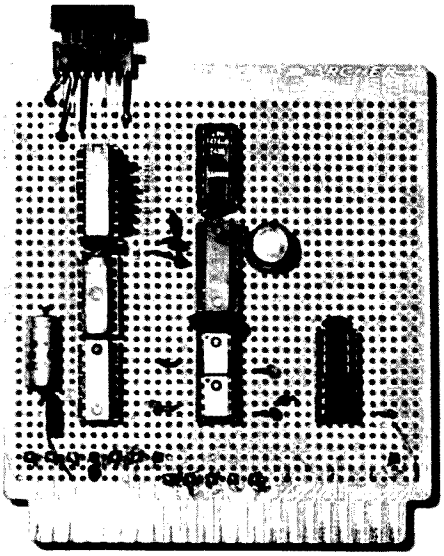
The heart of the sequence detector consists of three 4-bit by 256-word programmable read only memories (PROMs). To address the 256 words of the PROMs, an 8-bit address is required. Referring to Fig. 5, this 8-bit address is provided by a 4-bit binary counter and the 4-bit word from the DTMF detector circuitry previously described. PROM #1, combined with PROM #2 and PROM #3, provides eleven control bits that are used to activate or deactivate control functions.

Detection of a valid access code occurs as follows: Initially, the 4-bit binary counter outputs are all 0. When a digit is received by the DTMF detector, its 4-bit binary word combines with the binary counter word to produce a PROM address. One output bit of PROM #1 is called the valid sequence bit. If the digit received by the DTMF detector is the first one in the access code sequence, the PROM #1 output accessed by the 8-digit address will contain a binary 1 for the valid sequence bit. This bit causes the 4-bit binary counter to increment by one count. When the second valid sequence digit is received, its 4-bit binary word, combined with the 4-bit binary counter which is now 0001, will also address a location in PROM #1 where the valid sequence digit has been preprogrammed to logical one. In this way, the binary counter continues to increment and combine with the DTMF detector output to address different parts of PROM #1 where valid sequence bits are stored. If an invalid digit is received, it, combined with the binary counter, addresses a part of PROM #1 where the valid sequence bit was never preprogrammed to logical one and is, instead, zero. Logical zero causes the 4-bit binary counter to be reset to all zeros, thus terminating valid sequence detection.

After the proper access code has been received, the next digit received by the DTMF detector, combined with the counter circuit, addresses a location in PROM #1, #2, or #3 where a word was preprogrammed to activate an appropriate control bit.

When the control digit is received, the PROM #1 location addressed does not have the valid sequence bit set. Therefore, the 4-bit binary counter is again reset to zero and further control cannot occur unless the proper access code is again received.

Table 1 provides additional information on the programming of PROM #1. Study of this table will give you a better understanding of how the access code and control bits are programmed. For example, an access code of 2-7-0-3-1 is shown. You could use any digit combination. The access code could be fewer digits or more digits (up to 15), depending on your own individual requirements. Note that the 8 bits of the PROM address (A0-A7) are made up of a 4-bit word from a binary counter (A0-A3) and a 4-bit word from the DTMF detector (A4-A7). The binary counter portion of the address word is all zeros for the first digit, 0001 for the second digit, 0010 for the third digit, and so forth.



Output interface and display driver board.

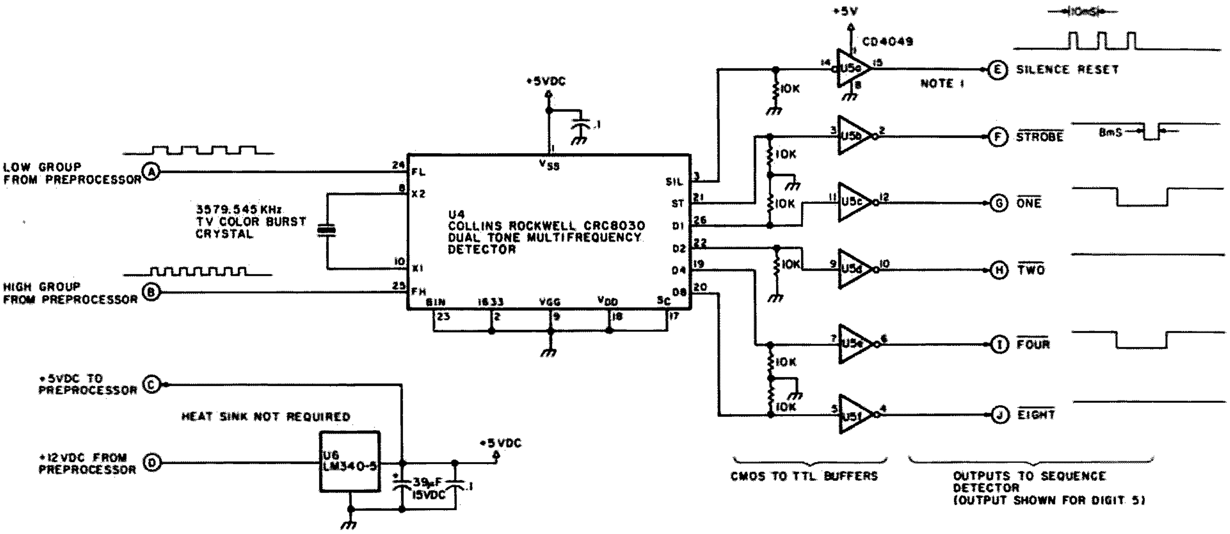


Fig. 4. Dual-tone multifrequency detector. Note 1 — buffer can drive two TTL loads maximum.

The remaining 4 bits of the address are a function of the access code as shown.

PROM #1, which initially has all of its output bits unprogrammed at zero, is programmed at the five access code addresses shown to have output bit 0_1 to be 1. The control digits represent the last digit sent in a sequence, and, therefore, the binary counter portion of the PROM address would be 0101 as shown, representing the sixth digit received. I have programmed PROM #1 to respond to the control digits 9, 0, and *. These addresses are used in the PROM programming process to set output bits 0_2, 0_3, and 0_4 to logical one as shown. Note that the output bit 0_1 (valid sequence bit) is set to 0 for these addresses, which will cause the circuitry to recognize that the end of a valid sequence has occurred.

Since 1 bit of PROM #1 is used as the valid sequence bit, only 3 bits remain to activate control functions. To have additional control functions, additional PROMs must be added. Tables 2 and 3 give the programming instructions for PROM #2 and PROM #3, respectively. Since PROM #1 contains all of the information for determining if a valid access code has occurred, the other two PROMs need only be concerned with providing additional control bit outputs. As in PROM #1, when a control digit is received, the binary counter is 0101 as shown. The remainder of the address is determined by the control digit (1, 2, 3, 4, 5, 6, 7, and 8). These addresses are the only words in PROMs #2 and #3 that have any output bits set. Since no information related to the access code is required in PROM #2 or #3, any change in the access code only requires programming one new PROM (PROM #1).

Sequence Detector Circuitry

The sequence detector circuitry is shown in Fig. 6. The six signals from the DTMF detector are further buffered by a 7404 hex inverter. This provides adequate drive to address up to 10 PROMs. The PROMs, Signetics 82S129s, were chosen for their ready availability and their low cost. The PROMs are tristate; 270-Ohm resistors from the output pins to ground ensure that the following TTL circuitry can be properly driven.

The 7493 binary counter is incremented by the trailing edge of the strobe pulse. After the incoming digit has gone away, the silence reset signal will begin to pulse and will reset the binary counter to zero if the 7474 D flip-flop is not set. The flip-flop will be set, thus disabling silence reset from resetting the binary counter, if the digit received was part of the access code. The valid sequence bit only exists for the duration of the strobe pulse. It is stretched by the 0.1 uF capacitor, 270-Ohm resistor parallel combination, so it is still present when the D flip-flop is clocked by the trailing edge of the strobe pulse. An LED connected to the $\bar{Q}$ output of the flip-flop lights if a valid sequence is being received. As long as the LED is on, the sequence is valid.

The outputs from the PROMs are pulses of duration equal to the strobe pulse. RS flip-flops consisting of 7402 NAND gates store the control instructions. For example, function 1 is activated by a 1 on PROM #3 output line 0_4. Function 1 is deactivated by a 1 on PROM #3 output line 0_3. From Table 2, you can see that this corresponds to a digit 1 setting the flip-flop and a digit 2 resetting the flip-flop. Again, these digits represent the last digit to be transmitted in a control sequence. LEDs are connected to the flip-flops to show the status of the various control functions.

Note that output 0_2 of PROM #1 is not connected to a flip-flop. The pulse that occurs on this output line is used to activate a one-shot that will be described later.

The sequence detector circuitry fits on a 4″ × 4½″ circuit board, as shown in the photograph.

The sequence detector could be used for other than DTMF applications. For example, a key pad connected to this sequence detector would make a great electronic combination lock. You would have to include in your key pad circuitry something to generate the strobe and silence reset signals and some gates to convert the 2-of-8 output that is typical of most pads to 4-bit binary.

Output Interface

The output interface is shown in Fig. 7. Functions 1 through 5 are buffered by 75452 peripheral drivers which are capable of sinking up to 300 milliamps with collector-to-emitter voltages as high as 30 volts dc. A 400-milliwatt maximum power dissipation for each transistor must be observed.

In my unit, I elected to have the transistors drive some miniature 24-volt dc relays which I had in the junk box. These relays have a set of normally-open and normally-closed contacts which give me great flexibility in interfacing; I can control both ac- and dc-operated devices. Relays have the further advantage of assuring electrical isolation of the devices being driven from the control system. If you elect to drive relays, include the 1N4002 diodes, which will keep the back EMF from the relay coil from getting back into the circuitry.

Function 6 is a pulse produced by a 74123 one-shot which I arbitrarily adjusted to provide a one-second contact closure at the output. The 100 uF capacitor connected to the 74123 can be changed in value to lengthen or shorten the contact closure time.

Status Display

Also shown in Fig. 7 is

TOUCHTONE* DIGIT	DTMF DETECTOR WORD				BINARY COUNTER				PROM OUTPUT BITS (NOTE 1) — CONTROL BITS			
	8	4	2	1	8	4	2	1				
	PROM ADDRESS (MSB)							(LSB)				
CONTROL DIGITS	A7	A6	A5	A4	A3	A2	A1	A0	O1	O2	O3	O4
5	0	1	0	1	0	1	0	1	0	0	0	1
6	0	1	1	0	0	1	0	1	0	0	1	0
7	1	1	1	1	0	1	0	1	0	1	0	0
8	1	0	0	0	0	1	0	1	1	0	0	0

Table 2. PROM #2 (U10) programming chart.

CONTROL DIGITS	A7	A6	A5	A4	A3	A2	A1	A0	O1	O2	O3	O4
1	0	0	0	1	0	1	0	1	0	0	0	1
2	0	0	1	0	0	1	0	1	0	0	1	0
3	0	0	1	1	0	1	0	1	0	1	0	0
4	0	1	0	0	0	1	0	1	1	0	0	0

Table 3. PROM #3 (U11) programming chart. Note: All other PROM outputs are left unprogrammed (binary 0).

the circuitry for the MAN-7 front panel LED indicator. The MAN-7 is driven by a 7447 decoder/driver. Inputs to the decoder/driver are latched by the 7474 D flip-flops. The display circuitry is straightforward, with one exception. The 7447 normally responds to

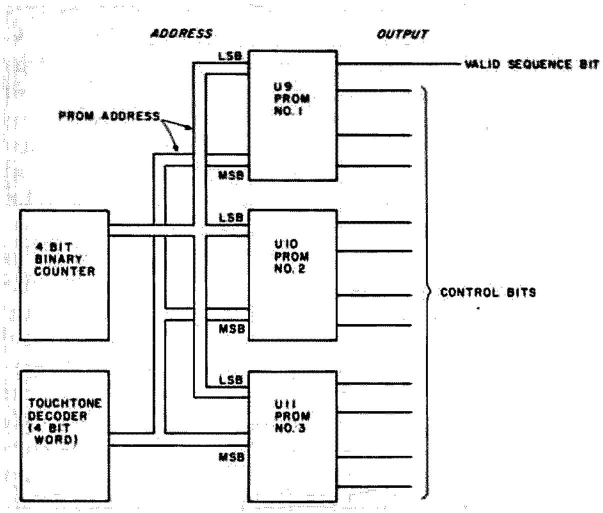


Fig. 5. PROM addressing.

all inputs at logic 0 as representing the decimal digit 0. The output of the DTMF detector for the digit 0 is binary 1010. A 7420 NAND gate decodes the presence of binary 1010 and clears the four flip-flops so that the LED display will truly represent the presence of the digit 0.

The LED display cannot represent properly the two control digits, * and #. For *, the LED display will show a small backward C. For #, the display will show a small u. All the numerical digits are displayed correctly.

The LED digit display is optional; it is not really needed for proper functioning of the system. It does allow you to see if your access code is being sent. It is also useful in determining if a user's touchtone pad is functioning properly. For example, using this display, I quickly found out that one of my touchtone pads was not transmitting the digit 6 correctly. Without it, I would have suspected the control system rather than the touchtone pad.

The output interface and status display circuitry easily fits on a 4" × 4½" circuit board, as shown in the photograph.

Power Supply

A 117-volt power supply is shown in Fig. 8. In addition to supplying voltages for the control system, it also provides necessary voltages to the PROM blast-

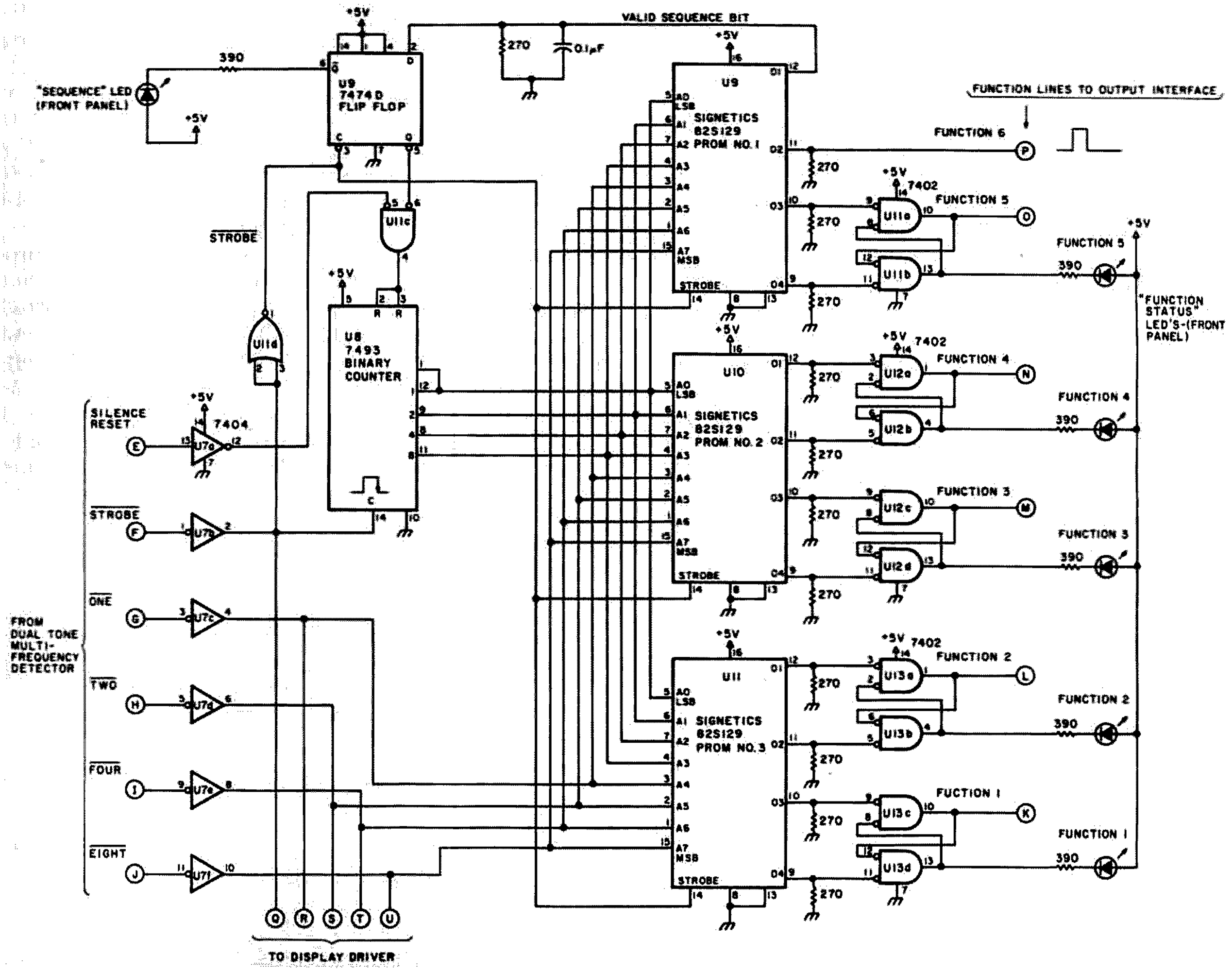


Fig. 6. Sequence detector. See text for PROM programming instructions. Bypass each IC power pin with 0.1 uF capacitor. Bypass +5 V input to circuit card with 39 uF 15 V dc capacitor.

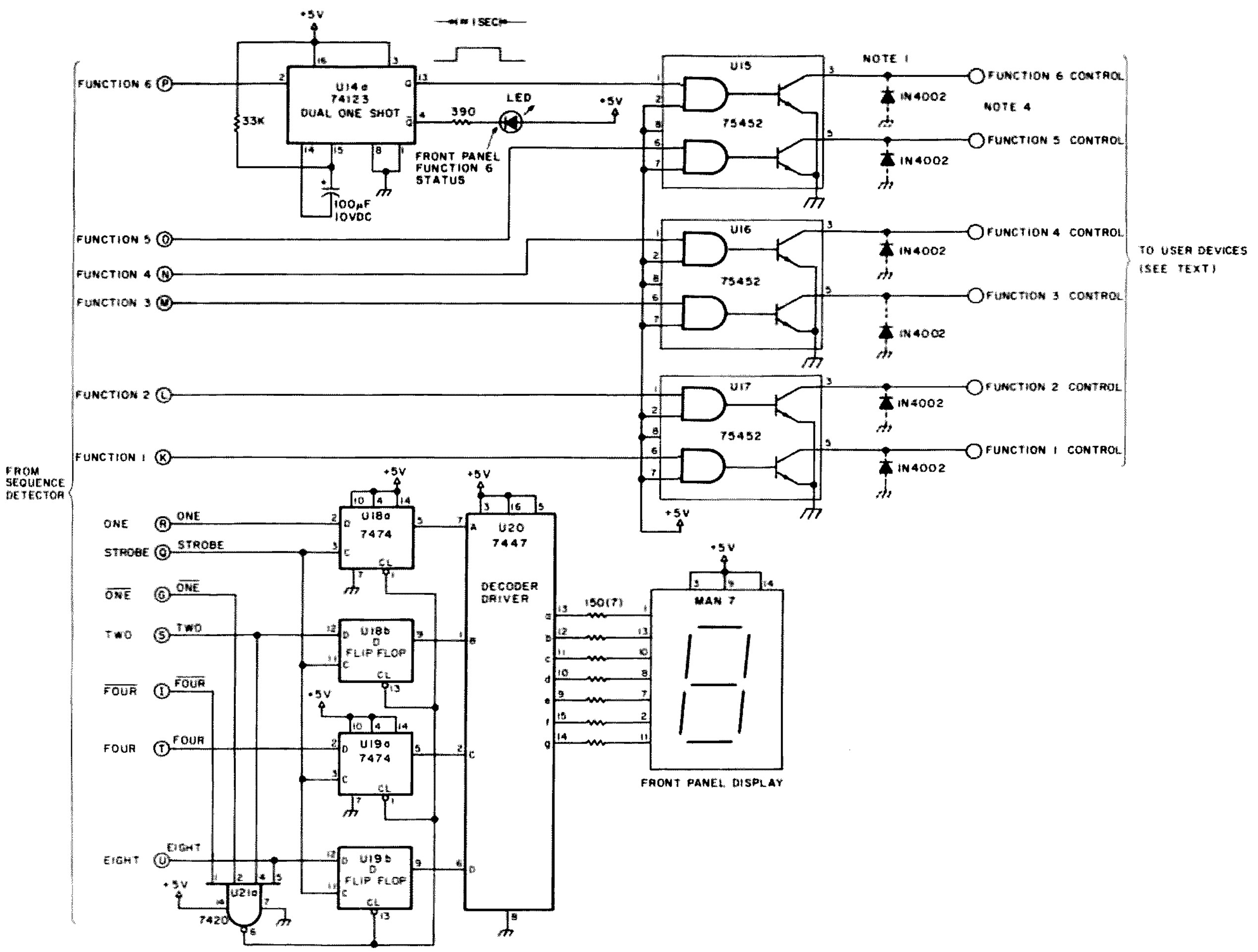


Fig. 7. Output interface and display driver circuitry. Notes: 1 — Output transistors are 30 V dc maximum voltage, 300 mA maximum current, 400 milliwatts maximum power dissipation. 2 — Bypass each IC power pin with 0.1 uF capacitor. 3 — Bypass +5 V dc input to circuit card with 39 uF, 15 V dc capacitor. 4 — Diodes are optional; required when driving inductive load such as a relay.

er (to be described shortly).

Construction

The construction is well illustrated by the photographs. The touchtone detector circuit board was wired point-to-point, whereas the other circuit boards used wire-wrapped sockets and interconnections were made by wire-wrap.

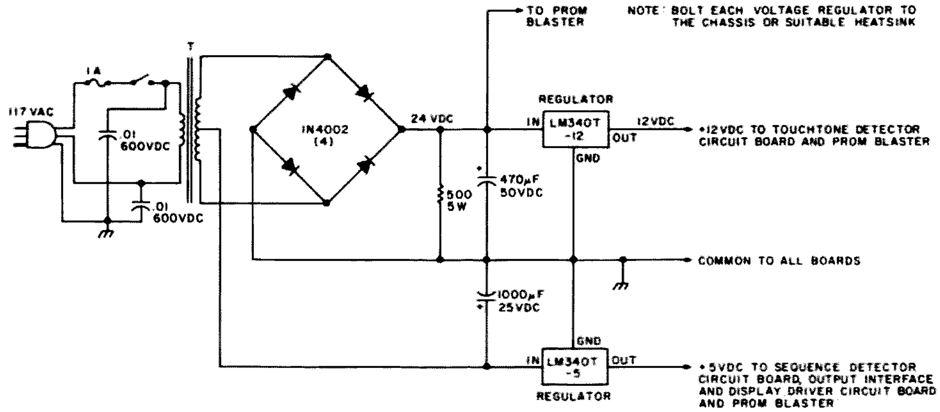


Fig. 8. Power supply. Transformer T — 117 V ac primary, 18 V ac center-tap secondary at 1 Amp minimum.

Most of the parts are readily available from distributors that advertise in this magazine. One part deserves special note. The CRC-8030 DTMF detector can be purchased from your local Hamilton Avenet Electronics distributor or can be purchased directly from Rockwell Collins, 4311 Jamboree Boulevard, Newport Beach, California 92663, Attention: Component Sales.

The CRC-8030 represents the only expensive part in this entire system, selling for $42 (plastic) as of January, 1978. While relatively expensive, it provides one heck of a lot of performance. Prices will probably drop rapidly as these chips are produced in quantity, so you should check the current price before ordering.

The PROMs can be pur-

chased from S.D. Sales, P. O. Box 28810-B, Dallas, Texas 75228. The PROMs sell for $2.50. I recommend you buy one or two additional PROMs in the event that you accidentally program one of yours incorrectly.

Programming the PROMs

Fig. 9 shows the PROM blaster circuitry. This circuitry is almost identical to that provided in the Signetics data sheet that will accompany your PROMs. I recommend that you use an oscilloscope to verify proper operation of the PROM blaster circuitry as per the waveforms shown before you begin your programming. If you don't have a scope, enlist the help of a friend who does. Programming is straightforward. Set the address switches to logic 1 or logic 0 as per Table 1, 2, or 3 to set up an address. Next, choose the correct output bit to be programmed and move its program switch to the programming position momentarily and then return it to the display position. The LED will light if the bit has been programmed. If the light does not light, then the bit still remains at logic 0 and programming of that bit has not taken place.

The electrical programming sequence is as follows: When one of the programming switches is moved from the read position to the program position, a 5-millisecond-long pulse is generated which raises the 5-volt dc power supply to pin 16 of the 82S129 to 8.75 volts dc. At the same time, a 1-millisecond delay pulse is generated, which, when it is completed, activates a 3-millisecond pulse which raises the voltage on the output bit being programmed from 0 volts to 17 volts dc. The voltage is approximate; the regulator which provides drive to the output bit being programmed is a current source which holds the programming current to 200 milliamps plus or minus 20 milliamps. The 3-millisecond pulse, in addition to raising the output voltage of the bit being programmed, triggers a 1-millisecond delay which, at its conclusion, activates a 1.5-millisecond pulse which causes the enable line, pin 14 of the 82S129, to be taken low, at which time the output bit is actually blasted. At the conclusion of the 5-millisecond time period, the enable line is again brought low, enabling the chip so that, when you return the programming switch to the read position, the status of the output line can be read by its associated LED.

When you get done programming your PROMs, mark each PROM with the proper PROM number so that you will know which socket it should be plugged into.

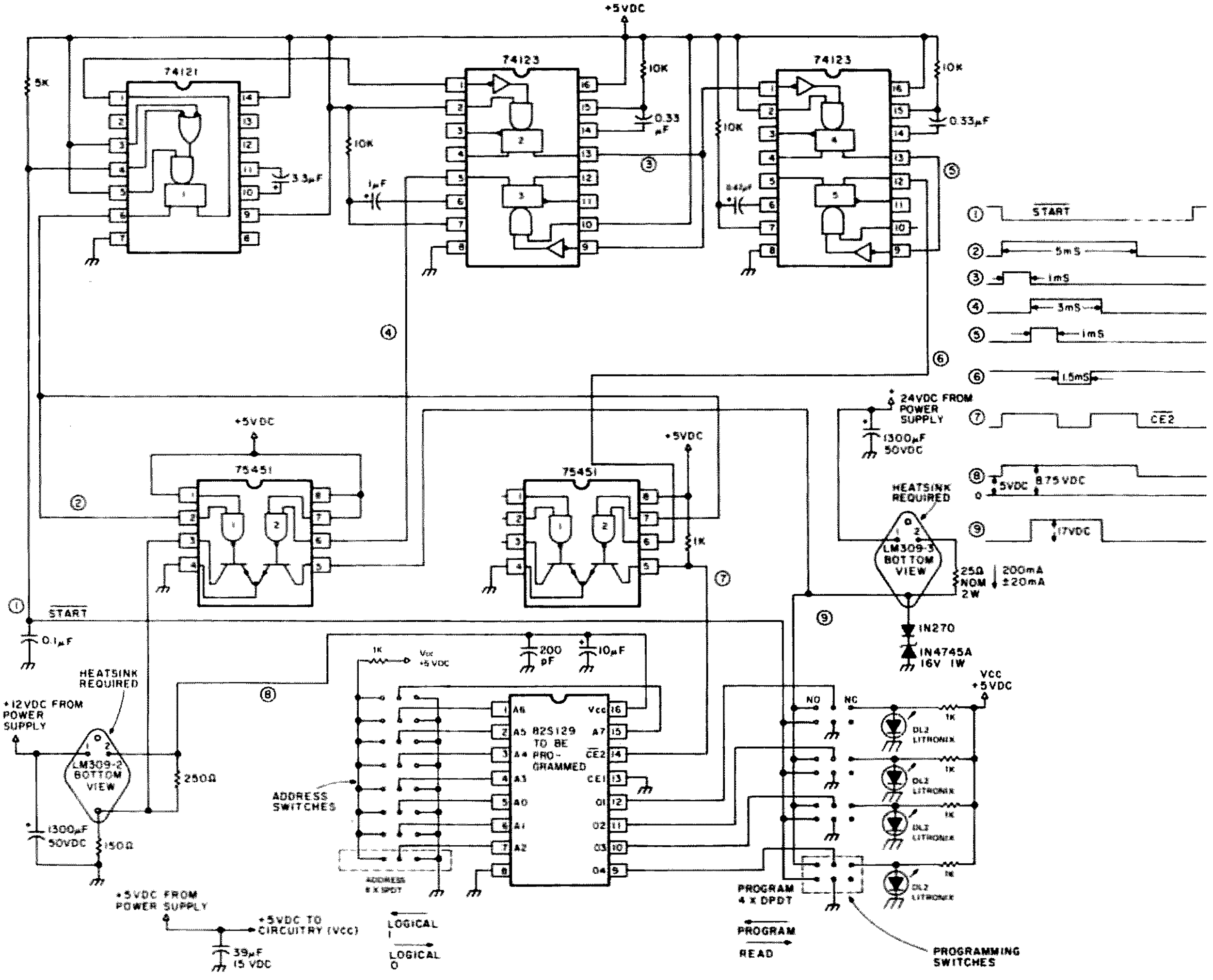


Fig. 9. PROM blaster circuitry. Notes: 1—All resistors ¼ Watt unless otherwise indicated. 2—All capacitors are uF unless otherwise indicated.

Adjustments

The only adjustment required to your touchtone control system is the alignment of the preprocessor circuitry. Refer to Fig. 3 and proceed as follows. Connect the audio input to your source of touchtone signals. Verify with an oscilloscope that the audio level at the wiper arm of the two gain pots, Rg, is 100 millivolts peak-to-peak. Beginning with the low-tone group, generate a 697-Hz tone by depressing both digits 1 and 2 on your touchtone pad. While observing the output signal at the first amplifier, U1a, on an oscilloscope, adjust R_{LL} for maximum signal. Next, move your oscilloscope to the output of U1b, generate a 941-Hz tone by depressing the digit 0 and the digit * on the touchtone pad, and adjust R_{LH} for maximum signal. Returning to the 697-Hz tone, adjust the R_{LL} associated with U1c for maximum signal at the output of U1c. Returning to the generation of the 941-Hz signal, adjust R_{LH} associated with U1d while observing the output of U1d. Repeat the adjustment sequence while observing the output at U1d. Adjust the potentiometers as necessary to get uniform response to the 697-Hz tone, the 941-Hz tone, and the two tones in between, 770 Hz and 852 Hz. If the circuitry is working properly and is properly aligned, you should observe voltage levels at the output of U1d as shown in Fig. 3.

The high-tone group filter is aligned in a similar way, with the R_{HL}s adjusted for a maximum output from the 1209-Hz tone (digits 1 and 4 held down simultaneously) and the R_{HH}s adjusted for a maximum from the 1477-Hz tone (digits 3 and 6 held down simultaneously). After alignment of the bandpass filters is completed, go back and adjust the gain pots, Rg, so that the voltages at the output of U1d and U2d are equal.

Next, using a voltmeter or an oscilloscope, adjust the voltage at the wiper arm of pot Rc to 3.7 volts dc. This should correspond to 0.5 volts dc lower than the dc voltage at the output of U1d and U2d. Next, observe the output of U3a and U3b on an oscilloscope while depressing digits on your touchtone pad. The signals observed should look very similar to square waves with timing between pulses a function of the tone frequency being received.

Extending Performance

The system can be easily extended to control more than the six functions that I have described. To do this, additional circuitry must be added and a method to address these additional control functions is required. The additional circuitry consists of adding more 82S129 PROMs, function flip-flops (7402s), and appropriate output circuitry. Each additional PROM will permit you to control two or more on-off functions or four one-shot functions. The binary counter and hex inverter that buffers the signals from the DTMF detector will drive up to 10 PROMs.

Access to these additional functions is obtained as follows: Note that the # digit on the touchtone pad has thus far not been used. Program your #1 PROM so that, when the digit # is depressed as the next digit after the access code, none of the control bits are set to logic 1, but the valid sequence bit continues to be logic 1. Now program your additional PROMs so that they will respond to the next digit received. If you want additional control digits beyond this, then program your #1 PROM so that additional control functions can be accessed by the access code followed by #, #, and then the control digit, etc.

The unused digit # can be used for other functions. For example, if each of the members of your radio club had one of these units connected to his receiver, he could have it disable his speaker unless someone dials his access code followed by the appropriate digit to turn his speaker on. However, in an emergency, you might like to activate all of the club members' speakers simultaneously. Perhaps you have chosen a 5-digit access code with the first 2 digits unique to your club and the last three digits to identify the club member. By programming the PROM that activates the speaker to also respond to the first two digits followed by the #, with # programmed to set the speaker control bit, you could activate all club members' radios by the club identification number followed by the #. Normal function of the control system would not be affected. If you understand at this point how the PROMs are programmed, you should have little trouble determining the PROM address and output bit that should be programmed to permit this capability.

Another use for the # digit might be to turn on or off all of your devices at once. In this case, you would program the PROMs so that, at the conclusion of your access code, receipt of the # would cause all of the bits of all of the PROMs that reset flip-flops to be programmed for logic 1. Again, normal operation would not be affected.

These are probably just a few of the ways that the performance of this control system can be enhanced. The use of inexpensive PROMs permits you to try all sorts of ideas without the need to rewire circuitry.

Conclusion

I have described a small, easily reproduced, flexible and extendable touchtone control system that can be used to control any electrically-activated device remotely. Performance of this device has been most gratifying. I have had it operating for several months on my two meter receiver, and I have yet to experience any false decoding. I am using a five-digit access code. The system responds reliably and rapidly to touchtone signals, with a performance that parallels what you expect of a commercial touchtone telephone.

In the last ten years, DTMF detector circuitry has evolved from LC filters to 567 phase locked loops to, now, the CRC-8030 DTMF detector. With our rapid growth in IC technology, I am sure the 8030 will someday be obsolete, but replacing it will give the semiconductor manufacturers a hard act to follow. ■

References

1. National Semiconductor Corporation Linear Applications, volume 1, 1976, *Designing RC Active Filters* (with the LM3900 quad "Norton" amplifier), paragraph 6.4, "A single amplifier bandpass active filter," pages AN7-15 through AN7-16.
2. J. H. Everhart WA3BXH, "Toward a More Perfect Touchtone Decoder," *73*, November, 1976, pages 178-181.
3. Rockwell-Collins CRC-8030 MOS/LSI dual-tone multifrequency detector data sheet. Rockwell International, 4311 Jamboree Boulevard, Newport Beach, California 92663.
4. M. Hammad, Rockwell-Collins application note CRC-8030, *Telephone DTMF Telephone Receiver*, January, 1977, Rockwell International, Newport Beach, California.

CB to 10

—part XVII: SBE and Pace rigs

Easy conversions mean happy QRP mobiling.

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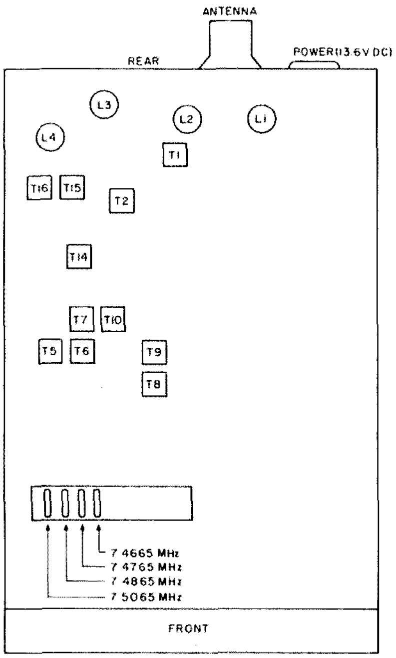

Fig. 1. SBE Sidebander III (SBE-18CB).

One of the easiest projects I have undertaken as an amateur and also one of the most rewarding has been the conversion of 23-channel CB rigs to 10 meters. I first converted an SBE "Sidebander III" a week before Christmas, 1977, and, with very little actual time on the air, worked eleven states and Europe from my car! I was hooked.

I have always found the 10 meter band to be friendly, and, although 5 Watts input power may not seem like much to some readers, it sure packs a punch in that delightful world of 28 MHz. Rather than fear the "big guys" on 10 meters, as some authors have suggested, my rig starts off at 28.510 MHz as channel 1, resulting in the bánd plan listed in Table 1. This hot little rig has performed so well that I have set myself a goal of "WAS 10 meter QRP mobile" for this year, which I have every confidence of reaching.

I have since converted, and helped others in this area to convert, AM and SSB CB rigs of various other manufacture. One thing I have learned and would like to stress here is that "conversion" from 11 to 10 meters is easy. The only parts swapping required is the change in crystals. Once the crystals have been changed, only straightforward realignment of the oscillator, mixer, and rf portions of the rig affected by the frequency change is necessary. That is, no i-f alignment or alignment of those oscillator sections using the original crystals is necessary. Furthermore, the little realignment that is required can be accomplished with the barest minimum of test equipment. I estimate that ninety percent of all

23-channel CB rigs now available can be converted using only a 12-volt power supply, a piece of wire a few feet long (2 or 3 feet suffices, used as a signal source for oscillator/receiver mixer/receiver alignment), a cheap CB wattmeter or other output power indicator, and a 5-Watt dummy load (52-Ohm resistor, 5 Watt, or less, if properly heat sinked). A frequency counter or friend with a calibrated receiver permits certain refinements regarding netting and checking SSB "clarifier" ranges once the basic tune-up has been completed.

Practical Conversion Hints

First, I recommend that anyone undertaking this project either purchase or borrow the Sams *Photofacts* covering the CB to be converted. The *Photofacts* provides a readable circuit diagram, parts locator guides, and alignment procedures which can be easily adapted to the new frequency.

Secondly, avail yourself of a good set of properly-fitting nonmetallic alignment tools. The cores of many of the inductors/transformers in the typical CB rig are small and very fragile. Use a properly fitting tool and do not force it. A broken core usually jams in the form and is extremely difficult to remove without damaging the inductor or transformer. I broke the core in the synthesizer oscillator transformer in a Claricon CB and spent two hours on one conversion which should normally have taken less than fifteen minutes!

Finally, some cores are sealed in place at the factory using either a soft wax or a thin cement. For those cores sealed with wax, apply a small amount of heat to the wax to liquify it, using the tip of a soldering iron, while gently rocking the core back and forth with the alignment tool until the core loosens. For those cores sealed with cement, carefully chip away the cement using a small, sharp blade such as an X-Acto™ tool. These cements are more difficult to deal with than the wax, but are also not as commonly used.

Choosing a Band Plan

For those of you converting a sideband CB and looking for DX contacts, design your band plan to cover the lower 300 kHz of the phone band. I start with 28.510 MHz as channel 1, which keeps me comfortably away from the band edge. You will find plenty of action there!

For AMers, most of the activity I have observed is above 28.8 MHz. This is as it should be, because AM and SSB are not truly compatible. AM activity is still a little sparse, but should grow rapidly as the band conditions continue to improve and the number of CB conversions increases.

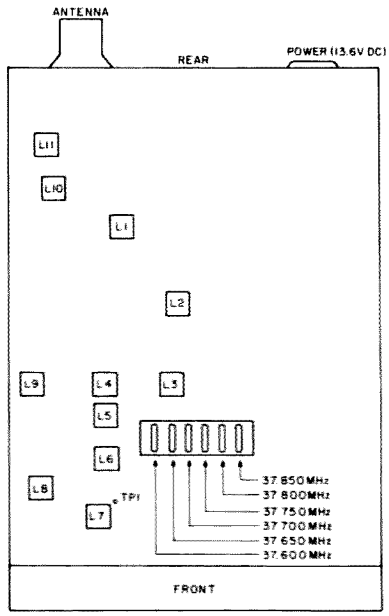

Fig. 2. Pace 123A.

Prior to my first AM conversions, several proposed band plans were in the literature. Unfortunately, none of these offered much in the way of either rationale or authoritativeness, so my first conversions started with 28.8 MHz as channel 1. I now favor the so-called "73 band plan" (see Wayne Green's editorial in the February, 1978, issue of *73 Magazine*). Although this plan offers no special magic over others I have seen, it has the support of the media (*73 Magazine*) and, for that reason, has a fighting chance of being generally adopted. The *73* band plan frequencies are exactly 2 MHz above their CB counterparts, with channel 1 being 28.965

Channel #	CB frequency	Original crystal	New crystal	10m frequency
1	26.965 MHz	7.4665 MHz	9.0115 MHz	28.510 MHz
2	26.975 MHz	7.4765 MHz	9.0215 MHz	28.520 MHz
3	26.985 MHz	7.4865 MHz	9.0315 MHz	28.530 MHz
4	27.005 MHz	7.5065 MHz	9.0515 MHz	28.550 MHz
5	27.015 MHz			28.560 MHz
6	27.025 MHz			28.570 MHz
7	27.035 MHz			28.580 MHz
8	27.055 MHz			28.600 MHz
9	27.065 MHz			28.610 MHz
10	27.075 MHz			28.620 MHz
11	27.085 MHz			28.630 MHz
12	27.105 MHz			28.650 MHz
13	27.115 MHz			28.660 MHz
14	27.125 MHz			28.670 MHz
15	27.135 MHz			28.680 MHz
16	27.155 MHz			28.700 MHz
17	27.165 MHz			28.710 MHz
18	27.175 MHz			28.720 MHz
19	27.185 MHz			28.730 MHz
20	27.205 MHz			28.750 MHz
21	27.215 MHz			28.760 MHz
22	27.225 MHz			28.770 MHz
blank				
23	27.255 MHz			28.800 MHz

Table 1. SSB band plan.

Channel #	CB frequency	Original crystal	New crystal	10m frequency
1	26.965 MHz	37.600 MHz	39.435 MHz	28.800 MHz
2	26.975 MHz	37.600 MHz	39.435 MHz	28.810 MHz
3	26.985 MHz	37.600 MHz	39.435 MHz	28.820 MHz
4	27.005 MHz	37.600 MHz	39.435 MHz	28.840 MHz
5	27.015 MHz	37.650 MHz	39.485 MHz	28.850 MHz
6	27.025 MHz	37.650 MHz	39.485 MHz	28.860 MHz
7	27.035 MHz	37.650 MHz	39.485 MHz	28.870 MHz
8	27.055 MHz	37.650 MHz	39.485 MHz	28.890 MHz
9	27.065 MHz	37.700 MHz	39.535 MHz	28.900 MHz
10	27.075 MHz	37.700 MHz	39.535 MHz	28.910 MHz
11	27.085 MHz	37.700 MHz	39.535 MHz	28.920 MHz
12	27.105 MHz	37.700 MHz	39.535 MHz	28.940 MHz
13	27.115 MHz	37.750 MHz	39.585 MHz	28.950 MHz
14	27.125 MHz	37.750 MHz	39.585 MHz	28.960 MHz
15	27.135 MHz	37.750 MHz	39.585 MHz	28.970 MHz
16	27.155 MHz	37.750 MHz	39.585 MHz	28.990 MHz
17	27.165 MHz	37.800 MHz	39.635 MHz	29.000 MHz
18	27.175 MHz	37.800 MHz	39.635 MHz	29.010 MHz
19	27.185 MHz	37.800 MHz	39.635 MHz	29.020 MHz
20	27.205 MHz	37.800 MHz	39.635 MHz	29.040 MHz
21	27.215 MHz	37.850 MHz	39.685 MHz	29.050 MHz
22	27.225 MHz	37.850 MHz	39.685 MHz	29.060 MHz
blank				
23	27.255 MHz	37.850 MHz	39.685 MHz	29.020 MHz

Table 2. AM band plan.

MHz. At least two manufacturers (Standard and Bristol) have adopted the plan and presently market 40-channel 10 meter rigs.

A coordinated band plan offers many exciting possibilities for the channelized rigs. For example, moving mobile operation could be greatly simplified by designating certain channels as calling channels, similar to marine VHF operation. Once contact is made, the participants could move to another channel to carry on the QSO. Beacon stations would indicate when and to where the band is open.

Crystal Selection

Your choice of crystal frequency will depend on your band plan and the crystal lineup in your rig. Most rigs follow a 6-4-4 arrangement where the deck of six crystals serves as the master oscillator. For some sideband rigs, it is possible to retain both upper and lower sideband capability by changing only four crystals, while others require changing six crystals (it is assumed here that you are converting for a full 23-channel capability). Your *Photofacts* will indicate what crystal frequencies are used and how they are mixed to obtain the channel frequencies.

Once you have selected which crystals you wish to change and the frequencies of the new crystals, the problem of figuring the crystal formula arises (load capacitance, parallel/series resonant, fundamental or overtone mode, etc.). Here is where it is wise to choose an established crystal company for your supplier. Most of these keep an up-to-date file on amateur, CB, and commercial equipment using crystals, and can really help you here. I have dealt with Sentry (800-654-8850) in Chickasha, Oklahoma, and have found them to be both helpful and friendly. Their crystals work and the prices are reasonable.

By-the-Numbers Conversion

The following describes a step-by-step approach for converting some example CB rigs, using the bare bones of test equipment. It is the technique I now use and it works!

SBE "Sidebander III" — This is the first rig I converted and the one that is going to win me WAS. The rig uses two synthesizer oscillators, one switching six crystals in the 11.7-MHz range and one switching four crystals in the 7.4-MHz range. Since this rig retains both upper and lower sideband capability whichever synthesizer frequency is changed, the obvious choice is the 7.4-MHz oscillator. Since I wished channel 1 on the converted rig to be 28.510 MHz, and CB channel 1 is 26.965 MHz, it was necessary to raise each crystal frequency in the 7.4-MHz oscillator by exactly 28.510 minus 26.965 MHz or 1.545 MHz. The crystals were ordered, and, on receipt, the conversion was performed using the following step-by-step procedure:

Step 1: Remove cover from the rig and connect to 12-volt power supply.

Step 2: Plug in microphone (necessary for this rig to receive), and attach piece of wire to center terminal of antenna connector.

Step 3: Preset all controls as follows:
channel switch to channel 1;
noise limiter switch off;
squelch control fully counterclockwise (squelch open);
CB/PA switch to CB;
rf gain control fully clockwise (max gain);
on/off volume control on and fully clockwise;
USB/LSB switch in USB;
clarifier control — any position.

Step 4: Apply power (you will hear noise and possibly CB signals coming over speaker).

Step 5: Remove 7.4665-MHz crystal and replace with 9.0115-MHz crystal. See Fig. 1. Noise over speaker will greatly diminish with this operation.

Step 6: Using appropriate alignment tools, tune T5 and T6 (synthesizer mixer), T7 (USB buffer), and T1 and T2 (receiver rf amp) for maximum noise level over speaker (this completes all necessary alignment to receive 10 meters on upper sideband).

Step 7: Switch USB/LSB switch to LSB and tune T8 and T9 (LSB mixer) and T10 (LSB buffer) for maximum noise level over speaker (this completes the receiver alignment).

Step 8: Remove piece of wire from antenna connector, connect power meter to antenna connector, and dummy load to power meter (don't use antenna as load as this creates unnecessary QRM on 10 meter band while you are tuning up the transmitter).

Step 9: Depress microphone button, and, while whistling into the microphone at as steady a level as possible, tune T14, T15, T16, L4, L3, L2, and L1 for maximum indicated power output (this rig operates sideband only, and it must

be modulated to obtain any power output).

Step 10: Replace the remaining 37-MHz crystals with their 10 meter counterparts, set the channel switch to channel 13, and repeat steps 2 through 9 (this "centers" the alignment over the band span of the rig).

Step 11: Button up the rig; it is ready to go on the air!

Pace 123A—This is an AM rig I converted to operate with 28.8 MHz as channel 1, resulting in the band plan listed in Table 2. The rig uses a master synthesizer oscillator that switches six crystals in the 37.8-MHz range. I purchased replacement crystals having frequencies 28.8 minus 26.965 MHz, or 1.835 MHz higher than their counterparts. The steps for this conversion were as follows:

Step 1: Remove cover from the rig and connect to 12-volt power supply.

Step 2: Attach piece of wire to center terminal of antenna connector (the rig will receive without the microphone being plugged in).

Step 3: Preset all controls as follows:
channel switch to channel 1;
LCL/DIST switch to DIST;
squelch control fully counterclockwise (squelch open);
CB/PA switch to CB;
on/off volume control on and fully clockwise.

Step 4: Apply power (you will hear noise and possibly CB signals coming over speaker).

Step 5: Remove 37.600-MHz crystal and replace with 39.435-MHz crystal. See Fig. 2. Noise over speaker will greatly diminish with this operation.

Step 6: Using appropriate alignment tools, tune L3 (synthesizer oscillator) and L1 and L2 (receiver rf amp) for maximum noise level over speaker (this completes all necessary alignment to receive 10 meters).

Step 7: Remove piece of wire from antenna connector, connect power meter to antenna connector, dummy load to power meter, and plug in microphone.

Step 8: Depress microphone button and carefully tune L4, L5, and L6 (transmit mixer), and L7, L8, L9, L10, and L11 for maximum indicated power output. (The tuning of L4 through L6 is a bit tricky since you will have little or no output power to go by until these three are in tune. Turn the cores in a little at a time until an indication is obtained. If you have a VTVM or scope, observing the transmit buffer emitter voltage at TP5 makes things easier. The emitter voltage rises as you approach proper tuning.)

Step 9: Replace the remaining 7-MHz crystals with their 10 meter counterparts, set the channel switch to channel 13, and repeat steps 2 through 8 (again, to "center" the rig alignment).

Step 10: Button up the rig; it is ready to go on the air!

The Pace 113 uses a board identical to the Pace 123A, and the conversion procedure is therefore identical. I have used this approach with each rig I have converted, and, if done carefully, the final result is as good as if done with a laboratory full of instruments.

In closing, 10 meter band openings are becoming more and more frequent and lasting longer and longer each time. The converted CB rig gives you an easy in to QRP operation and a dandy mobile rig that is easy to operate. ■

✓ Reader Service—see page 227

FCC

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MAKING SPECIAL CALL SIGNS AVAILABLE TO STATIONS LICENSEE TO AMATEUR EXTRA CLASS OPERATORS

AGENCY: Federal Communications Commission.

ACTION: Second Report and Order.

SUMMARY: The Commission is terminating its proposal to allow Amateur Extra Class licensees to request certain types of specific call signs.

EFFECTIVE DATE: Nonapplicable.

ADDRESSES: Federal Communications Commission, Washington, D.C. 20554.

FOR FURTHER INFORMATION:

Contact Mr. Joseph Johnson, FCC 1919 "M" Street NW., Washington, D.C. 20554, 202-632-7175.

SUPPLEMENTARY INFORMATION: See attached document.

In the matter of amendment of part 97 to make special call signs available to stations licensed to Amateur Extra Class operators. (Docket 20092; See 41 FR 17734).

Adopted: October 19, 1976.
Released: October 26, 1978.
By the Commission:

1. A Notice of Proposed Rule Making in the above captioned matter was released on July 2, 1974. In that Notice, the Commission proposed to amend Part 97 of the rules to permit Amateur Extra Class licensees to request any available specific unassigned call signs for their primary and/or secondary stations. It was also proposed to discontinue the availability of "in memoriam" call signs, i.e., call signs requested by Amateur club stations for the purpose of honoring a deceased member.

2. On April 22, 1976 the Commission adopted a First Report and Order in this proceeding which adopted in part the proposals made in the Notice. Specifically, Amateur Extra Class licensees were permitted to request specific "two-letter" all signs, (call signs consisting of a single or double letter prefix, a digit, and a two letter suffix); action was deferred on permitting licensees to request specific "three-letter" call signs, (call signs consisting of a single or double letter prefix, a degit, and a three letter suffix). On March 11, 1977, the Commission released a Notice of Proposed Rule Making in Docket 21135 which, among other things, proposed to delete from the rules the provisions adopted under Docket 20092 which permitted Amateur Extra Class licensees to obtain specific call signs of their choice. On February 23, 1978, a First Report and Order in Docket 21135 was released which adopted this proposal. This action was taken because of the additional workload imposed by the call sign program. In amending its rules, the Commission provided that, henceforth, all call signs would be assigned systematically, with the details of the system to be announced.

3. In light of our experience with the call sign provisions adopted under Docket 20092, we see not further usefulness in continuing that proceeding. Therefore, It is ordered that Docket 20092 is terminated effective immediately.

FEDERAL COMMUNICATIONS COMMISSION,
WILLIAM J. TRICARCIO,
Secretary.

CARF

Canadian Amateur Radio Federation, Inc.

from page 12

Ince of Alberta, Dome Petroleum Limited, the Amateur Radio League of Alberta, and the Canadian Imperial Bank of Commerce, for their financial assistance and support.

GRS HAS SYMPOSIUM, TOO

For some of the DOC headquarters people attending the amateur symposium, it was the second weekend in a row devoted to radio users. At a National GRS Symposium held in Ottawa on September 21, the DOC unveiled a plan for 100 new GRS ("CB") channels in the 900 MHz area. In a speech for the Minister of Communications, (parliamentary assistant) Crawford Douglas of the DOC forecast that the GRS would evolve into a sophisticated technology which could be integrated with telephone and computer systems. Good news for amateurs was the fact that Dr. John deMercado, head of the Regulatory Service, stated, in answer to the GRS complaint that they were often blamed for TVI in poorly designed sets, that the first well-shielded sets would be on the market next year. This move would be of little significance in solving the problem for the GRS and amateurs for 4 or 5 years.

Better news still was the fact that in Mr. Douglas's speech, when reference was made to the fact that the DOC was considering 900 MHz for the GRS, there was no reference to the use of the 220 MHz band for this purpose. CARF sources in the U.S. forecast that an October 12th meeting of the FCC would also kill the idea of 220 MHz for the CB.

OSCAR Orbits

The listed data tells you the time and place that OSCAR 7 and OSCAR 8 cross the equator in an ascending orbit for the first time each day. To calculate successive OSCAR 7 orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the day's first ascending (northbound) equatorial crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world from you, it will descend over you. To find the equatorial descending longitude, subtract 166° from the ascending longitude. To find the time OSCAR 7 passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR 7 when it is within 45 degrees of you. The easiest way to determine if OSCAR is above the horizon (and thus within range) at your location is to take a globe and draw a circle with a radius of 2450 miles (4000 kilometers) from your QTH. If OSCAR passes above that circle, you should be able to hear it. If it passes right overhead, you should hear it for about 24 minutes total. OSCAR 7 will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15° east or west of you, add another minute; at 30°, three minutes; at 45°, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

OSCAR 8 calculations are similar to those for OSCAR 7, with some important exceptions. Instead of making 13 orbits each day, OSCAR 8 makes 14 orbits during each 24-hour period. The orbital period of OSCAR 8 is therefore somewhat shorter: 103 minutes.

To calculate successive OSCAR 8 orbits, make a list of the first orbit number (from the OSCAR 8 chart) and the next thirteen orbits for that day. List the time of the first orbit. Each successive orbit is then 103 minutes later. Due to incorrect tracking information obtained during the early days of OSCAR 8, the equator crossing times contained in most published charts are in error. To correct this error, multiply the orbit number by 0.00205 minutes and add the result to the equator crossing time as printed in the chart. For example, the published time for orbit number 3352, the first equatorial crossing on November 1, 1978, is 0018:50 UTC. Thus, for orbit number 3352, the corrected equatorial crossing time would be:

$$\text{Corrected time} = 0018{:}50 + (3352 \times 0.00205 \text{ minutes})$$
$$= 0018{:}50 + (6.8716 \text{ minutes})$$
$$= 0025{:}42.3$$

The longitude figures contained in the OSCAR 8 chart are virtually unaffected by this tracking error. The chart gives the longitude of the day's first ascending equatorial crossing. Add 26° for each succeeding orbit. To find the time OSCAR 8 passes the North Pole, add 26 minutes to the time it crosses the equator. OSCAR 8 will cross the imaginary San Francisco-to-Norfolk line about 11 minutes after crossing the equator. Mode A: 145.85-.95 MHz uplink, 29.4-29.50 MHz downlink, beacon at 29.40 MHz. Mode J: 145.90-146.00 MHz uplink, 435.20-435.10 MHz downlink, beacon at 435.090 MHz.

Oscar 7 Orbital Information

Orbit	Date (Jan)	Time (GMT)	Longitude of Eq. Crossing °W
18884Q	1	0121:40	81.2
18896	2	0021:00	66.1
18909X	3	0115:17	79.7
18921	4	0014:38	64.5
18934	5	0108:55	78.1
18946	6	0008:15	62.9
18959	7	0102:32	76.5
18971Q	8	0001:52	61.4
18984	9	0056:09	75.0
18997X	10	0150:26	88.6
19009	11	0049:47	73.4
19022	12	0144:04	87.0
19034	13	0043:24	71.8
19047	14	0137:41	85.4
19059Q	15	0037:01	70.3
19072	16	0131:18	83.9
19084X	17	0030:39	68.7
19097	18	0124:56	82.3
19109	19	0024:16	67.2
19122	20	0118:33	80.7
19134	21	0017:53	65.6
19147Q	22	0112:10	79.2
19159	23	0011:31	64.0
19172X	24	0105:48	77.6
19184	25	0005:08	62.5
19197	26	0059:25	76.1
19210	27	0153:42	89.6
19222	28	0053:02	74.5
19235Q	29	0147:19	88.1
19247	30	0046:39	72.9
19260X	31	0140:56	86.5

Oscar 8 Orbital Information

Orbit	Date (Jan)	Time (GMT)	Longitude of Eq. Crossing °W
4203A	1	0034:53	50.9
4217A	2	0040:05	52.2
4231X	3	0045:18	53.5
4245A	4	0050:31	54.9
4259A	5	0055:43	56.2
4273J	6	0100:56	57.5
4287J	7	0106:09	58.8
4301A	8	0111:21	60.1
4315A	9	0116:34	61.4
4329X	10	0121:46	62.8
4343A	11	0126:59	64.1
4357A	12	0132:12	65.4
4371J	13	0137:24	66.7
4385J	14	0142:37	68.0
4398A	15	0004:35	43.5
4212A	16	0009:48	44.9
4426X	17	0015:00	46.2
4440A	18	0020:13	47.5
4454A	19	0025:25	48.8
4468J	20	0030:38	50.1
4482J	21	0035:50	51.4
4496A	22	0041:03	52.7
4510A	23	0046:15	54.1
4524X	24	0051:27	55.4
4538A	25	0056:40	56.7
4552A	26	0101:52	58.0
4566J	27	0107:05	59.3
4580J	28	0112:17	60.6
4594A	29	0117:29	62.0
4608A	30	0122:42	63.3
4622A	31	0127:54	64.6

Electronics Education by Mail Order

—successful student reports

A trade school extension course may be your ticket to a ticket.

R.S. Isenson N6UE
4168 Glenview Drive
Santa Maria CA 93454

Have you ever wondered, while reading the advertising for electronics courses, what it would be like to take one? In common, the schools, institutes, or whatever they call themselves, emphasize the "goodies" that come with the course: 25-inch color TV sets, quadraphonic stereos, digital computers, various types of mouth-watering test equipment, and even transceivers. It's almost a case of, "If you can name it, someone offers it!" Sometimes the promises sound almost too good to be true, yet you sort of feel that most, if not all, of the heavily advertised correspondence schools must have fairly decent integrity. They must, in one way or another, meet their advertising claims or the post office would grab at them like an alligator on a short-squelch-tailed repeater going after a windbag.

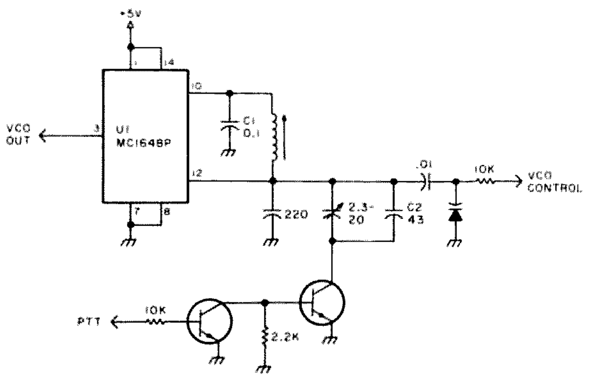

Fig. 1. Voltage-controlled oscillator.

From the advertising, it's obvious that some of the schools offer Heathkits as the hardware inducements. Others claim to offer kits of their own design. If it's the former, the Heath catalog spells out the specifications for the would-be student. If it isn't, it could be pretty tough to assess the hardware unless someone else who's taken the course broadcasts his experience. The latter is what this article is all about: my experiences with and impressions of one of the correspondence courses, and my personal, nonprofessional assessment of the "main goody," the CONAR 452 2 meter transceiver.

Late in 1976, NRI (The National Radio Institute, Washington, DC) announced a new communications/electronics course that held out, for me, a double appeal. First, their advertising promised that, if one pursued the course to its conclusion, he would be able to pass the FCC Commercial First Class Radio/Telephone examination, or his money would be refunded. Second, the pièce de résistance of the home study course was a digital, phase-locked-loop, synthesized 2 meter transceiver.

Having a requirement, at that time, for a Commercial First Class ticket, and knowing full well that I needed some motivation—like a significant financial commitment—to keep my nose in the books, the NRI course made a lot of sense. The fact that my 2 meter FM capability consisted of a clobbered together,

many-times-recycled VHF Engineering transmitter strip, and a salvaged Pace HF/VHF scanner, didn't make the synthesized rig any less appealing. So I signed the contract form, letting myself in for a reasonably solid educational experience as well as a lot of aggravation and a bit of exasperation. Ye who seek the first and would avoid the latter, read on!

NRI advertises that the student sets his own pace. The hard rock truth is that this isn't necessarily so, particularly if, as in my case, the student plans to get through the course in less than six months. Perhaps a 12 to 18 month schedule is more in keeping with the Institute's gearing. That impedance mismatch accounted for a considerable part of my unhappiness, but far from all of it. The real heartburn was caused by the very much delayed delivery of significant parts of the 2 meter transceiver.

NRI, and probably every one of the other correspondence schools, sends kit hardware to the students in subassembly portions. The student assembles the hardware in that packet, conducts some prescribed experiments on or with it, mails to the school the answers to some questions pertaining to the experiments, and waits for the school to make the next move. Receipt by the school of the set of answers supposedly triggers the next shipment. Three "training kits" contain the hardware for the CONAR 2 meter transceiver. Five months transpired between the time that I mailed the answers to questions on the first kit and I received the third kit; five months, a number of protesting letters, and a couple of cross-country telephone calls spells "exasperation" to me.

I learned, after receiving the third kit, that the fault wasn't all NRI's. The Institute had been caught up in the April 15, 1977, "Purity of Emission" FCC regulation change (Part 97.73). NRI had to rework the final and output filter to meet the 60 dB spurious emission limit in order to get FCC type approval. Had the Institute only said something about their problems when I first started complaining, some aggravation could have been avoided. If there's a lesson to be learned from all of this, I guess it's threefold: Don't try to get through an extension course in a hurry, don't be in a hurry to sign up for a newly offered course, and don't expect a correspondence school to be sensitive to student personnel problems.

Photo A. CONAR 452 2 meter synthesized transceiver. CONAR 380 power supply.

The academic program was found to be reasonably comprehensive, touching on almost every significant facet of communications/electronics. The proclaimed objective of the course is preparation for the FCC Commercial First Class radiotelephone license. Therefore, it wasn't surprising to see primary attention focused on entertainment and commercial communications equipment rather than amateur gear. Similarly, concern with FCC regulations is for parts other than Part 97 (Amateur Radio Services). The technical level is trade school rather than university. That is, high school algebra is all one needs for the mathematical background.

The "Complete Communications/Electronics" course consists of 57 lessons, each including a short multiple-choice test, a set of 14 supplemental study guides, each with a pamphlet containing a number of FCC-type questions designed to prepare the student for the Commercial Class license, and ten hardware kits. The kits include a TVOM, a modern version of a breadboard with built-in power supplies and provisions for quickly setting up prototype circuits of discrete components or ICs, a 6- to 7-MHz digital frequency counter, a crude but practical antenna test facility, a regulated power supply, and the 2 meter transceiver.

The antenna range can be a useful addition to any ham shack.

After completing the NRI prescribed antenna modeling and tests, I used mine to try out scale models of various low-band antenna configurations, the full-size versions of which could be fitted into the backyard of the home QTH. That exercise resulted in the gaining of some interesting antenna insight, and the empirical design of a much improved (for me) 75 and 40 meter antenna system. But that's another story!

In short, except for the difficulty in attaining my desired time schedule, the course was interesting and fun. Anyone completing it should have no difficulty with the technical portion of any FCC commercial or amateur licensing exami-

nation. The ham need only brush up on the legal aspects of Part 97 and get his code speed up to go right through to an Extra Class ticket. So much for my impression of the academics. Now on to the CONAR 452 2 meter transceiver.

Photo A shows the rig along with the ac power supply furnished as part of the course. The transceiver isn't small. It measures 4" high × 8¼" wide × 11½" deep, as compared to, for example, the 2¾" × 8¼" × 9-7/8" of the Heathkit HW-2036A, and the latter is no pygmy. It weighs about one ounce less than the HW-2036A's 6.25 lbs. The front panel is fairly clean, with a seven-segment LED display for receiver frequency. Additional LED displays indicate transmitter offset status, phase-locked-loop status, and the 5-kHz increment. As a real boon for under-dash mounting, it has a front-panel-mounted speaker. Much of the size of the NRI rig is attributable to a design concept resulting in outstanding accessibility. This is one of the easiest pieces of electronic gear to work on that I've seen since germanium replaced the vacuum.

Photo B shows the transceiver with its top cover removed and with the receiver board extended. Each of the other four boards can be extended, one at a time, for test or alignment purposes. Front and rear panels (Photo C) swivel out on the assembly screws to afford access to components mounted on those panels.

The transmitter has a switch-selected high/low power option. As measured with a Thruline wattmeter to a matched dummy load, low rf power out was between 2.5 and 3 Watts across a selected 2-MHz portion of the 2 meter band. In the high-power position, the rf output varied between 19.5 and 20 Watts over the same 146-to 148 MHz portion of the band. On-the-air reports were good. The rig has a clean, natural sound.

For the receiver, a 0.5-microvolt signal was crudely measured to be the squelch threshold. A 4-microvolt signal into the antenna terminal resulted in absolutely full quieting. Numbers aside, the CONAR 452 offers an adequate receiver with acceptable sensitivity and selectivity. It has double conversion i-fs, 10.7-MHz and 455-kHz, with crystal filtering or control on each. It has, however, a couple of design weaknesses, the first of which took an embarrassing number of hours to identify and reduce.

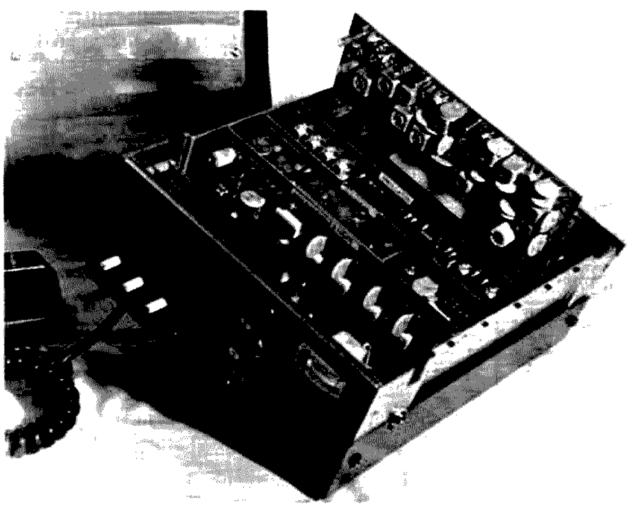

Photo B. CONAR 452 transceiver with top cover removed and receiver board extended.

Remember my comment about the clever layout that permitted the front and rear panels to be swung out for component accessibility? The design is great for maintenance, but it doesn't afford a very good electrical path between the end panels and the main chassis. NRI neglected the latter point. The volume control and squelch control potentiometers are both "grounded" to the front panel. The result, at least in my rig, was a ground loop that, in turn, furnished enough feedback to drive the LM380 audio amplifier into oscillation at the volume setting needed to override my "VW-type QRN." After much fumbling and groping, the problem was identified and reduced by adding a grounding strap from the front panel to the main chassis and running a separate wire from the bottom side of the two potentiometers to a clip fastener that was added to the audio board. The clip fastener was used to retain the flexibility of board removal.

The other audio problem results from the configuration of the top and bottom covers. These rather large, unsupported, flat metal surfaces find their resonant frequencies low in the audio band. At high volume settings, they tend to vibrate noisily! Some strips of electrician's rubber tape applied so as to provide pressure contacts between the top cover and the internal baffles of the housing (Photo B) help some, but don't eliminate the problem.

Assembly of the transceiver was straightforward. Most of the components mount on one or another of the five PC boards. The instruction manuals are very similar to those of Heath. A few errors were spotted, and there were a few examples of things being done the hard way. The kits were short a few components, though nothing significant—a couple common resistors and some discaps. I had all of the necessary replacements in the junk box. Comments on the discrepancies, textual and component, were sent to NRI, and the missing parts were received by return mail. The other comments may well have been reduced to errata notes. The parts shortages and assembly instruction errors are just part of the price one pays for being in a hurry to try a newly announced kit, I guess!

For some reason, NRI chose to use ½-Watt and larger resistors. This undoubtedly adds to the size and weight of the transceiver without offering any obvious compensation unless it's lowered parts cost.

A multiple component problem in the voltage controlled oscillator of the PLL synthesizer almost drove me up that proverbial wall! The digital, phase-locked-loop synthesizer is the well known, circa 1970, Motorola circuit. Finding it in a transceiver that supposedly was a 1976 design was a bit disappointing. In light of all the CMOS one- and two-chip synthesizers that have reached the market in the last few years, it's difficult to understand why NRI opted for the power-hungry, high-part-count TTL approach, unless it was the lower cost of TTL and its relative immunity to static discharge. The first indication of trouble was the observation that the MC1648 voltage-controlled oscillator had two modes of operation. At random, it would oscillate at nominally 24 MHz, where it should have, or at about 43 kHz. If power was

applied to the transceiver and the vco went into the low-frequency mode, it would remain there until something upset it, such as flicking power off and back on. Once I was aware of the phenomenon, it was easy enough to tell when the vco was in the wrong mode—the loop-unlock warning lamp would remain on! The precise frequency of oscillation in either mode could be varied by adjusting the tank coil (Fig. 1). This, of course, pointed to the chip as the part at fault. Additionally, in the desired 24-MHz mode, the oscillator was very unstable, drifting slowly up and down with peak frequency excursions sometimes exceeding 300 kHz. For all practical purposes, the set was inoperable.

Replacing the 14-pin DIP MC1648, a nasty job because it's soldered to the PC board, eliminated the low-frequency oscillation mode, but didn't affect the drift problem. The latter was finally reduced to a tolerable level by replacing, one by one, every frequency-determining component in the vco circuit. Replacing the 43-pF silver mica used to offset the vco in the receive mode (Fig. 1.) helped considerably, but not enough. The 43 pF is an odd value. I didn't have one, so I used the more common 47 pF. It worked fine.

Final stabilization of the vco required replacing a 0.1μF discap with a polystyrene capacitor of the same value. In the circuit diagram, it looks like a simple bypass capacitor, and why it should make a difference is anyone's guess. In fact, replacing it was a desperation move; everything else had already been tried!

There's much sentiment against using ICs for vcos. Describing the new 11C85 PLL synthesizer in the November-December, 1977, issue of Fairchild's *Journal of Semiconductor Progress*, Eric Breeze said, "After considering the stringent vco requirements . . . it was concluded that discrete components offer more flexibility and better performance than anything that could be built on a chip." After hours and hours of fighting that vco stability problem, I can only say, "Hear! Hear!" As long as the MC1648 was involved, there was no way that I could visualize the full role played by that discap or the possibilities of its interactions. I suspect that this circuit will cause NRI considerable heartburn!

The TTL phase-locked-loop synthesizer and the LED readouts are significant contributors to the power appetite of this transceiver. In the receive mode, it takes about 1.5 Amps at 13 V. In the transmit mode, I measured about 2.5 Amps drawn in the low-power mode and about 5 Amps in the high-power mode.

In my judgment, another questionable choice of components was the T-R relay (Photo C). The relay is open framed and is mounted at the rear of the unit between the louvers in the top and bottom covers. Every time the PTT switch is closed, a field is created around that relay. Particularly in the dusty vehicular environment for which this type of rig is intended, that field will attract an oil and dirt film to the contact points. The relay should be replaced with an enclosed type. Hopefully, NRI will see fit to offer a more suitable, compatible replacement. I'll be pleased to pay a reasonable price for one.

On the positive side, in addition to the excellent mechanical layout, NRI has built in several nice features. Recall that 6- to 7-MHz digital-frequency counter? Bet you wondered what good that could be for aligning a 2 meter rig, didn't you? Well, by cleverly making use of the decade-dividing circuit that's part of the 10-MHz reference-frequency oscillator, NRI divides the receiver and transmitter simplex and offset frequencies from their 23- to 24-MHz range down to a figure that's 1/10th of that. The latter is easily handled by the little counter.

Photo C. Top cover removed to show swing-out panels and T-R relay.

Rf and i-f alignment are accomplished by using an already-present, harmonic-rich, 1-MHz TTL square wave as a signal source. It's a clever concept and permits a surprisingly good alignment. I double checked with a fairly elegant sweep generator and a wideband scope. Improvement in performance, if any, resulting from the more elaborate alignment technique, wasn't obvious.

The synthesizer is supposed to cover 400 channels, that is, any 2 MHz of the 4-MHz band in 5-kHz increments. Actually, it retains lock through almost 3 MHz of the 4. This may change as components age.

The power supply shown in Photo A has a variable voltage output—5 volts to about 15 volts. NRI rates it a 4-Amp steady load to 6 Amps with a 50% duty cycle. The heart of the power supply is the relatively new Fairchild 78GKC 4-lead TO3. Fairchild rates the device at 5 Amps. The supply is very well regulated and should be a welcome addition to any bench, as well as serve as an ac supply for the transceiver when it's in the shack.

I understand that the transceiver and the power supply are available from NRI in kit form, independent of the entire communications/electronics course. It's quite clear that the design engineers on the CONAR 452 transceiver were very cost-conscious. If NRI passes these savings along to the kit buyer, this 2 meter rig could be a very good buy.

Some weaknesses have been identified, but the fixes were described. Having debugged the transceiver, it's going to be a very adequate mobile rig, and I'll stack up its performance against anyone else's rig. That's about all I can say for it.

Finally, I didn't get a chance to test NRI's money-back guarantee. I got my First Class Commercial radiotelephone ticket, with radar endorsement, on the first try! ■

Social Events

from page 73

LAPORTE IN
FEB 25

The LaPorte Amateur Radio Club will hold its winter hamfest on Sunday, February 25, 1979, at the LaPorte Civic Auditorium, LaPorte, Indiana. There is a $1.00 table charge. Donation is $2.00 at the gate. Talk-in on .01/.61 and .52. For more information, contact LARC, Box 30, LaPorte IN 46350.

AKRON OH
FEB 25

The Cuyahoga Falls Amateur Radio Club will hold its annual electronic equipment auction and flea market on Sunday, February 25, 1979, at North High School, Akron, Ohio, from 9:00 am to 4:00 pm. Tickets are $2.00. You may bring you own tables, and there will be some available for $2.00 each. There will be refreshments, prizes, and a grand prize of a Triton IV. There is easy access to the high school on the Tallmadge Avenue off-ramp and the North Expressway (Rt. 8). Talk-in on 146.52 and 146.04/.64. For details, write CFARC, PO Box 6, Cuyahoga Falls OH 44222, or phone Bill Sovinsky K8JSL at (216)-923-3830.

DAVENPORT IA
FEB 25

The Davenport Radio Amateur Club will hold its hamfest on February 25, 1979, at the Masonic Temple in Davenport, Iowa. Admission is $2.00 in advance, $2.50 at the door. Refreshments and tables will be available. Talk-in on .28/.88 and .52. For further information, send an SASE to John S. Birmingham WB0QCC, 2022 Brown St., Davenport IA 52804.

LIVONIA MI
FEB 25

The Livonia Amateur Radio Club would like to announce that the 9th annual LARC Swap 'n Shop will be held on Sunday, February 25, 1979, from 8:00 am to 4:00 pm, at the new location of Churchill High School in Livonia MI. Tables, door prizes, refreshments, and free parking will be available. Talk-in on 146.52 simplex. Reserved table space of 12-foot minimum is available. For further information, send an SASE to Neil Coffin WA8GWL, c/o Livonia Amateur Radio Club, PO Box 2111, Livonia MI 48151.

VIENNA VA
FEB 25

The Vienna Wireless Society will hold its annual Winterfest on Sunday, February 25, 1979, at the Vienna Community Center, Vienna, Virginia. There will be tables, sales, prizes, food, and frostbite tailgating. Doors open at 6:30 am for vendors and 8:00 am for the general public. Admission is $3.00, including one prize ticket; $2.00 for an extra prize ticket and $1.00 for frostbite tailgaiting. Preteens with parents are free. Tables range from $2.00 to $5.00, depending on the quantity. Reservations close on February 15, 1979. For reservations, contact Carroll N. Guin, 7533 Oak Glen Court, Falls Church VA 22042. For information, contact the Vienna Wireless Society, PO Box 418, Vienna VA 22180.

VERO BEACH FL
MAR 17-18

The Treasure Coast Hamfest will be held on March 17-18, 1979, at the Vero Beach Community Center, Vero Beach, Florida. Activities will include prizes, drawings, and a QCWA luncheon. Admission is $3.00 per family. Talk-in on 146.13/.73, 146.52/.52, and 222.34/223.94. For information, write PO Box 3088, Vero Beach FL 32960.

WAUKEGAN IL
MAR 25

The Libertyville and Mundelein Amateur Radio Society will hold its second annual Lamarsfest on Sunday, March 25, 1979, at the J. M. Club, 708 Greenwood Ave., Waukegan, Illinois. Doors will open at 7:00 am. There will be plenty of free parking, door prizes, and a large indoor flea market for radio and electronic items. Tables will be available at $4.00 each. Advance tickets are $1.50; $2.00 at the gate, with children under 10 free. Hot lunch will be available and there will be plenty of commercial exhibits and demonstrations. Talk-in on 146.94. For further information, write LAMARS (include SASE, please) at 1226 Deer Trail Lane, Libertyville IL 60048, or call (312)-367-1599.

MUSKEGON MI
MAR 30-31

The Muskegon Area Amateur Radio Council is sponsoring the ARRL Great Lakes Division Convention and Hamfest at the Muskegon Community College in Muskegon, Michigan, on March 30-31, 1979. This event will feature manufacturers' exhibits, technical forums, and a large swap shop. Ample parking and dining facilities are available. Friday evening at the Muskegon Ramada Inn, there will be a "Ham Hospitality" with libation courtesy of the MAARC and a Wouf Hong initiation. For additional information, contact MAARC, PO Box 691, Muskegon MI 49443, or H. Riekels WA8GVK, (616)-722-1378/9.

UPPER HUTT NZ
JUNE 1-4

The 1979 Annual Conference of the New Zealand Association of Radio Transmitters will be held on June 1-4, 1979, at Upper Hutt, New Zealand. Visitors are welcome to attend this conference. For registration forms, contact the Secretary, 1979 Conference Committee, PO Box 40-212, Upper Hutt NZ.

LOUISVILLE KY
JUN 29-JUL 1

The Louisville Area Computer Club will hold its 4th annual Computerfest™ 1979 from June 29 through July 1, 1979, at the Bluegrass Convention Center, Louisville, Kentucky. Activities include a flea market, seminars, and exposition, as well as activities for the entire family. Seminar and exposition admission is $4.00. Pre-registered Ramada Inn guests ($29.00, single; $34.00, double) receive free admission. For advance mail information, write Computerfest '79, Louisville Area Computer Club, PO Box 70355, Louisville KY 40270, or phone Tom Eubank, Chairman, at (502)-895-1230.

GEORGETOWN IL
SEP 1-2

The 1979 Danville, Illinois, Area Hamfest will be held on September 1-2, 1979, at the Georgetown, Illinois, fairgrounds, located ten miles south of Danville on Illinois Rt. 1. Gates open at noon on Saturday for vendors to start setting up their displays. Gates open to the general public at 6:00 am Sunday. Facilities will consist of a large enclosed building 50 × 150 feet with electrical hookups available at no charge. Please bring your own tables and chairs and power cords. Outside space is also available at $2.00 per person gate charge. Overnight camping on the fairgrounds is available at $5.00 per vehicle. For information, contact Bob Wilson K9RBW, c/o Illiana Repeater Systems, Inc., PO Box "G", Catlin IL 61817.

Ham Help

I live close to an AM radio station and will be moving even closer to another one. I use an old army surplus receiver for shortwave and cannot use it at all when that station is on the air. Could anyone give me information on an article, or a copy of one, that would help me build a filter to filter out the broadcast station? Thank you very much.

Terry D. Wright WB8UPO
525 South Downing St.
Piqua OH 45356

I need a diagram or information on a "CHIBA" model CPF12 6-channel 2m hand-held transceiver with 16/76, 34/94, and 94 simplex built-in crystals.

Jung Y. Lem KB6BO
5222 Coringa Dr.
Los Angeles CA 90042

Does anyone have any information or a schematic on a Poly-Comm "B" 29-MHz transceiver? I will buy manual for above or pay for a copy. Thank you.

Peter J. St. Arnaud
PO Box 695
Lowell MA 01853

I need information about terminal antennas for satellite TV. Any info about suppliers for these kits would be greatly appreciated. Thanks.

Steve Hutchens
Rt. 1 Box 186C
Boonville NC 27011

I would like to add electronic switching to my TS-520S so that I might have full break-in on CW. If possible, I would like to leave the VOX circuit intact for SSB operation, but I would sacrifice that for the full break-in feature. I wonder if anyone has made this modification?

Dick Arnold WD8RZB
22901 Schafer
Mt. Clemens MI 48043

I have been working on my ticket and collecting equipment. I read where a Gonset Super 6, when used with a modified BC-453, makes a good receiver. I bought a Super 6 but now I need to know what voltages to hook up to the brown, red, orange, and white wires. I also need to know how to adjust the coils and trimmers. I will gladly reimburse mailing and duplicating expenses. Thank you.

Keith L. Brown
2537 Starling Rd.
Arnold MO 63010

73 Magazine *Staff*

Time-Domain Reflectometry

— to check out your transmission lines

This added dimension simplifies the location of an antenna system fault.

When the band seems dead or, worse yet, when the band sounds alright but you can't make contacts as usual, how often have you wondered about the condition of your antenna system? This is certainly one of the more frustrating feelings an amateur experiences, especially if parts of the antenna system are not visible from the operating position.

There are many methods that can be used to check an antenna system. A simple ohmmeter reading, especially if the ohmmeter used has good resolution in the low Ohms range, is useful for antenna systems which form a closed dc loop for measurement purposes.

The measurement of swr at the transmitter end of the transmission line remains one of the most basic and useful of measurements in the average situation, although there are circumstances where swr readings can be misleading. For instance, depending on the attenuation of the transmission line involved at a given frequency, the swr read at the transmitter end of a transmission line will be lower than that existing at the transmission line/antenna interface. Theoretically, the swr at the transmitter end could look perfect while there was no antenna connected to the other end of the transmission line. No practical situation would normally approach this condition, however.

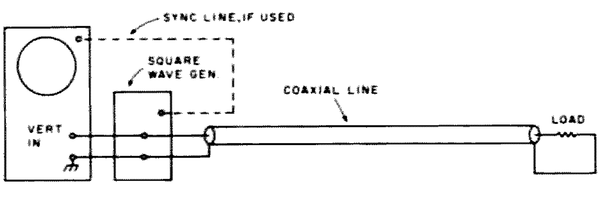

Fig. 1. Basic test setup for time-domain reflectometry. A fast-rise-time square-wave generator and a broadband oscilloscope are the basic test instruments needed.

Even if an swr reading indicates that something has changed in the antenna system, it does not give any information as to what might be at fault or where the fault might be located. "Time-domain reflectometry" is a rather impressive term for a transmission line measurement technique that can provide information on the nature and location of faults on a transmission line. In the commercial world, the equipment needed to make measurements using this technique can be sophisticated and expensive. The results can also be impressive — like being able to isolate a fault to a specific connector or almost down to the foot in an extensive cable TV distribution system.

The general improvement in quality of the test gear available even in the average ham shack, due to modern ICs, etc., makes the basic use of the technique interesting to explore for HF to VHF antenna system checks. Two basic items of test gear are necessary to implement the technique: a fast-rise-time square-wave generator and a broadband oscilloscope. (If a suitable square-wave generator is not available, a perfectly useful home-brew unit using only two ICs is described later.) The oscilloscope used should have a frequency response of 10 MHz or more, but some of the newer low-cost oscilloscopes which have a flat response to 5 MHz and a usable response up to several MHz more are also quite satisfactory for basic measurements (e.g., the Heath IO-4560 oscilloscope at $120). Older oscilloscopes with restricted frequency responses can also be used in many circumstances, but with varying results.

In simple terms, time-domain reflectometry works like a radar signal on a transmission line. The

square-wave generator sends out the necessary "pulse," and the scope is used to obtain a picture of the results. Problems on the transmission line or with the line termination will produce discontinuities on the oscilloscope display. The location of the problem is determined by knowing the speed at which the signal travels down the line and then noting where (time-wise on the horizontal sweep of the scope) a discontinuity occurs. With good equipment, one can calculate quite accurately the location of faults (opens, shorts, etc.) on the line, but this is not necessary in the average amateur installation. After having made a few good "signatures" of what the transmission line system looked like when it was known to be in good condition, and then comparing them to oscilloscope "signatures" when a problem occurs, one can be readily guided to the approximate location of a fault.

Fig. 1 shows the setup for measurement. The output of the square-wave generator is connected directly to the vertical input of the oscilloscope and to the coaxial line being tested. The connection should be as short as possible and preferably directly to the oscilloscope terminals. The square-wave generator to be described later can, in fact, be constructed compactly enough to fasten directly on the vertical input terminals of many oscilloscopes using binding posts or via a T-connector for oscilloscopes with a BNC- or UHF-type input connector.

It may seem a little difficult at first to understand why anything meaningful would be displayed on the oscilloscope with the square-wave generator output connected directly to the oscilloscope's input terminals. One may think the coaxial line just acts as a capacitor across the oscilloscope terminals. The key to the situation is to remember that the voltage step produced by the start of the square wave requires a finite time to travel down the coaxial line (the speed of light times the velocity factor of a specific cable). Therefore, the square-wave frequency used must be chosen taking into consideration the length of the coaxial line under test if a meaningful display is to be obtained. If the positive portion of the square wave lasts long enough timewise so that it is not completed before the length of time needed for the voltage step to travel down a given length of coaxial cable, any discontinuities in the line produce a reflection which travels back to the oscilloscope terminals. The reflected voltage adds or subtracts to the positive portion of the square wave which the oscilloscope is displaying and the pattern will change.

For instance, in Fig. 2(a), the coaxial line is terminated in a resistive load which matches the line. The square wave traveling down the line encounters no discontinuities, and so the oscilloscope display is essentially a square wave. In Fig. 2(b), the line is terminated in a load resistance which is less than the line impedance. The square wave, when it reaches the termination, is partly reflected back and, when it reaches the oscilloscope terminals, subtracts from the positive portion of the square wave the oscilloscope is trying to display. The display, therefore, is altered as shown. If the load resistance were higher than the line impedance, the reflected voltage would add to the displayed voltage.

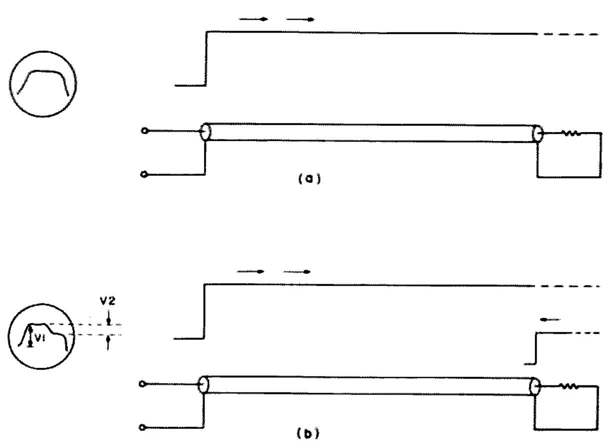

Fig. 2. The concept of a voltage step traveling down a line (a) and then part of that step being reflected back from an improperly matched load (b) is the basis for time-domain reflectometry.

The square-wave frequency used should be low enough to allow the reflection produced by a fault, even at the extreme end of the line, time enough to travel back to the oscilloscope terminals before the positive portion of the square wave is completed. On the other hand, the frequency shouldn't be lower than necessary or else resolution as to where a fault lies will be lost. One can calculate the optimum frequency for a given type of line, but it is rarely necessary to get so precise. Fig. 3 presents a rough guide as to the square-wave frequency one should use for given lengths of ordinary coaxial line.

If you have, or can borrow, two lengths of coaxial cable each at least 50 feet in length and the same impedance, I would suggest that the circuit of Fig. 1 be tried out. Use a resistor equal to the line impedance, and resistors lower and greater in value than the line impedance to terminate the line. Also, short and/or terminate the junction of the two sections of cable with various resistors.

Most amateurs do not believe the technique works until they try it out in this fashion. The idea of a reflection actually travel-

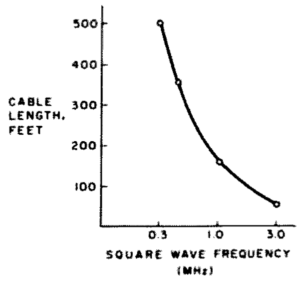

Fig. 3. This graph shows approximately what generator frequency to use when testing different lengths of line. Using a variable frequency generator, the generator frequency is actually adjusted for the best oscilloscope display.

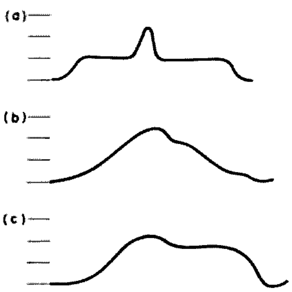

Fig. 4. These are some actual oscilloscope patterns obtained. (a) shows a line with a short circuit in the center of its run. (b) and (c) are discussed in the text and show the effect of an antenna fault.

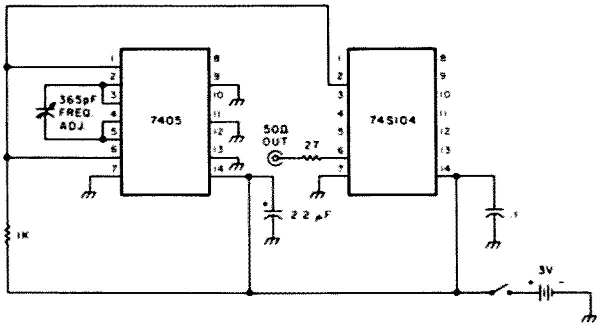

Fig. 6. Extremely simple square-wave generator has adjustable frequency output of 300 kHz to 3 MHz with a rise time of only a few nanoseconds. It is powered by two flashlight cells (C- or D-size) in series.

ing back up a line from a mismatched load is sometimes a difficult idea to grasp. The oscilloscope patterns one obtains depend upon the quality of the equipment used, but they should duplicate that of Fig. 2(a) for a properly-terminated line, that of Fig. 2(b) for a line terminated in a low-value load resistor, and that of Fig. 4(a) for a line terminated in its correct load resistance but with a short in the middle of the line. Obtaining an exact display is not so important as noting how sensitive the display is to changes in load terminations and to faults which take place at different places along the line.

If one can obtain a very sharp display, it will be noted that the display of Fig. 2(b) can be related to the load swr. V_2 is the reflected voltage amplitude and V_1 is the incident voltage amplitude. The swr is $(V_1 + V_2)/(V_1 - V_2)$. For instance, if V_1 is 2 volts and V_2 is 0.5 volts, the swr is 1.67. This type of display can be very useful for classroom situations where swr must be explained, and especially when you must make the point that terminating a transmission line in its characteristic impedance is important in most cases.

Applying the measurement technique to an actual antenna system produces more complex oscilloscope displays because of the reactances involved. But the technique can still be very useful if one is consistent with a test setup — that is, using the same length of test leads, square-wave frequency, amplitude, etc. One should obtain an oscilloscope "signature" of the antenna system as measured from the transmitter end when the antenna system is known to be in good order. If possible, a few faults should be simulated to see how the oscilloscope display changes. The actual faults, if they take place, will be relatively easy to identify. For instance, Fig. 4(a) shows the display obtained on a given antenna system when the transmission line was terminated in a dummy load but shorted in the center of its run. Fig. 4(b) shows the display of an antenna system using a multiband trap antenna but with two lengths of coaxial cable of the same impedance but different type (RG-58 and RG-8) hooked together to form a single transmission line. Fig. 4(c) shows the change in the display when one of the antenna loading coils was partially shorted to duplicate a fault in the antenna. The change in swr at the terminal end, as measured with a conventional swr meter, was barely noticeable in this case, although the oscilloscope display change was easily noticed. Again, it deserves some emphasis to note that the oscilloscope display obtained with any given antenna system will be unique depending on the system and the test equipment being used.

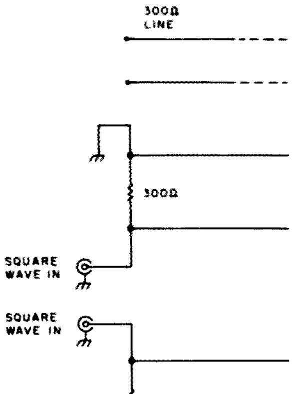

Fig. 5. Systems using a balanced line can be checked also. The line is terminated by a resistor as shown and then the square-wave signal applied alternatively to either side of the line. The balance of the line is also checked by this method.

For those amateurs who use a balanced transmission line/antenna system, the measurement technique described can still be used. For instance, if one uses a 300-Ohm transmission line system, the line is terminated at the transmitter end as shown in Fig. 5, and the square wave signal is alternatively applied to both sides of the line. Faults in the system will be displayed in the same manner as for a coaxial system when testing either side of the balanced line. The oscilloscope pattern obtained when testing either side of the balanced line should be the same if no faults are present and acts as a check on the true symmetry of the balanced system.

The purpose of the measurement technique described is to discover faults in an antenna system, either along the transmission line or in the transmission line termination — the antenna. One, therefore, has to start with a matched condition at the square-wave generator/coaxial line terminus, or else a confusing oscilloscope display will be obtained. Any sort of mismatch will cause a reflection in the system under test, and the reflection will bounce back and forth between mismatched or fault points in the system. Thus, if the square-wave generator/coaxial line end is not properly matched, a reflected voltage from a mismatched load will be reflected up the transmission line again once it meets the square-wave generator/coaxial line mismatch. Fortunately, this situation is easily prevented. The output of the square-wave generator being used, assuming its output impedance is at least several hundred Ohms, should be terminated in a resistor equal in value to the characteristic impedance of the line being tested (usually 50 or 70 Ohms).

If one does not have a suitable square-wave generator, the one shown in Fig. 6 is simple to build and very versatile. It utilizes a 7405 as an oscil-

lator and a 74S140 as an output/buffer. The square waves produced have the necessary fast rise time, and the 360 pF variable capacitor (a standard BC type) will allow varying the output frequency from about 300 kHz to 3 MHz. So a variety of transmission line lengths can be tested. The oscillator should be constructed in a metal enclosure and is simply powered by two 1.5 cells of either the C or D variety. The 27-Ohm series resistor from pin 6 of the 74S140 has already been chosen, in conjunction with the internal output impedance of the 74S140 section being used, to provide the correct terminating impedance for a 50-Ohm coaxial system. No further terminating resistor is necessary when the generator output is connected to an oscilloscope and a 50-Ohm coaxial line.

The use of a simple time-domain reflectometry setup to check an antenna system can prove to be of definite value, especially when swr readings give rise to doubt as to the condition of an antenna system. The usual swr meter reading is taken only at a definite point in the transmission line/antenna chain and it reflects conditions only at the point where the swr meter is inserted. Granted, the swr meter reading even at a fixed point in an antenna system is influenced by conditions throughout the antenna system. But there is no way to tell from the swr meter reading alone where a fault might have taken place in the total transmission line/antenna system. The oscilloscope display of the time-domain reflectometry method provides that extra dimension that makes locating a fault in an antenna system significantly easier. ■

W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

from page 110

the factory . . . and the factory is in Japan, so rots of ruck.

If you've priced shipping charges lately, you know another reason why there is much to be said for buying from you local dealer. Normally, the dealer picks up the charges from the factory to his place. If you buy from a dealer who has no service, you'll usually have to pick up the freight charges to and from the factory service department . . . and figure two weeks for shipping (at least).

The article suggested getting bids for ham gear and accepting the lowest bid. Some hams have been using the WATS line numbers for this already. There has been a growing number of cases in which some crafty people have set up as dealers, published a WATS number, and undercut everyone else on price. As Barnum said, there's a sucker born every day. These "dealers" seldom have much in stock, but they "can get it for you immediately." The manufacturers tend to fill orders from the better paying dealers first and, if anything is left over, fill the orders from these operators last. This means you can easily go several months waiting for delivery, while the dealer has your money.

Getting bids on ham gear will quickly put you in touch with dealers who are waiting for you with "bargains." The markup on ham gear is very small to start with, seldom running more than 25%. It takes all of this to run a store, prepay for equipment, carry out warranty service, etc. For every percent you manage to cut off that figure, you are laying yourself open to getting screwed. The lower the price, the more the chance that you are the one who is going to take the licking.

Sure, a dealer operating out of his cellar or garage, with no gear in stock, no employees, and no service, can sell very cheap. But you have to wait for the factory to honor his order for a drop shipment direct to you. This means you pay those shipping charges. It also usually means extended waits, no matter what the promises were on the phone.

The dealers were more than a little upset over a ham magazine promoting cutthroat selling, a practice that could quickly drive legitimate dealers out of the ham business. In the longer run, it could encourage manufacturers to start selling directly to the ham, a practice which at first has the seeming benefit of cutting out the middleman and bringing prices down. The fact is that every experiment with this form of selling has forced prices right back up because customer service gets to be an ogre and the need for local dealers becomes imperative.

In general, the rule is that the more discount you get, the longer you may have to wait and the more of an orphan you'll buy when it comes to problems. If you have infinite patience and are equipped with a good test lab and a lot of experience in working with the latest equipment, it may be worth your while to shave a few percentage points off the purchase price. Good luck.

AVUNCULAR ADVICE

Newcomers to amateur radio have a lot of catching up to do. Frankly, it takes years of forgetting most of what you read and much of what you hear to develop the learned ignorance of many old-timers. You can hear them pontificating on 75m long into the nights, often operating in groups and thus reinforcing their misinformation.

Well, the esoterics of radioteletype and slow scan television are still mysteries to the beginner, perhaps awed by his own bewilderment and the appearance of mastery by hams heard over the air. Take heart, pre-Novice, all is not as it seems. The buzzwords of amateur radio will soon be yours to cow family and friends, and your gradual understanding of electronics will be both a delight and a temptation to one-up CBers.

It is difficult, when surrounded by the delights of modern electronics, not to try to skimp on fundamentals. A partial understanding of some articles in *73* can give people false security, which can cause great harm later on when the lack of understanding of fundamentals assures that nothing is really thoroughly understood. You need a firm foundation in electricity, magnetism, motors and generators, etc.

One of the purposes of the Novice Class FCC exam is to encourage people to study basics. The FCC exam series is very well designed to carry the beginner right on through the steps of understanding which will make it possible to deal with more advanced technical concepts. The *73 Study Guides* have everything you need to know to start from scratch and work your way up to mastering electronics to the level where you should be able to pass a First Class Commercial FCC exam . . . and certainly have no trouble with the Amateur Extra exam, even with some of the very tricky questions the FCC throws at you.

Yes, the FCC resorts to tricks. I get a lot of complaints about this and some would-be amateurs get so angry about it that they want to take the FCC into court. Unfortunately, this is a losing battle, for the FCC has a whole bevy of staff lawyers, so the whole thing costs them nothing. Further, judges tend to be very wary of going against the government . . . that's where their promotions come from. The government generally has to really screw things up before they can lose a case. This means that you'll have to endure the warped minds which put together the ham exams and just figure that you'll have to allow a 10% margin for FCC bias.

The best response to FCC trickery is to come to their exams as over-prepared as you can. Be sure that you can pass the code test in a breeze, otherwise you may still be uptight when you get to the written part of the ritual and not be able to throw your full weight into it. If there is any code course even close to giving you the confidence of the *73* series, I'm honestly not aware of it . . . and if I were, you can be sure that I would make the *73* tapes even better.

On tape number four of the *73* Novice theory series, I discuss the questions on typical Novice exams. If anyone who has used these tapes has ever failed the exam, this has been kept a secret from me . . . and I would find it hard to believe in the face of the thousands of enthusiastic letters I've received from survivors.

Continued on page 190

High Seas Adventure — Ham Style

— part IV

W6YO's odyssey ends, as the *Yankee Trader* finally returns home.

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Jules Wenglare W6YO set sail aboard the *Yankee Trader* from Freeport, the Bahamas, on February 15, 1977, for a ten-month around-the-world cruise. His westerly circumnavigation of the globe, his search for adventure in strange and exotic ports of call, and his operation of amateur radio, both at sea and on land, were partly covered in the last three issues of *73*. Now, here in part IV you will venture with him during the final seven weeks of the most enjoyable and exciting trip anyone could ever experience.

In the tape recording Jules made after leaving Cape Town, South Africa, he said: "The seas are picking up here. We're kind of rolling a little. Let's see . . . the weather is overcast with the wind blowing whitecaps. The swells are five to ten feet high. They are good size, but we haven't had any rough weather yet. Can't do much about it. It's 1700 miles to St. Helena, around seven to ten days, one of our longer crossings . . ."

Jules was looking forward to meeting the ZD7 hams when he arrived. He hoped to obtain permission to operate amateur radio from the island.

The bands were very good at sea, and he made many contacts. He talked to Mac ZS1LK, whom he had met back in Cape Town, and Gordon ZS2MI, on Marion Island. Another QSO was with Bill ZD7SD and Sybil ZD7SS on St. Helena. He requested information about obtaining a license, and everything seemed favorable.

The *Trader* arrived at Jamestown, St. Helena, at 6:00 am, Saturday, October 29, and Bill ZD7SD, who was born on the island, came aboard to meet Jules. Later, they went ashore and headed downtown to a government office. Jules filled out some papers, and the governor's secretary asked him what call he would like to have. ZD7YO, of course. It took about a half hour, and the call was issued. The actual license was picked up later after having been signed by the governor of the island.

Jamestown is a very quaint and old rustic city with all the charm one would expect. Bill's home was located about 800 feet up the side of a mountain. "What a view," said Jules.

"You look out right over the ocean, back about a half mile, but at a fairly steep angle."

They hooked up Jules's equipment (along with Bill's rig) and set everything up for split frequency operation. The bands were checked but nothing was coming in, so they went for a sightseeing ride in the country. Jules said, "It was very beautiful—all lush and green here on the southern half of the island."

They later went back to the *Trader* and, for Bill, Jules got the fiberglass poles and spiders for the quad antenna I mentioned in part I which never got installed. They returned to Bill's home and got on the air. The first contact was with Rudy W3CXX at 1903 UT (7:00 pm local time). The fifth contact was with John W6UZ, back in good old Delano, Jules's hometown.

One of the contacts made was with Archie K4IBO, Miami, where Jules had stayed a couple of weeks before this world trip began. "It was really something," Jules commented, "to work Archie. First time since somewhere in the South Pacific. It was really a surprise."

Jules worked many friends, both on 15 and 20 meters. Most of the contacts were on SSB during the CQ DX contest—mostly split frequency, but some transceiver operation. At times, the bands didn't open up very well and no contacts were made. He did make close to 300 contacts as ZD7YO, with the final contact at 1613 UT the following day: a PY1. It was another successful ham operation from a country where he had less than 36 hours to visit.

One of the places he visited was what they call "Jacob's Ladder." He climbed to the top of this 699-step stairway that goes straight up from Jamestown on the side of a hill. It's really steep and was built years ago. The ladder is very famous, with cement steps about 10" high and a cast iron plate for railings and sides. "It's all bolted down to the solid rock hillside," Jules said, "at about a 45-degree angle."

Jules said it was quite a climb, but he and another *Trader* passenger went all the way to the top after a few rest stops. He said that the local boys slide down the rail. It was really a sight to see.

Bill took Jules to Napoleon's exile home. They went through the garden and the five or six room home and saw the room where Napoleon had died. A French flag flew inside the compound there on a British island. Jules said that this could be classified as a new country under the circumstances. The five-acre historical sight belongs to France exclusively, as a tribute to Napoleon.

Jules finally had to leave St. Helena, and Bill and Sybil bid him farewell at the dock as the air horns aboard the *Trader* sounded. Jules said, "It was another memorable stop. One of the rare islands of the world."

The day after leaving St. Helena, it was Halloween. Many of the passengers aboard the *Trader* dressed up in all sorts of attire. One young lady was dressed up as a "gas pump." She had a large paper bag with numbers painted on it slipped over her head, and carried a black hose around to simulate the hose and nozzle of the pump. Many unusual costumes were worn to celebrate Halloween.

The bands were pretty good about four days out to sea. Jules worked Dixie KG6JIO and Dave KØWIQ/DU2 (Clark AFB, the Philippines), and Father Denny P29CC even arranged for them to work ZD7SD for a new country. He had some tremendous signals coming in, with some good openings.

Remember the around-the-world yacht race I mentioned in part III? Well, Jules wrote another short piece about it for issue #10 of the *Trader Tales* newsletter.

"The *Yankee Trader* could have been taken as the 'mother ship' of the world's most elite bluewater racing yachts competing in the Whitbread Round-the-World while all were resting in Cape Town.

"The racers are sailing in an easterly circumnavigation, while we are cruising westerly. Our paths will 'cross' in the Atlantic, off the eastern tip of Brazil.

"The Traderites met the crew members of the sleek yachts while bending elbows at one of the finest yacht clubs in the world. This famous world yacht race started at Portsmouth, England, August 27, and

Photos by Jules Wenglare W6YO

Left to right: Bill ZD7SD and Sybil ZD7SS on St. Helena Island, with Jules W6YO. Jules operated here as ZD7YO for a short but successful DXpedition.

will end there sometime in April, Cape Town being the first of three stops. The second leg is expected to be the roughest, crossing the southern Indian Ocean to Auckland, New Zealand, in an area known as the 'Roaring Forties,' so close to the Antarctic that they may encounter icebergs. It is interesting to mention that their main communications are dependent on amateur radio 'ham' operators. Aboard the yacht *B and B Italia*, crew member Henry and his station I2NSX have been in contact with several hams—mainly with Gordon ZS2MI on lonely, isolated Marion Island, which South Africa staffs with a small group of weather professionals and one radio operator. This station will furnish the yachts vital wind directions and iceberg warnings.

"Gordon and Henry asked for my assistance in relaying weather and position reports at times when they could not copy each other (and I could) while we were heading to and away from St. Helena."

It was a pretty smooth crossing to Recife, a big seaport on the eastern tip of Brazil. Upon arrival, Jules called Fred PY7AZQ in Olinda, a nearby town, and made arrangements to meet him at the dock. Well, something happened and Fred didn't make it.

Sometime later, Jules took a bus to Olinda in hopes of finding him. No such luck; he couldn't find the house. On the way back to Recife by bus, he saw a ham antenna, got off the bus, and checked the house only to find that no one was there. He showed Fred's address to a cab driver, and about five minutes later the cab pulled up in front of Fred's home. The only one there was a babysitter, so Jules left a note for him and returned to Recife.

The following day, Fred, his wife, and daughter came to the ship and met Jules. They all took a taxi back to Fred's home for a visit. While there, Jim PY7BXC and Xavier PY7DA came over to meet him. He had a very enjoyable stay.

Jules was invited to a breakfast the following morning to celebrate a very special occasion. It was to do honor to Vic PY7AN, who was celebrating 40 years as an amateur radio operator.

Jules met Alex PY7PO when he was picked up at 5:30 am Saturday and taken to the special celebration. When they arrived, a large crowd had already assembled. "There were about 15 to 20 people there," Jules said. "One fellow was shooting off skyrockets. Boy, did they go off with a big bang way up high. There were 40 of these rockets. One for each year." Jules also mentioned that two buglers were playing to add a little extra color to an already happy event.

Jules saw Vic's ham room and setup. He had a number of awards and certificates on the wall. The antenna was rotated with a car steering wheel, as the turning shaft went straight up through the roof.

Another location visited was the local radio club, where Jules met a few more hams. The club had a nice station set up, with a large number of QSL cards on display. He said he was only there for about an hour.

One of the more interesting visits was at the home of Plinio PY7ACQ, a very active ham. "He went four times to Fernando de Noronha Island (PYØ), and made two trips to St. Peter and St. Paul's Rocks (PYØ). Just amazing. That evening he showed us 8 mm movies of them."

The films Jules saw showed the difficulty of getting on these rocks and setting up a ham DXpedition. He said it was a very good presentation. It was the first official ham operation from the rock islands (where they had to operate under pretty poor conditions). "It was an endurance check, that's for sure," commented Jules.

After a week of extensive activity in Recife, the *Trader* set sail at about 7:40 am on November 14. "I got on the air," mentioned Jules, "but there wasn't too much to work yet. I finally did have some contacts later that afternoon and evening. Even handled a few patches the first night out."

A couple of contacts were made with hams in Trinidad. He lined up some meetings for when he arrived. It's always nice to have talked by radio with someone you've never seen before and then meet him in person a few days later.

The seas were very smooth and calm almost all the way to Trinidad. Several of the passengers even saw a couple of extremely large killer whales. They came very close to the ship, and estimates were that they were over 30 feet in length. It was another acrobatic show at sea.

Remember those three novice students I mentioned Jules giving code practice to? Well, the birth of three new "ham" operators was reported by him.

Jules had Russell W4LAS in Virginia Beach send three tests to him in Recife. He picked them up at the post office and reported that Ted, George, and Roland passed their code test while crossing the Atlantic, and took their Novice FCC exam between Recife and Trinidad. Hopefully, all three received their ham tickets.

The *Trader* anchored in Trinidad late in the afternoon, quite some distance out in the harbor. On shore, Jules called Mike 9Y4UA, who works at the U.S. Embassy. He later went to the Embassy and met Mike and another ham from Caracas, but he doesn't remember his call. He also met Rusty 9Y4RH, whom he had talked to on the air.

"Mutiny on the Bounty" in 1789—and the resultant children of mutiny on Pitcairn Island—was fact. Ask Tom Christian VR6TC. Captain Bligh with the Bounty's breadfruit cargo never arrived in the West Indies. Captain Bligh and HMS Providence, *loaded with breadfruit plants, did—some fours years later, as the plaque and tree indicate, here on St. Vincent Island.*

Jules spent Thanksgiving Day on Trinidad, and talked amateur radio while enjoying lunch with Carl 9Y4OV and Rusty. Thanksgiving dinner was very well enjoyed aboard the *Trader*. It was a complete turkey dinner with all the trimmings.

About a half-hour drive from Port-of-Spain is the Omega Navigational Aid Station, which Jules visited. It is on 10.2 and 13.6 kHz. The antenna system is strung across the valley between two 1000-foot peaks.

From the left are Alex PY7PO, Jimmy PY7BXC, Plinio PY7ACQ, Vic PY7AN, and Jules W6YO. These are only four of the many hams Jules met during his visit to Recife, Brazil.

Jules said it is a reasonably nice transmitter setup, "coaxfed with large vacuum relays which switch the resonance of the antennas from one frequency to the other by a difference of 3.4 kHz. They have huge 20-foot diameter coils with motor-driven slugs to keep the antennas tuned. Stations like this are in Norway, Liberia, Hawaii, North Dakota, Reunion Island, Argentina, and Japan, in addition to this one on Trinidad."

The *Trader* set sail for St. George's Grenada Island on November 26. The following day, the ship arrived, having gone a distance of 103 miles.

On Grenada, Jules visited an old telegraph museum display. There was a tape show showing how telegraph messages were sent. He said, "There were two keys side by side, which were used to send the code. It was very interesting."

He met Leroy J3AI at a restaurant and then visited his home overlooking the harbor.

After a very short stop, the ship left for Carriacou, an island north of Grenada. While here, he said he ate an apple that had fallen from a tree. He only took a couple of bites, and soon after, his mouth and throat began to burn. Someone told him later that the apple was poisonous. This toxic apple has been known to be fatal to small children.

His throat was really burning by the time he got back to the ship. "It felt like I had drunk Tabasco sauce," Jules commented. It was about three days before his throat got back to normal.

The trip from Hillsboro, Carriacou, to Kingstown, St. Vincent Island, was made in about six hours. While sailing there, an event took place which many people would like to accomplish: The *Trader*, along with her passengers, crossed their outboard course at 0430 hours on November 30, 1977, and had now circumnavigated the globe—a sail of 29,346 miles in a little over nine months.

While on St. Vincent, Jules met and went to the home of Bill VP2SQ. His radio shack is built on top of his home. While checking his log, Jules found that Bill had just recently worked Frank W6KPC on 15 meters, as well as several other hams Jules knew personally. He said that Bill also worked 2 meters and on occasion gets into Trinidad, over 100 miles away.

It was in the year 1787 that *HMS Bounty* left England bound for Tahiti to collect and transport breadfruit plants to the West Indies. It is history that there was continued abuse and almost brutal treatment of the crew by Capt. William Bligh.

Some 16 months later, on the morning of April 28, 1789, with the *Bounty* laden with over a thousand breadfruit plants, the 23-year-old Master's Mate, Fletcher Christian, and a number of the crew mutinied against Capt. Bligh. Bligh and eighteen loyal seamen were cast adrift in an open boat and managed to sail that overladen craft 3,618 miles over almost uncharted waters, reaching the island of Timor in 41 days. Fletcher Christian and his fellow mutineers threw all the breadfruit plants overboard and sailed back to Tahiti.

Mr. Christian, along with eight other mutineers, six Tahitian men, and twelve Tahitian women, sailed the Pacific in search of a secure home. On January 15, 1790, they located and went ashore on uninhabited Pitcairn Island. This island, nearly two centuries later, is now the home of Thomas Coleman Christian VR6TC, great-great-great grandson of Fletcher Christian.

Captain Bligh eventually returned to England, and a few years later completed his task and transported breadfruit plants to the West Indies. Here on St. Vincent, Jules saw a breadfruit tree that grew from a shoot planted from an original plant brought there by Captain Bligh after the mutiny on the *Bounty*. There is a plaque in front of the tree telling of its origin.

Bill took Jules sightseeing all around the island. After a very enjoyable day together, Bill took Jules back to the dock and they bid farewell; the ship was scheduled to leave shortly.

The trip from St. Vincent to Dominica was made overnight. When Jules arrived, he met Austin VP2DAJ. Jules had talked to Austin some nine months earlier via amateur radio when the *Trader* was in this area at the beginning of its world cruise. Their eyeball QSO was short due to the fact that Jules was on the island only one day. Jules took in a few of the sights and went back to the ship.

On Friday morning, December 2, the *Trader* anchored in English Harbor, Antigua. After Jules went ashore, he saw some more of those small apples that had caused him so much misery. This time he only looked.

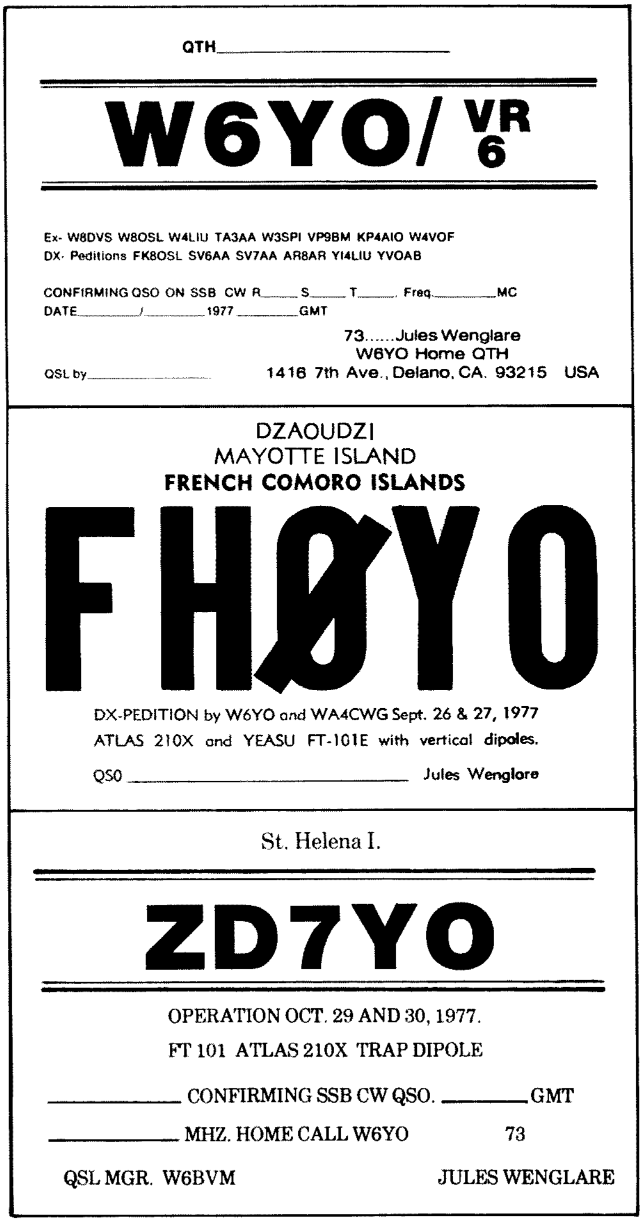
While walking around,

Jules saw a triband beam and inquired at the home. It was the residence of Jim VP2AB, who invited him in for a visit and a look at his ham room.

Jim later took Jules out of town about ten miles to see a high-powered shortwave broadcast station, a very modern up-to-date station only about a year old. Jules was given a tour of the station by Bob VP2AZB. He was there for about three hours.

The *Trader* left the island of Antigua about midnight, after a twelve-hour visit, and headed for St. Barthelemy Island (St. Bart's). The ship arrived shortly after Jules got off watch.

In the harbor was the *Polynesia*, a four-mast windjammer of Windjammer Cruises. This is one of the ships that takes one-week cruise tours into the West Indies.



Of the 53 stops Jules Wenglare W6YO and the Yankee Trader *made, three locations issued him a license to operate amateur radio. The first was on Pitcairn Island (VR6). The second was Mayotte Island (FHØYO), followed by St. Helena Island (ZD7YO). With these special calls, he made over 900 contacts, thanks to the countries and the officials who appreciate amateur radio and made it possible.*

Jules didn't do much here other than look around and take pictures. He said, "I just sat under a nice shady tree and admired the beach and everything about 150 to 200 feet down below. There was a group of boys and girls playing with a frisbee down on the half-mile-long beach. It was very peaceful up there . . . "

The ship left that afternoon and arrived at St. Martin Island that evening for a two-day stay. While walking in town, Jules saw what at first he thought was a rotary dipole. "It seemed funny with traps on it," Jules said. It turned out to be a triband antenna. The director and reflector had come off during a windstorm. He inquired at the home, but the ham wasn't in.

Jules said, "This was the first place I saw with big American cars. I saw more Cadillac and Lincoln taxis than I have anywhere in my life. Amazingly, they were all new ones!"

Jules mentioned that on these islands camera film is very expensive, about $10 for a roll of 110 or 35mm. So, if you happen to be making plans for a trip into this area, take along a good supply of film—or money.

Jules met Vince PJ7VL, who works at the weather station on St. Martin. He knows many of the hams Jules knows. They even had a chance to get on the air for a few stateside contacts on Vince's rig.

The following day, Jules had a cold, so he stayed aboard ship. There wasn't much else to see ashore, so he just relaxed a little.

The *Trader* left that evening, and the following day tied up to a buoy at Saba Island. With only a few hours there in port, Jules couldn't do much. A quick tour of the area and back to the ship. The next stop was the island of Tortola in the British Virgin Island group.

While at sea, Jules got on the air and talked to John 4S7JD in Sri Lanka, the ham he met back a few months ago. He also worked into ZL-land and talked to several old friends in California.

They finally arrived at Road Harbor, Tortola, on December 7. Jules took a cab into town, where he met Art VP2VJ, the radio inspector for the island. During their conversation, Jules asked, "Is it any trouble to get a license here?" Art said, "No, you want one now?" He said Art just started to fill out the papers for him. Jules was issued the call of VP2VEF.

Art told Jules that Bob Denniston WØDX, ex-ARRL president, now VP2VL, owns the Smuggler's Bay Inn here on the island. Art tried to get ahold of Bob by phone, but couldn't locate him. After Jules returned to the *Trader*, he had some visitors. Art had finally located Bob, and they came aboard for a visit.

Jules met Bob over 20 years ago and had even worked him on the air from Crete and many other places in years past. They all talked about DX and the old times during their visit in Jules's cabin.

When Jules got on the air as VP2VEF, the first contact was with Ed W7ZJ, a friend of his. Jules heard him on the air and gave him a call. He was told to "stand by." Ed was very surprised when he found out that it was actually Jules W6YO.

After the *Trader* stopped at one more island, St. Thomas Bay, Virgin Gorda, she left the area and headed for the Bahamas. Jules said, "On our way we crossed right over the Puer-

to Rican Trench, the deepest place in the Atlantic Ocean, nearly five and a half miles deep. As we passed the eastern reaches of the Grand Turks Islands, we had sailed 30,000 nautical miles.

"We were enjoying nice warm weather all along for months on end, it seemed. While listening to the radio news, we heard that the east coast was having blizzards and subfreezing temperatures. Then, on December 11, southeast of San Salvador, where Columbus made his first landfall and where we had hoped to visit for the second time, we were hit by a weather front that made us shiver. The storm that followed for two days kept things sliding off the tables at meal times and made walking difficult anywhere. For the second or third time on the trip, the ladies were missing their meals.

"Since leaving the Virgin Islands, it was great to make final contact with 4S7JD, VK4MW, ZS1ER, ZD7SD, 9Y4OV, and even Helen HC2HV, all of whom we had 'eyeballed' along the trip. Our contact with the ship's doctor's daughter, Jay WA2JBY, was achieved after many attempts and frustrations.

"We arrived in the busy port of Nassau on the morning of December 12. There were two large cruise ships in, and we were hardly noticed among the crowded shopping streets of a colorful city.

"Again, I mailed off over 20 copies of the *Trader Tales*, our monthly newspaper, to friends around the world and in the States.

"I did find a ham, Verne C6ANR, ex-VP7NR, who runs a nice men's clothing shop in town." The ship departed on the second day and headed for Freeport, the Bahamas, where, Jules said, "We arrived at 1400 zulu on the 14th of December, the place we departed 303 days ago . . ."

Jules said, "It was most gratifying to get all the weather data, phone patches, and just FB QSOs with so many hams around the world. The maritime mobile and other nets who give priority to sea-going hams certainly are a wonderful group of 'hams.' I've realized that this is the best system of communications for the smaller ships and yachtsmen.

"To get back to the U.S. mainland with all my gear, I was fortunate to have arranged over the air to sail back in a small luxury sloop of one of the passengers who only went as far as Singapore, but now was waiting in Freeport to pick up his many souvenirs and diving equipment left on the *Yankee Trader*.

"Three of us from the ship, with our belongings–one fellow had an 18-foot outrigger canoe from Tahiti–left at 4:00 am and hit strong head winds all the way to Bimini. We were constantly getting spray all over us up on the deck where we all took two-hour 'wheel watches.' After a needed rest in Bimini and some spearfishing for lobster and a good dinner, we set sail across for Miami, still going against strong winds and rough seas.

"It was great seeing the bright lights of Miami Beach reflecting on the horizon. We arrived practically at downtown Miami at 11:00 pm, where our skipper called the customs and immigration people, who came right over.

"I finally wound up packing close to 500 pounds of souvenirs, clothes, radio gear, and related stuff at the QTH of Bill WA4VOI, who was one of my main contacts around the world."

Jules shipped his belongings by truck back to California and caught a plane himself. He arrived at his home in Delano on the evening of December 23, 1977, and was warmly greeted by his wife, Lyla. Christmas came two days later.

Jules had planned on taking Lyla with him on this world cruise, but she decided that he would have more time for amateur radio activities if he went alone. They kept in contact with each other with phone patches provided for Jules by other hams. While he was gone, her sister came all the way from Australia and stayed with her for a very long vacation. Lyla is also from Australia.

I spent many hours with Jules going over the manuscripts for this article and selecting the many slides used for the photos to go with it. I only wish that every piece of information he gave me could have been used here in print, but unfortunately they all couldn't. I tried to hit the highlights at each stop and bring out the most interesting activities. I sincerely hope I did justice to such an extraordinary adventure.

I asked Jules a few questions about the trip which were not covered in any of the tapes. Here are part of the answers.

Of the 1,070 hours on Jules's transmitter's hour meter, he averaged 3½ hours each day while at sea. He spent 163 days in port (53 stops) and 139 days at sea. There were 3,600-plus QSOs, of which over 900 were made while on shore. He had over 125 "eyeball" QSOs with other hams on every continent of the world.

What location was the most enjoyable? "Cape Town, South Africa." He said the cleanest spot was the "Maldives." Of all the hams he met, the three that top the list were (and I'll put these in alphabetical order) Tom Christian VR6TC, Pitcairn Island; Father Dave Reddy CEØAE, Easter Island; and Bill Stevens ZD7SD, St. Helena Island.

Jules sailed 30,759 nautical miles aboard the *Yankee Trader*, a tough, rugged, and highly seaworthy vessel. The *Trader* was built in 1930 by the Spear Engineering Co., Norfolk, Virginia. It was originally commissioned by the U.S. Coast and Geodetic Survey as an oceanographic research vessel. Her original name was the *Hydrographer*. She has assisted in charting the world's major bodies of water, including the Arctic and Antarctic Oceans. During WWII, she served in the Pacific. When a new oceanographic research vessel was built in the mid-60s, she was renamed *Yankee Trader* and converted to become part of the Windjammer fleet.

Constructed of nickel iron, the *Trader* is considered to be an exceptionally strong, stable vessel. She has twin diesel electric engines generating 1500 hp each. She has a single screw (propeller), 11 feet in diameter. Her registered tonnage is 1180. Her cruising speed is a variable 10 knots, with a range of 18,000 miles.

To embark on a 10-month around-the-world cruise to strange and exotic ports of call is true adventure. If you take amateur radio and put the two together, you have the greatest sea experience and personal search for adventure ever possible. I experienced this great adventure when I wrote about it. You went along while reading it. But for Jules Wenglare W6YO, the experience was reality, for he took amateur radio aboard the *Trader* with him and lived it—at the four corners of the globe. ■

W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

from page 181

WHAT SHOULD YOU BUY?

One of the curses which can drive a beginner to drink is the reluctance to spend a lot of money on equipment. The result of this is that many Novices get on the air with junk and find amateur radio a terrible experience. They have trouble separating signals and lose contacts to interference a lot. The obvious answer is to spend a little more and get something first rate in the way of a receiver.

You don't have to buy new equipment, but, on the other hand, you'll regret it if you go too far back and load up with an old tube-type receiver. Moderation is the watchword... old, but not too old. Just about any rig with solid state except for the final transmitter stages and made within the last ten to twelve years should provide you with a usable station. Get the very best you can, so you don't have to cope with drift, adjacent channel garbage, wide i-fs, etc.

Not to put flea markets and auctions down, but I seldom see anything I'd recommend buying at these low-end debris exchanges. Oh, you *can* luck out, but I look more for gadgets and parts at these affairs than for rigs. A better source of a rig is to join the nearest ham club and let the members know you are in the market. If it is any size club, some of the members will be wanting to update their shack with the newest gear and be looking for a good home for their old stuff. This means you'll have a better handle on the history of the equipment and probably some help in service when the inevitable happens.

Another possibility is your nearby ham dealer. Now I don't necessarily mean for you to run down and shop from the used ham gear shelf, which is probably rather scantily occupied most of the time. Used equipment doesn't last long in a store. I suggest you check over the used gear to see if they have what you really want. If not, talk with the owner of the store and explain what you are looking for and suggest that he keep an eye open for it as a trade-in on some new gear. This can be to both your and his advantage. If he knows he has a good fast sale for something, he can offer a little more for it ... and he won't have to mark it up as much since it won't be taking up space and costing him money to keep in inventory.

But what about the ads in ham magazines for used equipment where hundreds of old sets are advertised? As far as I know, this is more of a come-on than anything else. Your chances of actually finding one of those advertised rigs in stock is slight. One more warning, while I'm at it. I had a chap working for me one time who had been with one of the major ham stores. He swore that the equipment which they had been selling as "reconditioned" went out of the store without ever being plugged in to see if it would work.

WHAT ABOUT THE CODE?

One of the more unfortunate aspects of the Morse code is that it is mandatory for a ham license. If a knowledge of the code were optional, I'm convinced that a lot more hams would use it and enjoy it. But, since there is no choice, don't let the code be a big deal... it isn't, if you manage to get started the right way.

There are some incredibly bad systems for learning the code. Sams had probably the worst I've ever seen... the sight and sound method, I think they called it. I wonder if anyone ever managed to learn the code with that. The age-old ARRL system of gently increasing speeds has lost us hundreds of thousands of prospective hams. If it hadn't been for the Sams system, I would make the claim that it would take a truly deviant mind to come up with a more frustrating and failure-prone system for teaching the code than the ARRL has been pushing for about 50 years.

Some recent experiments with students starting with high-speed code have confirmed earlier tests. The fact is that it takes very little longer to start right out at 13 words per minute than at five. In fact, there are more and more students starting out at 20 words per minute and able to pass the FCC exam with just three or four days of intense practice.

Four-year-old kids, barely able to write, even in block letters, have been passing the code test. How many of you are willing to admit that a four-year-old can outperform you... even a *smart* four-year-old? Learning code has nothing to do with brains, as you'll discover when you meet a few hams and find out what a wide range of intelligence is involved. Some hams may have been a little hard of hearing when brains were handed out and said, "Trains? They make me sick... no, thanks."

The code system that works the fastest and will give you the confidence you need to beat the bastards is on the *73* code cassettes. I dislike putting in that commercial, but I guess it's necessary because every now and then I talk to a club where they are using the ARRL materials and driving people crazy. It just isn't fair ... and being an ARRL-affiliated club doesn't mean you have to take it out on defenseless students.

ANTENNAS

Until the day comes when you go the truly practical route with a 73-foot tower and a good quality three-element beam ... and find that you have a signal into any spot in the world where a DX operator chances to pop up ... you'll go through what most of the rest of us have—continual experimenting with various antennas. Sure, the tower, rotor, and beam are expensive... and it will spoil all the fun of being ground into dust in DX pileups, of losing contact in the QRM with that 50th state just as he was about to get your call letters ... and of other growth-promoting traumas. Perhaps you won't really appreciate a good antenna system unless you apprentice with dipoles, longwires, and such for a few years.

Not that dipoles are all that bad on the lower bands. You can get a dipole to plunk a signal almost anywhere in the world if you put it in a good spot and then fill it with a good solid signal. I had the thrill of hearing my own dipole putting through an S-9 signal into Australia on 75 meters one night while I was operating from VK3ATN. *That* was exciting!

YOUR EXPERIENCES?

It's been a long time since I first braved the ham bands... and they were sure different then. With very few exceptions, everyone had to use crystals for frequency control, so the standard mode for operating was to go on the air, call CQ, and then tune the band for a call. Forty meters was a CW band, but then about 90% of the ham contacts in those days were made on CW. The 100 kHz wide 20m phone band was pretty well filled up with big signal stations... and a phone kilowatt in those days cost on the order of $20,000, so you didn't casually buy one. The other Class A phone band was 75m and it, too, was pretty well taken up with about six or seven nets of kilowatt phone stations. The band was 100 kHz wide and each net took 10 kHz of this, leaving very little for the 50-Watt average ham.

The great unwashed hung out on 160m... the Class B band. There were no commercial transmitters then, so most rigs were copied out of *Radio* magazine or *QST*. *Radio* had the better projects by a wide margin.

How about writing about some of your own experiences? I'll bet you've had some which would strike a familiar cord with other readers. And perhaps you have some good advice on rigs, antennas, QSLing, etc.

ARRL VS. WOMEN

A couple of months ago I brought up the matter of Mary Lewis W7QGP and her battle with the League. Mary was disqualified for the post of SCM unfairly, she thought, so she took the League to court over this. The real battle seemed to be over Mary's threat of becoming the very first woman director of the League. She is the only person running against the incumbent Thurston. The League position has been clearly explained to Mary: No way will there ever be a woman director.

Mary won the first big battle when the case came up in court and the judge ruled 100% for Mary. Firstly, he said that the League should have charged Mary for the mailing list if that was a problem, and should not have disqualified her for the post of SCM. Then he went on to say that the League should stop stalling on the director election and proceed with it. The League maneuver on this apparently was to postpone the election as long as possible, allowing their yes-man Thurston to remain in power in the interim.

My mail has been heavy with compliments for Mary and badmouthing for Thurston, who apparently has given a great many Pacific area hams the idea that he holds them in great contempt. Every one of the readers has asked not to be identified for fear of reprisals by Thurston or the League.

If we should lose amateur radio next year, we will have only ourselves to blame for permitting directors like Thurston and his ilk to refuse to put capable people into office at HQ.

RTTY Loop

from page 14

nections. This figure shows you how to do it. This point is also useful for those of you working on computer transmitting routines who have to key the loop from the computer.

Now, as mentioned, this is far from an ideal way to produce a string of RYs. In fact, since the need arises to automatically send text like "THE QUICK BROWN FOX JUMPED OVER THE LAZY YELLOW DOG 1234567890 TIMES" (the sentence containing all letters of the alphabet for those of you who just joined us), or IDs like "DE WA3AJR," it would be nice to have a circuit that could be set up to put that out. A block diagram of such a circuit is shown in Fig. 4. What we are going to do is encode what we want to send on a diode matrix, and then put it out using parallel-to-serial conversion. I know, you all are saying, "There he goes with that computer stuff again!", but I promise, no computer. Everything we will do will be with hardware, and I hope to explain it well enough that it is clear. If not, it's my fault! We'll get into it next month.

Turning to the *vox populi*, we'll take some overseas correspondence this month. Sgt. Gary Kohtala HL9TG/WA7NTF is looking for information in general on RTTY. Well, Gary, that's what we're here for. While you're stationed overseas, you may want to look into the MARS program. This has been a particularly fruitful source of RTTY gear for the ham in the service, and many a serviceman has come into amateur radio through contact with a MARS station. For those of you who don't know what I'm talking about, MARS is the Military Affiliate Radio System, and, while it is not as active as it was during the Vietnam "conflict," many hams still maintain regular net schedules to keep up the morale of our servicemen across the globe. Much of the traffic handled is on RTTY, only they call it RATT, and equipment is frequently available to the amateur willing to invest a small part of his time and get a big return—in more than one way.

Bernard Malandain 3D2BM writes that his Model 28ASR is equipped with downshift-on-space, a feature that is annoying when trying to copy groups of figures in weather broadcasts. Although he has studied the manuals, he states that he is unable to disable this function. Well, Fig. 5 is reproduced rather loosely from the Teletype Corporation's manual for the 28, Volume 1, Fig. 5-56. You can see that tightening the disabling screw will prevent the pawl from engaging the function lever and prevent downshifting-on-space. If this is not clear, at least I have pointed you in the right direction. Bernard also needs information on synch gears for the 28 to run on the 50-Hz current they have there, and the 84018 and 84019 gears for his Model 15 on the same current. Readers with information may write me or send it to him, at Box 590, Suva, Fiji.

Several readers have written with questions regarding the new Microlog RTTY units. The October, 1978, issue of *73* carried a nice review by K3CMY of his unit, and I will refer you all to that article for details. I met with the makers of the unit about a month back and had a chance to see it In action. Very impressive! Unfortunately, the data they were going to rush me has not materialized as yet, so I can say little other than what I have gathered by talking to users of the system. One problem that has cropped up in one station was rf overload of the device, shutting it down when the transmitter was keyed. I don't know if this is swr- or frequency-dependent, but I would be on the lookout for this sticky wicket.

Next month, we will look into the circuit for sending that RY or BROWN FOX painlessly, and maybe even understand how it works. Meanwhile, I look for your input to tell me what you want to see in RTTY Loop!

New Products

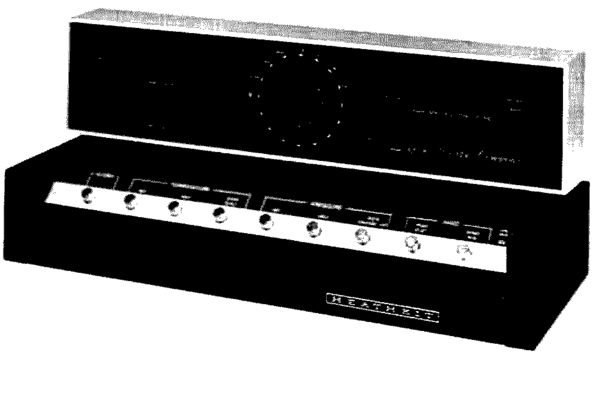
from page 17

mail to *SST Electronics, PO Box 1, Lawndale CA 90260.* Reader Service number S10.

HEATH ANNOUNCES FIRST COMPUTERIZED WEATHER STATION

Heath Company, the world's largest manufacturer of electronic kits, announces the availability of its new ID-4001 computerized weather station. The microprocessor-based ID-4001 indicates time, indoor and outdoor temperatures, wind speed and direction, and barometric pressure on an upright display panel utilizing large LED readouts. It will also display average wind speed and automatically calculate wind chill factor as well. The ID-4001's memory allows instant recall of date and time of maximum and minimum temperatures, date and time of wind gusts, and the date and time of maximum and minimum barometric pressure. It can even indicate the barometric pressure's rate of change per hour and tell if it is rising or falling. The ID-4001's 6-digit time/date display shows time in hours, minutes, and seconds, and the date in month and day. The time/date can be displayed alternately, or either may be displayed continuously. The 12-hour time format has an am-pm indicator. A 2-digit display shows wind speed in mph, kph, or knots. A 16-indicator wind vector display identified by compass points and radial degrees indicates wind direction. The thermometer display indicates indoor or outdoor temperature in degrees F or C with + or − signs. A 4-digit display shows barometric pressure in inches of mercury or millibars. Separate indicators show rising or falling pressure. Kit and assembled versions of the ID-4001 are available.

For more information about the ID-4001, send for a free copy of the latest Heathkit catalog. Write *Heath Company, Dept. 350-730, Benton Harbor MI 49022.* Reader Service number H5.



First computerized weather station from Heath.

NEW 2 METER FM MOBILE TRANSCEIVER WITH MEMORY FEATURES OPTIONAL MICROPROCESSOR CONTROL UNIT

The TR-7600 2 meter FM mobile transceiver with memory, and an optional RM-76 microprocessor control unit, which provides six memories and various scanning functions, have been introduced by Trio-Kenwood Communications, Inc.

The TR-7600 provides full 4-MHz coverage (800 channels) on 2 meters and includes a memory channel. It operates on simplex (same transmit and receive frequencies) or repeater (plus or minus 600-kHz transmitter offset) modes. Furthermore, the memory can be used to provide a transmit frequency for accessing a repeater with a nonstandard frequency pair.

The TR-7600 also features a digital frequency display with large, bright, orange LEDs. Another LED, called an "unlock" indicator, shows transceiver protection when the frequency selector switches are improperly positioned or the PLL has malfunctioned. Selecting frequencies with the TR-7600 is fast and easy with its dual concentric knobs, 5-kHz offset switch, and MHz selector switch.

Power output is switchable between 10 Watts and 1 Watt (adjustable from 1 to 10 Watts). The TR-7600 is ideal for mobile use and comes with the MC-30S noise-canceling dynamic microphone. The compact transceiver measures only 6-7/16 inches wide, 2-7/16 Inches high, and 9-3/16 inches deep.

The optional RM-76 microprocessor control unit allows the TR-7600 to perform many interesting new functions. Using the RM-76 keyboard, the amateur can select any 2 meter frequency (including MARS on 143.95 MHz simplex), store frequencies in six memories, automati-

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The Kenwood TR-7600 2m mobile transceiver.

cally scan up the band in 5-kHz steps, manually scan up or down in 5-kHz steps, set lower and upper scan frequency limits, scan for busy or open channel, reset scan to 144 MHz, stop scan, cancel scan (for transmitting), and select repeater mode (simplex, plus or minus 600-kHz or 1-MHz transmit frequency offset, or one memory transmit frequency).

The RM-76's digital display indicates frequency (even while scanning) and functions (such as autoscan, lower scan frequency limit, upper scan limit, error, and call channel).

The TR-7600 was scheduled to be available by late November, 1978. The RM-76 microprocessor control unit will be available by the end of January, 1979. *Trio-Kenwood Communications, Inc., 1111 West Walnut Street, Compton CA 90220.*

MIRAGE B108 VHF POWER AMPLIFIER WITH BUILT-IN RX PREAMP

Mirage Communications is proud to introduce its new 2 meter solid state amplifier—the B108.

The B108 represents a new generation of all-mode amplifiers for VHF use. It incorporates operation features that have not been available before in a single amplifier.

The B108 is designed to operate on AM, FM, SSB, or CW, with a power output of at least 80 Watts for 10 Watts input.

A built-in receive preamp is standard. The preamp utilizes a J310 FET in the latest low-noise circuit design. It provides at least 10 dB of gain and a 2-2.5 dB noise figure. The preamp may be operated with or without the power amp being turned on.

Also standard is a rear panel connector, providing remote control operation. An optional remote head, the RC-1, is available with either a 6-foot or 18-foot cable.

Keying is provided by the internal rf sensing circuit, or the unit may be keyed from the external transmitter.

For SSB operation, the relay dropout delay is fully adjustable.

The B108 will strengthen the transmitter output, providing crisp, clear communications. The built-in receiver preamp will really help pull in the weak signals.

For further details, contact your local dealer or *Mirage Communications, PO Box 1393, Gilroy CA 95020, (408)-847-1857.* Reader Service number M75.

Mirage's B108 VHF power amplifier.

TELE-TOW'R BREAKOVER MODEL 55 TOWER

My impression at first sight of the Tele-Tow'r Breakover Model 55 can be expressed in one word:unprepossessing. And that's precisely what I was looking for!

While it may be mighty nice to have a couple of 120-footers with big monobanders on top in the backyard, I've never been fortunate enough to live where I could get away with putting up anything like that. For me, reality has meant striking a compromise between what the zoning laws, neighbors, and my budget would permit, and the performance I would like to have.

Actually, during the first few months after moving to New Hampshire, I did quite well with a variety of dipoles and random wires. But I knew that if I was going to be able to take advantage of improving conditions on 10, 15, and 20 meters, I'd need beams and a good tower to hold them. I also needed a tower to be able to properly evaluate occasional antennas and other items for *73*'s New Products column.

Surveying my present location, I concluded that I could probably maintain a reasonable state of peace with my neighbors and still attain a useful degree of performance with a tower in the 40- to 60-foot range. Another requirement would be that the tower be as inconspicuous as possible. The tower should be of the telescoping, tiltover type, so that work on it or the rotor and antenna could be done from the ground. It should also be fully self-supporting.

After looking over various manufacturers' ads and literature, I decided that the Tele-Tow'r Breakover Model 55 would definitely bear further investigation. A careful study of the literature and a phone conversation with one of the owners of Tele-Tow'r convinced me that the Breakover Model 55 was just what I was looking for. And if I had any lingering doubts, they were dispelled at my first sight of the tower as it was being unloaded from the freight truck.

The Breakover Model 55 may be quite unprepossessing in appearance, especially at first glance, but behind its slim, clean lines lie lots of engineering skill and design innovations—as well as quality materials and workmanship. One of the most attractive things about the tower is that it comes truly complete and ready to install—nothing else is needed.

Tele-Tow'r does offer one accessory item that, while not required for a complete tower installation, can be mighty convenient—particularly if there's a possibility you may want to move your tower at some future date. The item is a tubular steel sleeve into which the tower's base, or breakover riser section, can be slipped instead of setting it directly in concrete. By using the mounting sleeve, you can simply lift the riser section out and carry it away to another location. Otherwise, you're stuck with the choice of digging it out of a 2' x 2' x 3' block of concrete or of leaving it behind and buying a new section.

Try lifting the riser section or the telescoping main part of the tower and you'll instantly gain an appreciation of the solid, rugged construction of the Breakover Model 55. The main part of the tower weighs 300 pounds and is made of three different-sized sections of steel pipe and tubing. The largest section is steel pipe with an outside diameter of 4 inches and .234-inch wall thickness. Next comes a section of steel tubing with an outside diagonal measurement of 2½ inches and a wall thickness of .188 inches. The third section is 10-gauge steel tubing with a 2-inch outside diameter. The winches, the 3/16-inch aircraft control cables, and other fittings are all of excellent quality and workmanship, and are capable of providing years of troublefree service.

The toughest and most time-consuming part of installing the Breakover Model 55 was digging the hole and pouring the concrete for the base. In my own case, I quickly discovered why New Hampshire is called the Granite State. Everywhere I attempted to dig in the area I had chosen for the tower, I ran into stones and small boulders. Eventually I got the job done, but I came away with some beautiful blisters from swinging a pick for the better part of an hour.

Once the hole was dug, things proceeded very smoothly. I had decided to use the accessory mounting sleeve, so it was slipped onto the breakover riser base section and the assembly was placed in the hole. After pouring the concrete, I used a carpenter's level to check that the riser section was level, and left it for a couple of days while

The model 820 portable digital capacitance meter from B&K Precision.

the concrete set.

With the breakover riser section in place and the concrete set, completion of the installation took 15 minutes or less. The first step was to position the tower with winch downward and base against the riser section. The tower was then secured to the riser with a ¾ x 6-inch bolt and nut. Next, the pulley was removed from its housing near the bottom of the tower, the winch on the riser section was released, and the cable was looped over the pulley. The pulley was then reinstalled in its housing and the pulley shaft bolt tightened securely. The tower was then cranked into the upright position and a 3/8-inch U-bolt was installed just below the level of the winch on the riser section, securing the tower to the base.

Fully extended, and without an antenna, the Breakover Model 55 looks more like a flagpole than an antenna tower, something that can be a tremendous asset in a residential neighborhood. The towers come with a silver finish, but you can easily paint them another color or colors to help them blend more effectively with their surroundings, something quite a few owners are apparently choosing to do. In my own case, I think I'll paint the bottom section green, to blend with nearby evergreens, and make the upper portion sky blue.

The Breakover Model 55 is designed to withstand 60 mph winds with 50 pounds of rotor and antenna with a vertical area of 6 square feet when fully extended to 55 feet. With the same loading, the tower will withstand 70 mph winds when cranked down to 45 feet. And, of course, for added safety in high winds or icy conditions or simply when it is not in use, the tower can be cranked down to 23 feet. If you wish, coax and rotor cables can be run inside the tower. Just drill an appropriate-sized hole and feed the cables through, making sure they retract and extend with the tower.

The tower's designers have incorporated a number of interesting and innovative features, including the patented guiding and cable systems and safety stop. The use of round to square to round steel pipe and tubing also contributes to greater ease and safety of operation. While several of the tower's most interesting and important features are internal and of a proprietary nature, thus precluding any detailed description, they clearly help to make the Breakover Model 55 a product of superior quality and performance. I'm mighty glad I chose one for my personal use.

Tele-Tow'r makes four different models. The Breakover Model 55 (extends from 23 to 55 feet) and the Breakover Model 40 (extends from 23 to 40 feet) are telescoping, break over at ground level, and are fully self-supporting. The Model 55 (extends from 21 to 55 feet) and Model 40 (extends from 21 to 40 feet) are telescoping and fully self-supporting. Prices are $618.46 for the Breakover Model 55 and $411.80 for the Breakover Model 40. The Model 55 sells for $442.97 and the Model 40 goes for $242.15. The accessory sleeve is $35.10 for the 40-foot models and $45.90 for the 55-foot models.

The towers and accessory sleeves are available from selected dealers or direct from *Tele-Tow'r Mfg. Co., PO Box 3412, Enid OK 73701, (405)-233-4412.* Reader Service number T52.

Morgan W. Godwin W4WFL
Peterborough NH

LOW-COST PORTABLE DIGITAL CAPACITANCE METER ANNOUNCED BY DYNASCAN

Dynascan Corporation has just announced the introduction of the B&K Precision model 820 portable digital capacitance meter. The 820 is a compact instrument capable of measurement over the wide capacitance range of 0.1 pF to 1 farad. Accuracy is said to greatly exceed the tolerance of most capacitors. The unit features a bright 4-digit LED display for easy reading in laboratories, product lines, or field applications.

The capacitance of virtually any capacitor can be measured quickly and accurately with the 820. Because the accuracy of this unit greatly exceeds the tolerance requirements of most users, required values can be "hand-selected." Matched capacitors can also be singled out for use in bridge circuits and other critical applications.

The 820 allows quick measurement of unmarked capacitors or verification that a capacitor is within tolerance. Virtually any type of capacitor can be measured, from miniature disks to pole-mounted power types. Even the small amounts of capacitance encountered in cable or switches can be measured.

For production line applications, the 820 is an excellent means of pretesting critical capacitors or accurately adjusting trimmer capacitors. The simplicity of operation allows even untrained workers to be quickly instructed in proper operation. To facilitate fast incoming component sorting and selection, slot-type front panel lead-insertion jacks are used. The slot jacks eliminate the time-wasting step of guiding a capacitor lead into the type of small lead-insertion holes commonly found on other instruments.

In classroom applications, the 820 can be used to verify capacitor network calculations by measuring the actual value of a network. The operation of a variable capacitor can also be demonstrated, as can the effects of heat or cold on a capacitor.

The B&K Precision model 820 comes with a 26-page detailed manual. Optional accessories include the BP-28 rechargeable battery pack, the BC-28 charger, and the LC-28 carrying case. The 820 is now available for immediate delivery at local B&K Precision distributors. For additional information, contact *B&K Precision, Sales Department, 6460 West Cortland Street, Chicago IL 60635, (312)-889-9087.* Reader Service number B45.

HAMTRONICS' VHF LINEAR AMPLIFIERS

One of the best and least expensive ways I know of getting started on VHF/UHF, or of expanding your capabilities if you're already active on those frequencies, is with the growing line of Hamtronics kits. Two of the more recent kits are the model LPA 2-45 and LPA 8-45 two-meter linear power amplifiers. The LPA 2-45 is designed to amplify the 2 Watts PEP output of the Hamtronics XV2 Transmitting Converter or the T50 FM Exciter or any other 2-Watt two-meter rf power source to 45 Watts PEP. As a linear, it may be used on any mode, including SSB, CW, AM, and FM. The LPA 8-45 is designed to boost the 8-10 Watt output of the popular two-meter multimode transceivers or other rigs in that power range to 45 Watts PEP. Both models use the same circuitry, with the exception that the first two stages are omitted in the LPA 8-45. Input and output impedance is 50 Ohms. Power requirement is 13.6 V dc at 8 to 10 Amps. The amplifiers may be tuned to any frequency in the 140 to 175 MHz range, and have a passband of 2 MHz.

One of the first things you notice when unpacking the kit is that the power transistors and PC board have been preassembled for you so that the proper spacing, heat-sink compound application, and transistor stud torque are taken care of for you. It's a nice touch and makes the project go more quickly and easily. The transistors are the latest, emitter-ballasted, high-gain types, and are operated well below their full output capability to remain in the linear range. Impedance matching is done with high Q, discrete coil-capacitor-tuned circuits to aid signal purity.

Construction is simple and straightforward. Although the instructions are not of the detailed step-by-step type, they are more than adequate for anyone who has done a bit of home brewing or kit building and who reads them over carefully a couple of times before starting. In fact, building the LPA 8-45 is very much like working from a well-written magazine construction article. Coil winding and special parts mounting procedures are fully detailed, and even I got through the process without any problems or delays. Either model makes an easy and enjoyable afternoon or evening project.

Alignment is very simple. Just connect the input to a two-meter rf source of the appropriate power rating. Connect a VTVM or VOM to the test point pad on the PC board and

The Message Memory Keyer from Trac.

apply moderate drive and B+. Then tune the six trimmer capacitors alternately for maximum output. Continue increasing the drive slightly and repeaking the capacitors until maximum output is achieved (about 10 Amps maximum current drain). Of course, during normal operation you would not drive the amplifier to its limit. However, for alignment, you want to tune for absolute maximum output to establish the proper load for the PA transistors for best linearity on SSB.

The amplifier has an rf output meter detector circuit that may, if desired, be used as an aid during normal operation. A VTVM or VOM, or even a sensitive panel microammeter, may be used to monitor output. An ammeter in the B+ line is another handy operating indicator.

T/R switching of the antenna is not provided for. If a single antenna is to be used with the amplifier and a receiver, some form of coax relay or other method of switching suitable for use in the 144-MHz range must be provided.

Current drain of the amplifier at full output is 8 Amps for the LPA 8-45. If the unit is used in a mobile application, or powered by anything other than a well-regulated and protected power supply, an outboard filter is recommended for hash and transient filtering and reverse polarity protection.

If desired, the amplifier may be mounted to a panel with screws in the left- and right-hand edges of the heat sink. It may be mounted with standoffs to clear the components, or a cutout can be made in the rear panel to clear the PC board and the heat sink then mounted flush to the panel. However the unit is mounted, the fins should be in free air to allow for good convection cooling.

The amplifier has not only given a big boost to my two-meter signal, but it's also provided the satisfaction of building a useful piece of equipment without the hassle of having to round up all the individual bits and pieces needed for such a project. And best of all, at $109.95 for the LPA 2-45 and $89.95 for the LPA 8-45, plus $2.00 per kit for postage, they're affordable. Both models are also available for 6 meters. Heavy-duty versions, rated for 100% duty cycle, are $15.00 more. There is also a 15-Watt amplifier for six and two meters and 220 MHz. The standard version, model LPA 2-15, sells for $59.95, and the heavy-duty version is $69.95, plus $2.00 postage per kit.

Hamtronics kits may be ordered by mail or phone. VISA and Mastercharge cards are accepted. A handy pocket-size free catalog describing all of the Hamtronics kits plus a useful selection of hard-to-find components, antennas, etc., is available on request. *Hamtronics, Inc., 65 Moul Road, Hilton NY 14468. (716)-392-9430.* Reader Service number H16.

Morgan W. Godwin W4WFL
Peterborough NH

TRAC MESSAGE MEMORY KEYER

Trac Electronics, Inc., has introduced a new completely CMOS state-of-the-art Message Memory Keyer. Containing all CMOS integrated circuitry, the Message Memory Keyer contains two-message capacity. Each message has expanded 512-bit memory capacity (50 characters, approximately). The keyer can record at any speed and the messages may be replayed at the same or any other speed. A unique repeat function allows the operator to repeat the message played, as in calling CQ. The heart of the Message Memory is a 1024 x 1 bit CMOS random access memory chip. The all-CMOS unit is virtually rf-proof. In addition to the dual message functions, the keyer contains both dot and dash memory keying, iambic keying, 5-50 wpm, speed, volume, tune, tone, and weight controls, as well as a sidetone with speaker. The unit keys both negative and positive keyed rigs. Available direct from *Trac Electronics, Inc., 1106 Rand Building, Buffalo, New York 14203,* or at most dealers throughout the U.S. and Canada. Reader Service number T18.

RADICAL NEW TOTALLY CONCEALED UHF ANTENNA INTRODUCED BY ANTENNA SPECIALISTS

A new UHF communications antenna designed for total concealment yet offering performance comparable to external mobile antennas has been announced by The Antenna Specialists Co., major producer of land mobile antennas and accessories. The new model ASP-1000 covert antenna is similar in design concept to antennas utilized for jet aircraft (A/S is also a major supplier of avionic antennas).

Producing a vertically-polarized radiation pattern, this cavity-backed slot antenna is constructed of rugged reinforced aluminum with an iridite finish. Included is a silver-plated matching network enclosed in a protective cover. Two screwdriver tuning adjustments allow for precise tuning of the antenna to the required operating frequency.

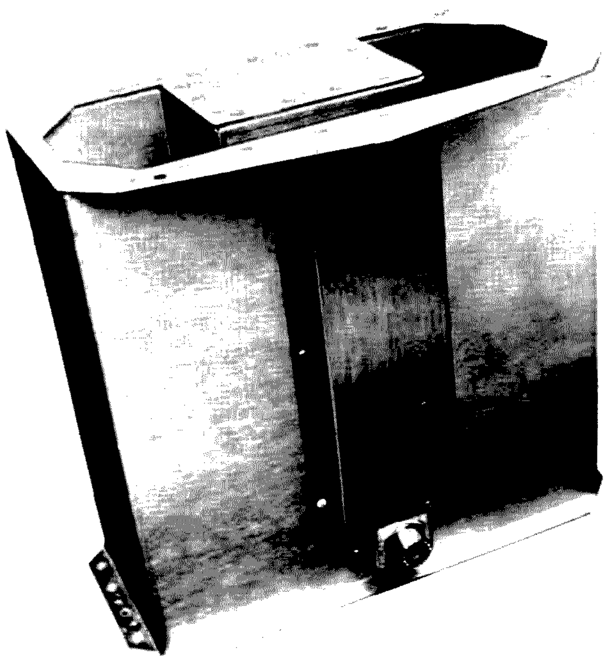
With performance comparable to an antenna mounted externally, the new **ASP-1000** is configured to fit precisely into the space inside an automobile trunk originally designed for mounting a 6" x 9" rear deck speaker. The antenna mounting holes mate with those provided for the speaker and the antenna matches exactly the 6" × 9" oval cutout.

Rf power rating is 125 Watts continuous, bandwidth is 5 MHz minimum, and nominal impedance is 50 Ohms. The ASP-1000 covers the 406 to 512 MHz range. For further information, contact *The Antenna Specialists Co., 12435 Euclid Avenue, Cleveland OH 44106.* Reader Service number A62.

WV-1 WILSON VERTICAL TRAP ANTENNA

No bandswitching is necessary with the new WV-1 antenna. It is an excellent low-cost 10-40 meter vertical that offers an electrical quarter wavelength and a low angle of radiation. Advanced design assures a low swr on each band.

For more information, see your favorite dealer, or contact *Wilson Electronics Corporation, Consumer Products Division, PO Box 19000, Las Vegas NV 89119.* Reader Service number W2.



New concealed UHF antenna from Antenna Specialists.

CONTESTS

from page 8

all DUF countries as per the diploma of the Union F List, 9 Belgian provinces (2 letters), DA2 STN/FBA (Belgian forces in DL), 22 cantons of Switzerland (2 letters), and all other Francophone countries—LX, 40, OD, 3B, 9Q, 9U, 9X, HH, VE2. French stations will give their department number after the call. Example: F6ZZZ/67 and FFA will give DA . . . /FFA. Final score is the sum of the QSO points times the sum of multipliers. Send logs and summary sheet to the REF Traffic Manager, 2, Square Trudaine, 75009 Paris, France.

CLASSIC RADIO EXCHANGE
Starts: 2000 GMT Sunday, January 28
Ends: 0300 GMT Monday, January 29

Sponsored by the Southeast ARC, K8EMY, Cleveland OH, the contest is open to all. Object is to restore, operate, and enjoy older equipment with like-minded hams. A classic radio is any equipment built since 1945 but at least 10 years old, an advantage, but not required in the exchange. Exchange your name, RST, QTH, receiver and transmitter type (home brew send PA tube, i.e., "6L6"), and other interesting pleasantries. The same station may be worked with different equipment combinations, and on each mode on each band. CW call is "CQ CX." Phone call is "CQ EXCHANGE." Non-contestants may be worked for credit. Suggested frequencies: CW—up 60 kHz from low band edges; phone—3910, 7280, 14280, 21380, 28580; Novice/Tech—3720, 7120, 21120, 28120. Listen to 10 meters on the quarter hour, 20 on the half hour, 15 on the three-quarter hour.

SCORING:

Add the numbers of different transmitters, receivers, states/provinces/countries contacted for each band. Multiply by total number of QSOs. Multiply that total by the Classic Multiplier: total years old of all transmitters and receivers used, three QSOs minimum per unit. For transceivers, multiply years old by two.

ENTRIES:

Please send logs, comments, anecdotes, etc., to Stu Stephens K8SJ, 2386 Queenston Road, Cleveland Heights OH 44118. Include an SASE for results and a copy of the *Classic Radio Newsletter*.

MINNESOTA—ST. LOUIS COUNTY AWARD

This award is issued for having contacts with three stations in St. Louis county, Minnesota, with no date, mode, or frequency restrictions. The award is also available to SWLs on a "heard" basis. Do not submit QSL cards; send log information, $1.00, and two 15¢ stamps to: Wilderness Ham Radio Operators, Certificate Manager, Ron Heruth WA0WNV, 321 Wyandotte Rd., Hoyt Lakes MN 55750.

BEATA OPERATION

A Dominican ham radio group affiliated with the Dominican Radio Club is concentrating its efforts on trying to offer its country and the world the possibility of working for the first time the HI1 prefix. Beata Island is a restricted area, a military restricted area under the administration of the Dominican Marine Corps. As of October 19, the activity was scheduled for January 25-28 and the group will include: Waldo HI8WPC, Max HI8MVF, Joe HI8JAG, Mike HI8MRF, Tim HI8MFP, and Carlos HI8XPT.

No stations other than the above-mentioned are authorized to work the HI1 prefix. If any call was made prior to the date of this DXpedition, it would not be valid. A weekly bulletin will be issued until the exact day of the DXpedition, containing interesting information about the island and the operation. Suggestions or information can be requested at: Beata Operation Public Relations, HI8MFP, Box 2191, Santo Domingo, Dominican Republic, West Indies.

THE 73 BAND PLAN

Channel	Freq.(MHz)	
1	28.965	Listening & calling
2	28.975	Autocall monitoring
3	28.985	County hunting—not rag chew
4	29.005	Beacon monitoring
5	29.015	
6	29.025	Rag chewing (lowest)
7	29.035	
8	29.055	
9	29.065	
10	29.075	
11	29.085	
12	29.105	
13	29.115	
14	29.125	
15	29.135	
16	29.155	
17	29.165	
18	29.175	
19	29.185	Repeater channel
20	29.205	RTTY
21	29.215	Oscar coordination
22	29.225	
23	29.255	SSTV
24	29.235	
25	29.245	Repeater
26	29.265	Repeater
27	29.275	Repeater
28	29.285	
29	29.295	
30	29.305	
31	29.315	
32	29.325	
33	29.335	
34	29.345	
35	29.355	
36	29.365	
37	29.375	
38	29.385	
39	29.395	
40	29.405	Oscar listening

THE 73 MAGAZINE 10 METER AWARDS

The return of vigorous solar activity means that 10 meters is once again a band to be reckoned with. Ol' Sol's 11-year cycle of sunspot production is about to hit a peak, with the result that QRP 10 meter DX is possible.

Now's the perfect time to convert that old CB rig to 10. American Crystal Supply makes a variety of simple and inexpensive conversion kits, or you can do-it-yourself from the articles in 73. True appliance operators can purchase ready-made rigs from Bristol Electronics or Standard Communications. To give you an added incentive, 73 is offering two nifty Certificates of Achievement for 10 meter channelized communications.

For domestic types, there is the 10-40 Award. This one should be pretty easy—just work 40 of the 50 states. The DX Decade Award goes to DXers who work 10 or more foreign countries with a channelized 10 meter rig. We have endorsement stickers, too—the whole bit.

To give everyone an equal shot at award #1, only contacts made October 1, 1978, or after will be valid.

Well, don't just sit there. Get out your soldering iron, order some crystals, and put that CB rig on 10. This is going to be fun, so don't miss out!

RULES

1) All contacts must be made in the 10 meter amateur band using channelized AM equipment. Both converted Citizens Band equipment and commercially-produced units may be used.

2) To be eligible for award credit, all contacts must be made October 1, 1978, or after.

3) The 10-40 Award is available to applicants showing proof of contact with stations in at least 40 of the 50 United States. A special endorsement sticker will be available to those working all 50 states.

4) The DX Decade Award is available to applicants showing proof of contact with at least 10 foreign countries. Endorsement stickers will be awarded for 25, 50, 75, and 100 countries.

5) A log of stations worked, with the date, time, and type of equipment used for each contact, must be submitted when applying for each award or endorsement.

6) Each application for an award or endorsement must be accompanied by a signed statement that all claimed contacts are valid. No QSL cards need be sent, but they must be in the possession of the applicant.

7) To cover costs, a fee of $5.00 must accompany each application for the 10-40 or DX Decade Award. The fee for endorsement stickers will be $2.00 each.

8) All award applications should be mailed to: Chuck Stuart N5KC, 5115 Menefee Drive, Dallas TX 75227.

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7A	7	7	7	7	7	7	7A	14	21A	21
ARGENTINA	14	7A	7	7	7	7	14	21	21A	21A	21A	21
AUSTRALIA	21	14	7B	7B	7	7	7	14B	14	14	21	21A
CANAL ZONE	14	7	7	7	7	7	14	21	21A	21A	21A	21
ENGLAND	7	7	7	7	7	7B	14	21A	21A	14	7B	7
HAWAII	21	14	7B	7	7	7	7	7B	7A	21	21A	21A
INDIA	7	7	7B	7B	7B	7B	14B	14	14B	7B	7B	7
JAPAN	14A	7B	7B	7	7	7	7	7	7B	7B	7B	14
MEXICO	14	7	7	7	7	7	7	14	21	21A	21A	21
PHILIPPINES	14	14	7B	7B	7B	7B	7	7	7B	7B	7B	7B
PUERTO RICO	14	7	7	7	7	7	14	21	21	21A	21	14
SOUTH AFRICA	14	7	7	7	7B	7A	21	21A	21A	21A	21	14
U. S. S. R.	7	7	7	3A	7	7B	14	14A	14	7B	7B	7
WEST COAST	21	14	7	7	7	7	7	14	21	21A	21A	21A

CENTRAL UNITED STATES TO:

ALASKA	21	14	7	7	7	7	7	7	7A	14	21A	21
ARGENTINA	14A	14	7A	7	7	7	7	14	21	21A	21A	21A
AUSTRALIA	21A	14	7B	7B	7	7	7	7B	14	14	21	21
CANAL ZONE	21	14	7	7	7	7	7	14	21A	21A	21A	21
ENGLAND	7	7	7	7	7	7	7B	14	21A	14	7B	7
HAWAII	21A	14	7B	7	7	7	7	7	7A	21	21A	21A
INDIA	7B	7A	7B	7B	7B	7B	7B	14B	14B	7B	7B	7B
JAPAN	21	14	7B	7	7	7	7	7	7	7B	7B	14
MEXICO	14	7A	7	7	7	7	7	14	21	21	21A	21
PHILIPPINES	21	14	7B	7B	7B	7B	7	7	7	7B	7B	14
PUERTO RICO	14	7A	7	7	7	7	14	21	21	21A	21A	21
SOUTH AFRICA	14	7	7	7	7B	7B	14	21	21A	21A	21	14
U. S. S. R.	7B	7	7	3A	7	7B	7B	14	14	14B	7B	7B

WESTERN UNITED STATES TO:

ALASKA	21	14	7	3	3	3	3	3	7	14	21	21
ARGENTINA	21A	14	14	7	7	7	7	14	21	21	21A	21A
AUSTRALIA	21A	21A	14	7B	7	7	7	7	7A	14	21	21
CANAL ZONE	21	14	7	7	7	7	7	14	21	21A	21A	21A
ENGLAND	7B	7	7	7	7	7	7B	7B	14A	14A	7B	7B
HAWAII	21A	21A	14	7	7	7	7	7	7A	21	21A	21A
INDIA	7B	14	7B	7B	7B	7B	7B	7	14B	7	7B	7B
JAPAN	21A	14	7B	7	7	7	7	7	7	7	7B	14
MEXICO	21	14	7	7	7	7	7	7A	21	21A	21A	21
PHILIPPINES	21A	21	7A	7B	7B	7	7	7	7	7B	7B	14
PUERTO RICO	14	7A	7	7	7	7	7	14	21	21A	21A	21
SOUTH AFRICA	14	14B	7	7	7B	7B	7B	14	21	21A	21A	14
U. S. S. R.	7B	7	7	3A	7	7B	7B	14B	14B	7B	7B	7B
EAST COAST	21	14	7	7	7	7	7	14	21	21A	21A	21A

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor
SF = Chance of solar flares

january

sun	mon	tue	wed	thu	fri	sat
	1 G	2 G	3 G/SF	4 P/SF	5 F	6 F
7 F/SF	8 P/SF	9 P	10 F	11 G	12 G	13 G
14 G	15 G	16 G	17 F	18 G	19 G	20 G
21 F	22 F	23 F/SF	24 F/SF	25 F	26 G	27 G
28 G	29 G	30 G	31 G			

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W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

ATLANTA IN JUNE

Dayton is still the largest hamfest in the country, but Atlanta is undoubtedly the second largest—and closing in on Dayton. Atlanta has two major pluses and one minor plus which Dayton doesn't have. The biggest plus is the city of Atlanta, with its incredible variety of entertainment and restaurants. That in itself is worth the visit. The second big plus is the masterful planning and enthusiasm of Chaz Cone W4GKF, the magician who has put this show together.

Chaz, with the help of cochairman Bob Verlander W4BCD, has organized a fast-paced and well-run show. They get the best in exhibits and somehow manage to bring in standing-room-only crowds for the forums. Perhaps it is the number and quality of the prizes that are responsible for keeping the place packed, even on Sunday. This is the *only* hamfest I've ever seen where it is even more packed on Sunday than on Saturday.

The minor plus, at least to some of us, is that I have an opportunity to speak in Atlanta . . . which I don't at Dayton. Last year at Atlanta, I held one session on current events in amateur radio and another on current events in microcomputing. I expect I'll be doing the same this year.

My ham session might be a good place for ARRL cultists to come to discover what many amateurs already know . . . that I don't hate the ARRL. It may be time to bring this out in the open and talk about it. You know, it's funny about that . . . when I'm critical of the FCC, everyone nods in agreement, and I don't hear any cries of anguish about me being anti-FCC. When I'm critical of our government, I don't get anything but agreement. When I'm critical of the League, then I'm "slamming" them. Baloney. Why should the League be a sacred cow, with people having apoplexy at criticism? Is the ARRL a religion? Let's put these things into perspective and not let a cult mind rule out intelligent discussion of ham events.

Sure, I suppose I should be more political and not so direct. If you don't offend anyone, you have no enemies . . . but neither have you any share in the satisfaction of helping to improve the world a notch. When I see something wrong, I speak out and try to do something about it, a trait which makes politicians nervous. I speak out about the government, about the FCC, the ARRL, civil defense, and anything else where I see things going wrong. Yes, and I expect to get stoned for my trouble . . . though I don't enjoy it. Can you name one person who has spoken out who didn't make people angry?

One of the things I believe in is amateur radio. I believe that our hobby is one of the reasons why the United States is so outstanding in electronics and communications. Over a million of the people in this country have been hams at one time or another, and this personal spark of self-interest sets them aside from the strictly professional technician or engineer. A ham will usually go that extra distance to get something done, while the "professional" knocks off at 5:00 pm to go home and watch television.

Amateur radio has changed the lives of these million kids . . . and the course of events for our country. Just look at the amazing correlation between the development of foreign countries and the number of their hams listed in the *Callbook* . . . do you really think that is a coincidence? We all know that hams discovered and pioneered most of the presently-used radio techniques . . . and would have worked out a lot more if they hadn't had the FCC fighting them at every turn for years.

Whether amateur radio means rag chewing, building special projects, civil defense, emergency nets, contests, DXing, repeaters . . . whatever it means, I feel that amateurs are part of a special breed which is very important to the world. Before you put down the jerk who sits there clunking the repeater, remember that with the right motivation this fellow may suddenly get into some special interest in amateur radio and pioneer a whole new mode of communications. I try to provide as much of this spark as I can with the articles in *73*.

When I hear or read that I'm trying to tear down amateur radio, I wonder who could possibly believe such bunk. I've built most of my life around amateur radio for the last 25 years . . . and that *is* most of my life. I've made it my business to keep up with just about everything going on and the people involved. I've participated with enthusiasm in just about every phase of the hobby, starting out back in the 1930s with CW on 40m and 2½m VHF work. I've been into DXing, DXpeditioning, contests, RTTY, SSB, and SSTV, got into FM and repeaters in the 60s with my own repeater, and have a reasonable score via OSCAR in mode B (the hard one). No, I'm not about to tear down amateur radio.

Come to Atlanta, and let's get together to see if we all aren't

Continued on page 166

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LETTERS

JONESTOWN

We believe that radio broadcasts were made from Guyana to San Francisco on the day before and the day that Congressman Leo Ryan was killed in Guyana.

Our office would appreciate your magazine printing a request for any ham radio operator who had contact with the People's Temple radio on November 17 and/or November 18, 1978, to contact the San Francisco District Attorney's Office at either (415)-553-1505 or (415)-553-1054 (call collect).

Thank you for your service.

Douglas N. Keener
Investigator
District Attorney's Office
San Francisco CA

AMMUNITION

As I was stuffing my husband's numerous magazines in the usual 99% of the closet (headache of wives of all hobbyists), I happened to drop your Aug., '77 issue of *Kilobaud*. It fell open to an article entitled, "Sooo, You Want To Be An Author." With nothing else to read in the house but medicine bottles and vegetable cans, I read it. I cannot possibly tell you of my utter amazement at having my husband so perfectly described. The excuses used by your aspiring authors(?) were classic—he's used every one of them, several times, in fact.

Believe me when I say that I am sick and tired of being used as a sounding board for ideas, criticisms, and comments perpetrated by your magazines (he's an avid *73/Kilobaud* reader). My question is this: Why discuss these subjects with a totally unwilling victim when there are people out there who would be happy to hear them? You must realize that I haven't the faintest idea what he's talking about.

I have tried tactful suggestions like "Why don't you get off your backside and write down your ideas and send them in?" Well, the answer, of course, is obvious. Just look at the list given in that article.

I finally drew the line when an article appeared in your magazine this month. The author had the same ideas that my husband had four months ago. And you paid the man one hundred dollars for it.

Just this month, my husband was wishing that there was some way he could buy the computer he wanted so he could start sending in programs (he's a computer technician working for his BSEE). He has the knowledge and the intelligence, but he has no confidence in himself. So, like the dutiful and loving wife that I am, I exercised my right to nag him until he actually sat down and started to write. It's been two days since he started and it's almost finished. Though I am by far no expert, I think it's great.

So, Mr. Green, thank you for supplying the ammunition that was needed for a short but productive battle.

Be looking for a superb article written by a very proud WB0FGO.

Jean M. Johnson
Sioux City IA

WRONGLY POINTED?

I am an avid reader of *73 Magazine* and appreciate your many disclosures of vendors who do not live up to their claims. I do feel it my duty, however, to advise you when it appears the finger has been wrongly pointed. Reference the letter entitled "Skin Disease" on page 118 of the October issue: I sympathize strongly with Mr. Carver about his treatment from Kensco Communications. His accusations towards Southeastern Communications, while certainly understandable, are not warranted, however.

I have dealt with this firm three times in the last six months, each time with excellent service. Actually, this firm seems to go out of its way to please. Upon receipt of the first order of six crystals, which arrived one week after order, one crystal was bad (no one's perfect). It was mailed back on Thursday, and its replacement arrived the following Wednesday. The second order was back-ordered and then shipped special delivery at Southeastern's expense when they were advised of the urgent need. The third was requested on a Thursday evening by phone and arrived the following Tuesday.

I don't know what more to say. Hopefully, it will not be long before service such as this is recognized. It seems unfair that a company should acquire the reputation of another just because they buy their stock.

Thanks for the chance to put in a good word for a good company. I hope you'll print this so others can see both sides of the story.

Keep up the good work, Wayne. You certainly help make an already interesting hobby more interesting.

Joe Bushel N4ARJ
Orange Park FL

SEEING THE LIGHT

After years of putting down "Chicken Banders," the light suddenly dawned that I might be missing something. My unfair speeding ticket for 50 mph in a country "30 mph zone" was the final clincher. I couldn't help but notice, as the polite but firm officer was writing my summons, that all cars with CB antennas were leisurely proceeding through the speed trap at a mere 29 mph.

I muttered all the way home: "I just gotta get me a CB." My XYL only shook her head—she's used to my muttering.

A short time later, while wandering through a local hamfest flea market, I encountered an enterprising CB dealer who was selling new (outlawed) 23-channel CB radios, sans mike, as "CB monitors" for only $7.00 each. He assured me that there was no transmitter in the case, only the receiver. Hmm—perhaps he was "mistaken" about the "missing transmitter." My sporting blood said "buy," but my intuition does not always give me the best advice. For instance, the bumper sticker on my Edsel used to say "AM—YES, SSB—NO." You get the drift!

So I bought the $7.00 wonder and after further searching and dickering bought a microphone for $1.00 and a used Hustler mobile CB antenna for $2.00.

Not wanting to wait until I arrived home to test the rig, I nervously connected power leads to fuse block and ground, plugged in the dollar mike, temporarily connected my 5/8-wave 2 meter FM antenna, and turned on the switch. Immediately my car was filled with rasping, squawking CB signals! At least the receiver section worked. Now for the acid test. I turned the channel selector to a relatively quiet channel, squeezed the push-to-talk switch, and timidly requested a signal report. "Wall to wall and treetop tall" came back the report from a mobile station claiming to be eight miles from my location! Success! I had achieved "Good Buddy" status for only $10.00. Could have had it for only $8.00, if I hadn't bought the antenna! Say, wonder if the guy who sold me the $2.00 Hustler will take it back at next year's Syracuse Hamfest?

Charles Willson K2GMZ
Palmyra NY

GOOD-BYE

I have received a notice that it is time to renew my long-standing subscription to *73 Magazine*. I have decided not to renew. Among the reasons for this decision, the following are the most pertinent.

The editorial policy of your magazine appears to promote unlawful activities and to encourage your readers to be scofflaws. I refer especially to your articles about radar jamming. Amateur radio does not need a spokesman who advocates this type of activity, and I certainly do not care to support the distribution of this type of material. Your proposal for the formation of a religious cult to further impede enforcement of the law borders on the ridiculous.

It would seem to me that if you would devote your talents to the enrichment of amateur radio instead of filling your editorial columns with attacks on the ARRL and the FCC, your magazine would benefit. One cannot build a desirable reputation by degrading others!

Your conduct is hurting not only amateur radio, but also your pocketbook, which, if I read between the lines correctly, is very near to your heart! It is my understanding that many others feel as I do and are not renewing their subscriptions. I was a charter subscriber to both *Byte* and *Kilobaud*, and when my *Kilobaud* subscription expires, it will not be renewed.

Mel Hart W0RV
St. Louis MO

MORE ON KM1CC

I was glad to read the article, "The KM1CC Story," in the October issue of *73 Magazine*. However, I should correct the statement made about the equipment loaned to KM1CC by RCA Global Communications, Inc. The reference to "a modern WCC inked-paper readout receiver" isn't quite correct.

First, the inked-paper re-

ceiver, more appropriately recorder, isn't a receiver as most of us would think of a receiver. Typically, when we speak of receivers in the amateur radio vernacular, we are talking about devices used to detect radio signals and convert them to a form of audio signal. The above-mentioned recorder does not detect radio signals; rather, it uses audio to control the deflection of a stylus, thus yielding an inked trace of the input audio.

Neither would I describe the equipment as *modern*, because it dates back before World War II and hasn't been used at WCC since about that time. Incidentally, the receiver loaned with the recorder was an old Radiomarine AR-67, an LF and MF band receiver used at WCC quite a few years ago and hardly modern.

The equipment loaned by WCC was to enable the non-amateur to observe a visual display of CW signals. In this case, the recorder and the AR-67 receiver were used to monitor the WCC 500 kHz, A-2, CW signal.

I felt these points should be brought out so that the astute reader doesn't get the impression that we (WCC) are still using the *old* inked-paper recorder and calling it *modern*.

Wm. H. Farris, Jr. K1WF
Chatham MA

PAINT RIP-OFF

This note is to notify your readers of a new rip-off. It's called "Paint falling off your car due to rf." This BS is being passed around to auto dealerships and auto paint shops—that rf makes paint fall off cars in the area of the antenna. In my case, my new '78 car's trunk lid is discolored and the paint is chipping off. The dealer says that my radios are making it do that and that they are not going to fix it. I have talked to several other radio ops and they were told the same thing about the paint on their cars.

If this happens to anyone else, call the local Consumer Affairs Office and raise hell. I did, and it worked.

Jim Menefee WA4KKY
Jacksonville FL

CODE SUCCESS

Your long-standing theory on teaching Morse characters at high speed while spacing them out to make 5 wpm is working out well for a class of prospective Novices I'm teaching. I explained that I was doing this in order to have them learn letter sounds instead of having them go through the double step of counting dots and dashes and then translating that to letters. They accepted the logic of this and seem to be having no trouble copying letters at 15 wpm, spaced to about 7.

Linc Thorner WDØCLB
Minot AFB ND

TOMBSTONE GAMBLING

"New Life for Old Transformers" in the January, 1978, issue was excellent, but one cringes when instructed to connect 110 volts to "what you suspect are the primary leads"! Gamble wrong and the author's address of Tombstone could become sadly appropriate.

A safe and constructive suggestion is offered: First, set the ac voltmeter to its highest range. Energize a separate 6.3-volt transformer and apply its low voltage to the unknown windings. When approximately 110 volts is measured across another winding, *that* is the primary, and the energized winding is a 6.3-volt winding. *Now* it is safe to apply 110 V ac to the primary and identify any remaining windings.

Gene Brizendine W4ATE
Hunstville AL

BOX-BUSTER

Well, Wayne, you have done it again!! Here I am looking at my nice new set of library shelf boxes and wondering how the heck I am going to get the December Issue of *73* into one of them which already contains the first eleven issues! Leave it to Green to sell you a product and then have such a thick set of magazines that you can't possibly fit a whole year's worth of mags into it. I didn't have any problem fitting in some of the other mags! Oh well, I guess I'll just have to put the December issue alongside the box when I get it! Keep up the good work, and keep those RTTY articles coming.

Robert J. Farrell Jr. WB2COY
Poughkeepsie NY

THE WORD FROM JEDDAH

My friend W9MXU receives current copies of *73 Magazine* here in Jeddah (costs $5.05 US to mail the copies to him each month). I would say you have a devoted subscriber indeed!!

What is great is that he shares *73* with me and now I want to be a subscriber—enclosed is my subscription for 3 years. Please send *73* to my home QTH in the USA.

There are many hams here in Jeddah from all over the world, as well as many from the U.S.A.—all we can do is listen to all those beautiful CQs on all the ham bands! I'm using a portable Toshiba RP-2000F receiver covering FM broadcast through 30 MHz; it also has a bfo for SSB and CW. It's a fine little receiver and I had not seen it in the U.S.A. before leaving for Arabia.

I hope when I arrive home I will have my first issue of *73*—that would be great. The very best to you and your organization on the outstanding job you do for amateur radio.

David O. Finnell W5LCL
Jeddah, Saudi Arabia

COMMON SENSE

My hat is off to Wayne Green and his magazine as the finest amateur radio publication on the market. Contrary to Merrill Eidson's comments that Wayne should stop attacking the ARRL and stick to improving *73*, I feel that Wayne is justified in his comments on the ARRL.

Merrill mentioned being a solid member of the ARRL for fifty years in his letter. This is indicative of quite a few members of the organization. Most are from the spark-gap era and the big guns running the organization operate it with this antiquated style.

I have been a ham for a number of years and feel that a magazine such as *73* is progressive and certainly represents the modern technology and operating practices of amateur radio. The only value I ever received from *QST* was who made DXCC, WAS, etc. As for technical articles of value, *QST* never did impress me.

The ARRL certainly needs to work more for the interests of all hams instead of trying to promote measures that will benefit the elite group. A more down-to-earth approach by the ARRL would restore my faith in the organization.

Wayne, keep up the good work. You have my full support. Your common-sense approach to amateur radio is needed to keep things in their perspective.

Dick Sullivan KØDQG
Des Moines IA

PETTING

Thanks to Paul A. Lilie for his fine article on the Commodore PET ("Look What Followed Me Home!", page 142, November, 1978). One of his "complaints" regarding the tape-handling system is the difficulty he experienced finding the end of program B on a tape when he wants to load a new program, A, on the same tape (he listens on an audio cassette deck for the end of the noise).

I have a better suggestion: Ask PET to VERIFY "B". PET will search for B, find it, compare it with A in memory and report a "VERIFY ERROR." No matter, you've found the *end* of B, which is what you need before asking PET to save "A". PET stops at the end of the VERIFY process.

The PET's implementation of the IEEE-488 bus makes it a truly professional machine, well beyond the mere "hobby video game" class.

How about some articles on the use of PET as a Morse/RTTY terminal?

Paul Birman WA2JPJ
Flushing NY

Ham Help

We would like to swap club newsletters with other amateur radio clubs. If interested, contact:

Sterling-Rock Falls Amateur Radio Society
c/o Donald Van Sant WA9PBS
1104 5th Ave.
Rock Falls IL 61071

In the last few years, I have been looking for a list of the frequency bands and power limitations of amateur stations in foreign countries. It is my opinion that such data would prove valuable to many amateurs, both foreign and domestic. Most of the information on the American amateur bands is widely published and well-known, but that of many foreign countries is believed to be considerably restricted. Help in directing me to a source of this type of information would certainly be appreciated. Thanks for any information anyone may be able to provide.

Paul Wiegert W8TH
1205 East Franklin St.
Centerville OH 45459

I would appreciate (and pay reasonable expenses, if necessary) info on solid-stating (ICs?) a WWII-type BC-221-m frequency meter. If I build modular, why can't I use it for CW vfo? All responses acknowledged. Thanks.

Justin B. Snyder WA9MQO
403 North Ave
Lake Bluff IL 60044

Contests

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

THE WEST AUSTRALIAN 150TH YEAR CELEBRATION CONTEST

The aim of the contest is for amateurs on all continents to contact amateurs in Western Australia (VK6) on all bands using all modes, this being to commemorate the 150th year celebration of the foundation of Western Australia.

The contest will commence at 1600Z on 31 December, 1978, and end at 1600Z on 31 December, 1979.

All authorized amateur bands may be used between 1.8 MHz and 28 MHz using any of the modes appropriate to the regulations applying to the entrant. Operators are encouraged to operate both phone and CW.

The three highest scores from each continent for mixed and individual modes will receive a commemoration certificate. This contest is also open to SWLs.

For VK amateurs and SWLs, the three highest scores from each state will be eligible for a certificate, while VK6 participants who have more than 100 out-of-state QSOs will get an award.

SCORING:

One contact in each mode is allowed in each band every day with the same station, for which the following scores and multipliers will apply: CW—5 points per contact; phone—3 points per contact; RTTY—6 points per contact. Multipliers: One point per band used, provided that 30 QSOs are obtained on that band, except for 1.8 and 3.5 MHz, where 1 QSO will count. Final score = total points × total multipliers.

LOGS:

Contest logs should show date, time, call, band, mode, RST out, RST in, points scored, and include a running total. The log should bear a front cover sheet bearing the following: call, address, claimed score, and signature. Contest logs are to be forwarded to: The Contest Manager, 150th Celebration Contest, PO Box 6250, Hay Street East, Perth 6000, Western Australia.

NEW HAMPSHIRE QSO PARTY
2000 GMT February 3 to 0500 GMT February 4
1400 GMT February 4 to 0200 GMT February 5

The contest is sponsored by the Concord Brasspounders, Inc., W1OC, to promote the Worked New Hampshire Award. Stations may be worked once per band per mode. NH stations may work each other.

EXCHANGE:

NH stations send RS(T) and county, others send RS(T) and ARRL section or country.

SCORING:

NH stations score 1 point per QSO times the number of ARRL sections plus countries plus NH counties. Others score 5 points per NH QSO times the number of NH counties.

FREQUENCIES:

CW—1810, 3555, 7055, 14055, 21055, 28130; Phone—1820, 3975, 7235, 14280, 21380, 28575; Novice—3730, 7130, 21130, 28130; VHF—50.115, 145.015, FM simplex (no repeaters!).

AWARDS:

Top scorer in each NH county and top scorer in each state, province, and country (50 points min.). Additional certificates available for confirmation of all 10 NH counties. Send logs, summary, and checksheets to: Concord Brasspounders, Inc., C. Halloway, 9 Via Tranquilla, Concord NH 03301. Mailing deadline is March 12. Include a business size SASE for results and/or award.

TEN-TEN INTERNATIONAL NET WINTER QSO PARTY
0000 TO 2400 GMT on February 4 and February 11

The contest is open to all amateurs, but only members are eligible for awards. All contacts must be made on 10 meters. Classes of operation include: single-op, multi-op, and QRP (20 Watts PEP or less). A station may be counted only once; all logs must be in GMT. Stations with new calls must list old callsign. All QRP stations must list equipment used.

THE 73 MAGAZINE 10 METER AWARDS

The return of vigorous solar activity means that 10 meters is once again a band to be reckoned with. Ol' Sol's 11-year cycle of sunspot production is about to hit a peak, with the result that QRP 10 meter DX is possible.

Now's the perfect time to convert that old CB rig to 10. American Crystal Supply makes a variety of simple and inexpensive conversion kits, or you can do-it-yourself from the articles in 73. True appliance operators can purchase ready-made rigs from Bristol Electronics or Standard Communications. To give you an added incentive, 73 is offering two nifty Certificates of Achievement for 10 meter channelized communications.

For domestic types, there is the 10-40 Award. This one should be pretty easy—just work 40 of the 50 states. The DX Decade Award goes to DXers who work 10 or more foreign countries with a channelized 10 meter rig. We have endorsement stickers, too—the whole bit.

To give everyone an equal shot at award #1, only contacts made October 1, 1978, or after will be valid.

Well, don't just sit there. Get out your soldering iron, order some crystals, and put that CB rig on 10. This is going to be fun, so don't miss out!

RULES

1) All contacts must be made in the 10 meter amateur band using channelized AM equipment. Both converted Citizens Band equipment and commercially-produced units may be used.

2) To be eligible for award credit, all contacts must be made October 1, 1978, or after.

3) The 10-40 Award is available to applicants showing proof of contact with stations in at least 40 of the 50 United States. A special endorsement sticker will be available to those working all 50 states.

4) The DX Decade Award is available to applicants showing proof of contact with at least 10 foreign countries. Endorsement stickers will be awarded for 25, 50, 75, and 100 countries.

5) A log of stations worked, with the date, time, and type of equipment used for each contact, must be submitted when applying for each award or endorsement.

6) Each application for an award or endorsement must be accompanied by a signed statement that all claimed contacts are valid. No QSL cards need be sent, but they must be in the possession of the applicant.

7) To cover costs, a fee of $5.00 must accompany each application for the 10-40 or DX Decade Award. The fee for endorsement stickers will be $2.00 each.

8) All award applications should be mailed to: Chuck Stuart N5KC, 5115 Menefee Drive, Dallas TX 75227.

Calendar

Feb 2-11	ARRL Novice Roundup
Feb 3-5	NH QSO Party
Feb 4, 11	10-10 Net Winter QSO Party
Feb 10-11	QCWA QSO Contest—CW
Feb 17-19	Two-Land QSO Party
Feb 17-Mar 4	University of Cape Town Festival Station
Feb 24-25*	French Contest—Phone
Mar 3-4	ARRL DX Competition—Phone
Mar 10-11	QCWA QSO Contest—Phone
Mar 17-18	ARRL DX Competition—CW
Mar 24-26	BARTG Spring RTTY Contest
Mar 31-Apr 1	International 10-10 Net Canterbury Chapter QSO Party
	North Dakota QSO Party
Apr 7-8	ARRL Open CD Party—CW
	QRP QSO Party
Apr 21-22	ARRL Open CD Party—Phone
	ARRL EME Contest
May 19-20	ARRL EME Contest
June 9-10	ARRL VHF QSO Party
June 23-24	ARRL Field Day
July 4	ARRL Straight Key Night
July 14-15	ARRL IARU Radiosport Competition
Aug 4-5	ARRL UHF Contest
Sept 8-9	ARRL VHF QSO Party
Sept 15-16	Scandinavian Activity—CW
Sept 22-23	Scandinavian Activity—Phone
Oct 13-14	ARRL CD Party—CW
Oct 20-21	ARRL CD Party—Phone
Nov 3-4	ARRL Sweepstakes—CW
Nov 17-18	ARRL Sweepstakes—Phone
Dec 1-2	ARRL 160 Meter Contest
Dec 8-9	ARRL 10 Meter Contest

* = described in last issue.

Stations can credit any chapter with their score as long as they hold a certificate from that chapter.

EXCHANGE:

Call, 10X number, ARRL section, and name.

SCORING:

Continental USA contacts are 1 point, 2 points if 10X member. DX (outside continental USA) are 2 points or 3 points if 10X member. QRP contacts are 2 points or 4 points if 10X member.

ENTRIES:

Members only send logs to Robert C. Mugherini WA1AKS, PO Box 169, Randolph MA 02368. Logs must be received no later than March 11. Results will be published in the 10-10 Net spring bulletin.

AWARDS:

For each class, 1st place certificate to each US district, KL7, KH6, and other US Pacific Islands; each VE district, Central America, and Caribbean; So. America; Europe; Africa; and So. Atlantic, Asia, Australia, New Zealand, and So. Pacific.

Results

RESULTS OF WASHINGTON STATE QSO PARTY FOR 1978
Sponsored by Boeing Employees' Amateur Radio Society (BEARS)

TOP SCORES, OUT-OF-STATE:

State	Call	QSOs	Mult.	Total
Alabama	K4ZGB	85	23	3910
Arizona	W7RIR	35	17	1190
California	N6PE	104	30	6240
Colorado	K0MT	62	28	3472
Connecticut	W1VH	50	19	1900
Delaware	N3AHA	2	2	8
Florida	K4DDB	68	19	2584
Georgia	N4NX	98	31	6076
Idaho	K7TAK	29	12	696
Illinois	K9BG	103	27	5562
Indiana	WB9BAI	70	18	2520
Iowa	WB0UIT	24	9	432
Kansas	K0FPC	22	9	396
Kentucky	WA4QMQ	28	14	784
Louisiana	W5WG	116	30	6960
Maine	W1DLC	46	13	1196
Maryland	W3PYZ	38	17	1292
Massachusetts	W1AQE	39	20	1560
Michigan	WA8VJE	44	12	1056
Minnesota	WB0LNO	39	14	1092
Missouri	K0RWL	15	10	300
Nevada	W7HI	32	14	896
New Jersey	WB2VFT	92	20	3680
New York	W2NRD	33	14	924
North Carolina	N4GF	9	6	108
Ohio	AD8J	41	14	1148
Oregon	K7DRD	5	4	40
Pennsylvania	WA3JXW	26	11	572
Rhode Island	WB1DET	20	10	400
South Carolina	K4BZD	37	12	888
South Dakota	WA0BZD	42	14	1176
Tennessee	WA4CMS	27	12	648
Texas	W5VGX	44	15	1320
Utah	W7LN	13	9	234
Virginia	W4KMS	33	11	726
Wisconsin	K9GTQ	41	18	1476
Ontario, Can.	VE3KK	52	20	2080
Nova Scotia, Can.	VE1BNN	5	4	40
Brazil	PY1BAR	16	9	288
Japan	JR1NRP	18	8	288
Sweden	SM3BCZ	15	10	300

TOP SCORES, WASHINGTON STATE:

County	Call	QSOs	Mult.	Total
Adams	W7GHT/M7	10	9	180
Asotin	W7GHT/M7	19	12	456
Chelan	N7RC	109	30	6540
Clark	N7ZZ	2090	114	476,520
Columbia	W7GHT/M7	18	12	432
Cowlitz	WA7PMW	466	62	57,784
Douglas	W7GHT/M7	28	13	728
Ferry	W7GHT/M7	20	10	400
Franklin	W7GHT/M7	25	17	850
Garfield	W7GHT/M7	25	16	800
Grant	W7WMO	393	53	41,658
Island	W7UMX	1053	90	189,540
King	K7GR	403	55	44,330
Kitsap	WA7UWE	620	56	69,440
Lincoln	W7GHT/M7	33	19	684
Okanogan	W7GHT/M7	14	11	308
Pend Orielle	W7GHT/M7	18	20	360
Skagit	WA7GVM	749	76	113,848
Snohomish	K7II	125	36	9000
Spokane	W7GHT/M7	29	16	928
Stevens	W7GHT/M7	38	21	1596
Thurston	N7RV	190	45	17,100
Wahkiakum	WB7OVA	46	19	1738
Whatcom	WA7YCZ	1430	71	203,060
Whitman	W7GHT/M7	19	13	494

QCWA MEMBERSHIP QSO CONTEST

CW:
0001 GMT Saturday, February 10 to 2400 GMT Sunday, February 11
Phone:
0001 GMT Saturday, March 10 to 2400 GMT, Sunday, March 11

Historically, the QCWA membership contest has been held on a single weekend for both modes of operation. For greater participation in 1979, the contest will be held on two weekends separated by one month. For additional interest and point-scoring purposes, three global areas have been established. Frequencies, confirmation texts, and related contest rules and guidelines are available in the *QCWA News.*

TWO-LAND QSO PARTY

2100 GMT Saturday, February 17 to 0700 GMT Sunday, February 18
1300 GMT Sunday, February 18 to 0300 GMT Monday, February 19

This is a new contest organized by the South Jersey Contest Coalition. There is no operating time limit within the contest periods, but there is a mandatory 6-hour rest period from 0700 to 1300 on Sunday. The same station may be worked once per band and mode, and mobiles and portables may be worked each time they change counties. The states of New Jersey and New York, with 83 counties, will try to work the world and vice versa!

EXCHANGE:

RS(T), county, and state for Two-Land stations. RS(T) and state, province, or country for others.

FREQUENCIES:

CW—1805, 3560, 7060, 21060, 28060; SSB—1815, 3900, 7230, 14280, 21355, 28600; Novice—3725, 7125, 21125, 28125.

SCORING:

Each QSO counts 2 points. For Two-Land stations, the multiplier is the number of states, provinces, and DX countries (by DXCC) plus the number of Two-Land counties. For all others, the multiplier is only the number of Two-Land counties (83 max.).

AWARDS:

Certificates to the top scoring station in each Two-Land county, each state, province, and DX country. Second- and third-place awards will be issued where justified. Awards also for top mobile, portable, multi-operator, Novice, and club.

ENTRIES:

Logs with over 200 QSOs should include a dupe sheet. Indicate each new multiplier as worked. Also, include a summary sheet and usual declaration. For results, include a large SASE; DX stations include a large SAE. Send entries to: South Jersey Contest Coalition, c/o AB2E, Darrell Neron, 322 S. Cummings Avenue, Glassboro NJ 08028.

THE UNIVERSITY OF CAPE TOWN FESTIVAL AND AWARD, 1979

To commemorate the 150th anniversary of the University of Cape Town, Cape Town, Republic of South Africa, the Cape Town branch of the SARL will operate a special festival station with call ZS1UCT (ZS1-*U*niversity of *C*ape *T*own) and issue an award.

The University of Cape Town Festival Station will operate Saturday, February 17, to Sunday, March 4, 1979, Saturdays and Sundays 0600 to 2000 GMT, and weekdays 0700 GMT to 1000 GMT, 1500 GMT to 2000 GMT.

FREQUENCIES:

Use for calling. Actual frequency will depend on QRM. 40 meters—7.050 MHz. 20 meters—14.210 MHz. 15 meters—21.200 MHz. 10 meters—28.580 MHz. 2 meters—145.500 MHz.

TRANSMISSION MODES:

SSB, CW, RTTY, and FM.

SARL Bureau, P.O. Box 3037, Cape Town 8000, Republic of South Africa.

RULES AND AWARDS:

The award is open to all licensed amateurs and shortwave listeners (SWLs). DX stations and SWLs must log **ZS1UCT** plus two **(2)** other ZS1 stations (ZS1 contacts to be logged between February 15 and March 15, 1979). ZS and ZR stations log ZS1UCT plus 5

Continued on page 172

Five-Chip Auto IDer

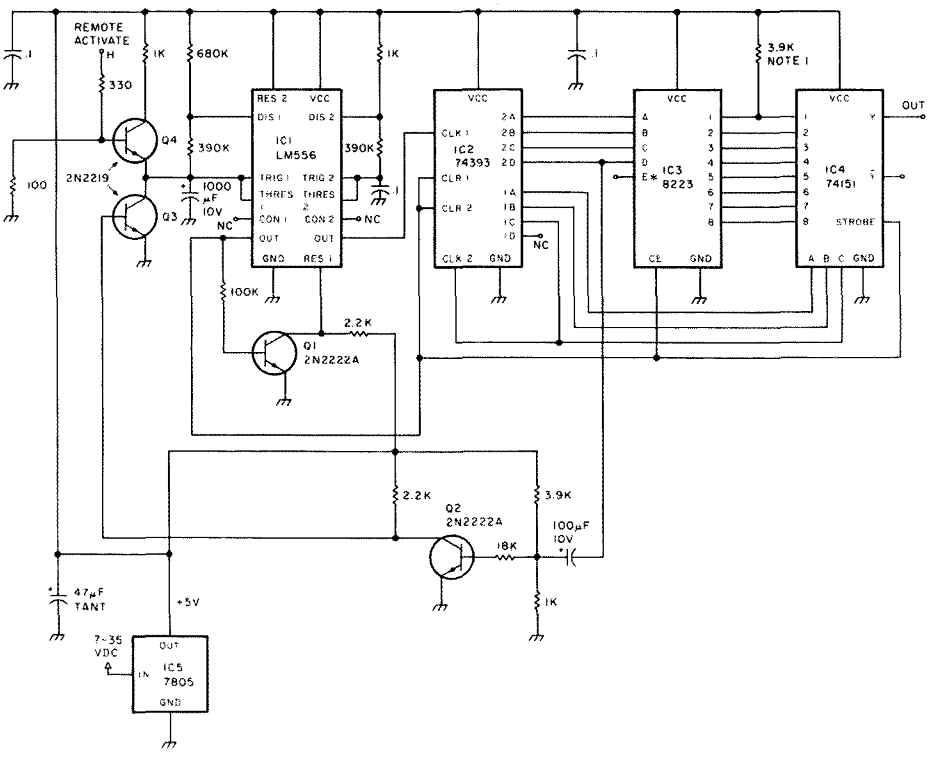
—in case you forget

You don't have to speak TV to use this one.

Richard Bartholomew
Box 300 Butler Terrace
Freeland PA 18224

Having seen several articles pertaining to automatic code identification, all using diode matrices or one-shots, I thought I'd share a circuit I developed for TV translators requiring much the same thing. This particular circuit uses only five ICs, three TTLs (cheap), one 5-volt regulator, and one 256-bit ROM (read only memory). There are also four transistors performing housekeeping chores such as inversion and pulse generation.

Referring to Fig. 1, the circuit operation can be explained as follows: IC1, an LM556 dual timer uses half of its internal circuitry to provide a 30-minute timer. The output of this timer is normally high. After timing-out, it goes low which turns off Q1 and forces the reset pin on the second half of the timer to go high. This enables the astable oscillator, and a clock stream, at about 8 Hz, toggles IC2, a dual 4-bit binary counter. This counter performs two functions. First, it addresses IC4, an 8-line-to-1-line multiplexer, which causes IC4 to selectively scan its inputs for a signal. Going back to IC2 now, it also addresses IC3, a 32 word, 8 bit/word ROM. The output of the first counter also drives the clock input of the second counter at a speed 8 times slower than the first half. This causes the multiplexer to scan each of its 8 inputs before the ROM address changes once.



The ROM is programmed as shown in Table 1. I always allow the first three bits at address 00000 to be 0. This allows for any clearing operations of the counters to com-

*Fig. 1. Schematic diagram of automatic code ID circuit. *Tie high or low depending on*

used the letters "DE W79QY7." I allowed 3 consecutive 1s for a dash and one 1 for a dot. Spacing between letters is three 0s and spacing between words is seven 0s. The table is read from address 00000, A through H, then address 00001, A through H, and continuing down through binary address 01111. As can be seen, the ROM outputs 8 bits at a time to the 8 inputs of the multiplexer. This is the reason for running the multiplexer 8 times faster than the ROM. As each 8 bits appear on the inputs to the multiplexer, the inputs are scanned and converted to serial data at the Y output.

At the completion of binary count 16, the negative-going edge on the 2D output of IC2 turns off Q2 for a period of about 100 ms. This causes its collector to go high. This high voltage on the base of Q3 forces it into heavy saturation, discharging the time-out capacitor at TRIG 2 on IC1. This causes the timer to reset to zero and start timing out 30 minutes, when the sequence will repeat. Q4 was added to allow remote triggering of the timer. This is accomplished by either a logic 1 at the remote activation input or tying this point to +5 volts.

IC5 is simply a 5-volt regulator which takes anywhere from 7 to 35 volts input and converts it to 5 volts for the rest of the circuity.

This circuit can be programmed to provide two separate 128-bit messages, selectable at the flip of a switch. Input E on IC3, which is shown open on the schematic, can be tied to an SPDT switch which has one side grounded and the other tied to +5 volts. When switched to ground, the address to the ROM will start with 00000 and when switched to +5 volts, it will start with 10000.

Being a computer freak and not a ham, I am not sure if this circuit will be an aid to anyone, but if so, I would like to hear from you regarding your uses and any changes you might have made. (For amateur use, the 30-minute timer sequence would have to be shortened to 10 minutes. The sample call sounds like a rare one.—Ed.) ■

BCD count to ROM	Desired output of ROM A	B	C	D	E	F	G	H
0 0 0 0 0	0	0	0	1	1	1	0	0
0 0 0 0 1	0	1	0	1	0	0	0	1
0 0 0 1 0	0	0	0	0	0	0	0	1
0 0 0 1 1	0	1	1	1	0	1	1	1
0 0 1 0 0	0	0	0	1	1	1	0	1
0 0 1 0 1	1	1	0	1	0	1	0	1
0 0 1 1 0	1	1	0	1	1	1	0	1
0 0 1 1 1	1	1	0	1	0	0	0	1
0 1 0 0 0	1	1	0	1	1	1	0	1
0 1 0 0 1	0	1	1	1	0	0	0	1
0 1 0 1 0	1	1	0	1	0	1	1	1
0 1 0 1 1	0	1	1	1	0	0	0	1
0 1 1 0 0	1	1	0	1	1	1	0	1
0 1 1 0 1	0	1	0	1	0	0	0	0
0 1 1 1 0	0	0	0	0	0	0	0	0
0 1 1 1 1	0	0	0	0	0	0	0	0
1 0 0 0 0	0	0	0	0	0	0	0	0

Table 1. ROM programming sample. Sample indicated is W79QY7.

The Vacationer

—B&W's portable antenna

Steve Schwartz WA2ALT
2770 West 5 St. Apt. 18A
Brooklyn NY 11224

If you travel a lot or live in an apartment, there's a great little antenna for the low bands. B&W makes a low-band antenna covering 2-40 meters and it virtually takes up no space. The antenna is about 4½ feet long. When the antenna is disassembled, it can fit in a small suitcase with all your clothes. This antenna is the Vacationer™.

The antenna comes with four coils and a shorting bar for 6 and 2 meters. The Vacationer also comes with coax, counterpoise, and all mounting hardware.

Changing coils is a breeze. To change a coil, all you have to do is loosen two screws and the coil slides right off. Tuning the antenna is just as easy. The whip itself does not have to ever be touched (except on 2 meters). Tuning is done by adjusting the length of the counterpoise. The counterpoise can hang out the window or lie along the floor in the room.

There's nothing else to buy for the antenna. The antenna mounts on the window via a vise-type mechanism. It's also great for you apartment-dwellers who can't put up antennas.

The only "tool" needed for assembly and disassembly is a flat screwdriver.

The Vacationer antenna can be ordered from any store which stocks B&W parts. The number of the antenna is the Model 370-10. The antenna lists for approximately $32.50.

There is a previous model, number 370, which is less in price and does not include 40 meters. If you would like the specifications, write to Barker and Willamson, Inc., 10 Canal St., Bristol PA 19007.

It's a great little antenna and the swr is adjustable to 1.1:1. ■

Tone Decoder Improvements

—another step toward perfection

With a signal conditioner and valid-digit recognizer, you can't go wrong.

Rick Swenton WA1LMV
19 Allen Street
Bristol CT 06010

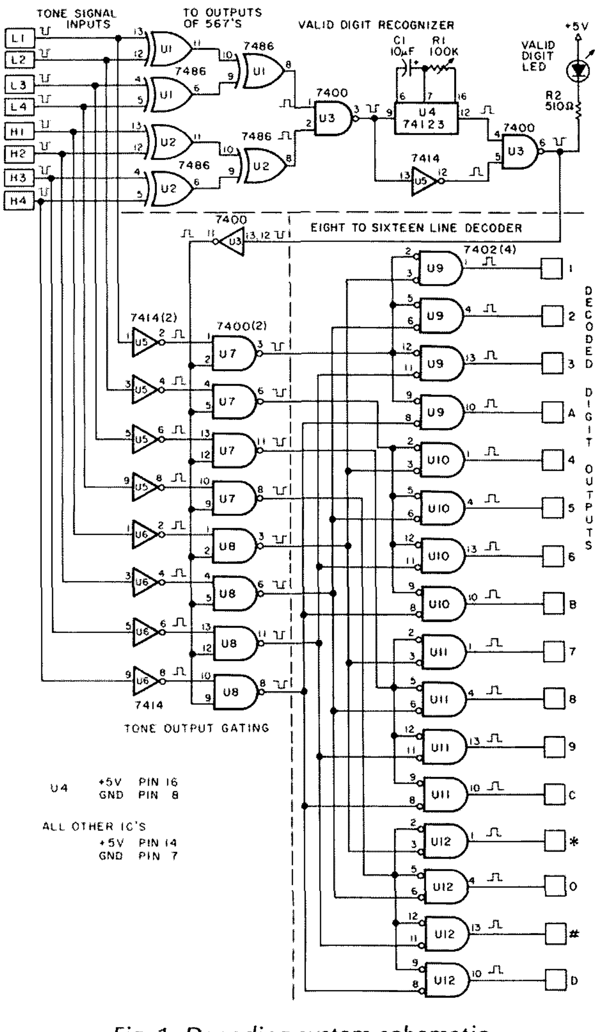


Fig. 1. Decoding system schematic.

The Signetics NE567 is my favorite toy. I'll never give it up. After working on several old telephone company decoders, I realized that they definitely leave something to be desired—especially if you were to attempt to build one from scratch! Also, after experiencing several commercial-quality state-of-the-art DTMF decoders, I realized that while they are terrific decoders, their price is out of sight. That leaves the NE567.

Mr. Everhart* described the limitations of the 567 in a very thorough presentation. However, its limitations can be worked around to yield a high quality, superior performing decoder. The 567 cannot stand alone without conditioning its output. The circuitry presented here is a sophisticated signal conditioner and valid-digit recognizer. It is an improved alternative to separate delay networks on the outputs of all eight 567s. (See Fig. 7 in referenced article.)

The block diagram of this system is in Fig. 2. It consists of two bandpass filters, one for the low-group tones, and one for the high-group tones, two limiters, eight frequency decoders, a valid-digit recognizer/signal conditioner, and an eight-to-sixteen-line decoder. To build your decoder, see Everhart's article for information on building the bandpass filters, limiters, and 567 decoders. The outputs of the eight 567 decoders are then fed into the valid-digit recognizer, Fig. 1. The valid-digit recognizer consists of U1 and U2 (7486 exclusive OR gates), U3 (7400 quad two-input NAND gate), U5 (7414 hex inverter), and U4 (74123 monostable multivibrator).

The function of U1 and U2 is to determine if the 567 decoders are sending only one low-tone signal and only one high-tone signal. The outputs of U1 and U2 are ANDed together by U3 so that the output of U3 (pin 3) goes low only when the following conditions are met: You

*J. H. Everhart WA3VXH, "Toward a More Perfect Touchtone Decoder," *73 Magazine*, November, 1976, pages 178-181.

must have only *one* low tone *and* only *one* high tone.

The next section of the valid-digit recognizer is the delay circuit consisting of U3, U4, and U5. R1 and C1 determine the time delay. The output of the valid-digit recognizer circuitry is U3, pin 3. Pin 3 of U3 goes low only when one low tone AND only one high tone are present and they must remain uninterrupted for the time duration set by R1 and C1. Optimum setting of R1 is from 0.25 to 0.5 seconds. This setting may vary for your particular setup. As a rule of thumb, set R1 to be fast enough for your signaling requirements, but slow enough to reject erratic pulsing. Remember that a condition could exist where a certain voice may be decoded as two tones which happen to be two touchtone™ frequencies. This would meet the requirements of only one low and only one high tone, but would not be decoded if R1 were set correctly.

Next, we use the output of the valid-digit recognizer to gate the outputs of the 567s into the eight-to-sixteen-line decoder. U5 and U6 are 7414 Schmitt triggers. They will further condition the outputs of the 567s and shape the output waveform. U7 and U8 (7400 NAND gates) provide the gating of the 567s to the sixteen-line decoder. Thus, no tone decoding can take place without valid-digit recognition because the outputs of the 567s are not being applied to the sixteen-line decoder unless valid-digit recognition has occurred. The outputs of the sixteen-line decoder, U9-U12 (7402s), are normally low and go high when the digit is decoded.

The system described here is in use at three repeaters in the Hartford CT area (WR1ABM: .28/.88 and 442.85-447.85 and WR1AFU: .75/.15) as autopatch and control decoders and are working well without any problems. With a 0.5-second response time, there has never been a false activation of any function. ■

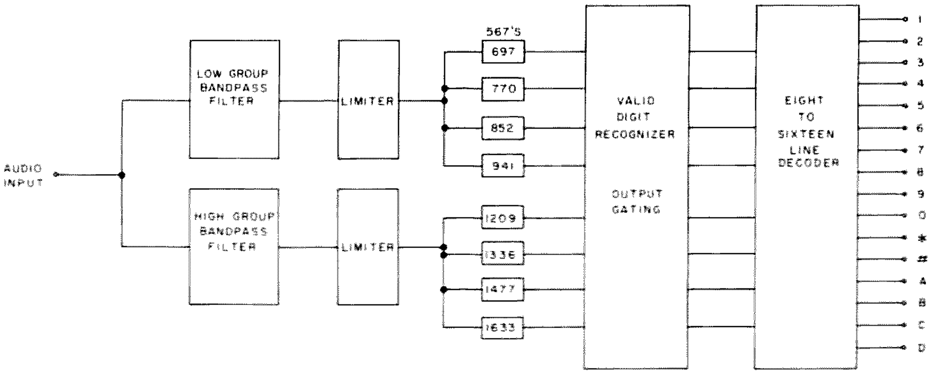


Fig. 2. Block diagram of decoding system.

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The All-Wrong Power Supply

—works in spite of itself

Power to the junk box!—and from it.

Usually when one builds a power supply, one takes a currently vogue circuit and uses it verbatim. For solid-state rig advocates, the present norm is using a transformer, a diode-bridge rectifier, and a series pass transistor. While I have no qualms about this circuit, I know many hams who spend time and money looking for the "proper" parts when, in reality, they can use junk box parts in an equivalent circuit.

The circuit in Fig. 1 is the power supply I have been using for my Icom IC-230. It delivers about 3.5 Amps at 12 volts. When one looks at the schematic, however, the circuit *looks* wrong. First, the transformer voltage is too high and everyone *knows* there are four diodes in every power supply worth mentioning. How can it work?

First, consider the transformer, rectifier, and filter capacitor combination. The output voltage with transformer secondary voltage V_t, load current I_l, and capacitor C connected in a half-wave circuits is: $V_{out} = 1.4V_t - I_l/120C$. The ac ripple on this voltage will be: $V_{ripple} = I_{out}/210C$. Inserting our values we find the following: $V_{out} = 1.4(28V) - 4\ \text{Amps}/(120 \times 4 \times 10^{-3}\ \text{Farad}) = 30.87$ volts and $V_{ripple} = 4/(210 \times 4 \times 10^{-3}) = 4.76$ volts. Thus, the output is a dc level of 30.87 volts with a 4.76 volt ac voltage impressed upon top of it. Therefore, we have a varying voltage from 26 to 36 volts at the input to the regulator.

We have just shown why we are using a higher voltage transformer with a half-wave rectifier. The transformer chosen was a surplus one with a 28 V, 4 A secondary, bought for $1.00. This is in contrast to the 18-volt types usually chosen for a similar supply, then operated with a bridge rectifier.

Practically, what these equations show is that if our regulator can follow an input voltage from roughly 25 to 36 volts, we can use this circuit to make a regulated power supply at a variety of voltages. Before slapping a three-terminal regulator on the output and going to look for a "cold 807," one must do a little more designing.

Returning to the voltage output equation, we note that at zero current our voltage across the filter capacitor is 1.4 × 28 or 39.2 volts. This value is the maximum voltage across the capacitor. Then a capacitor with a working voltage of at least 60 volts should be used.

The standard three-terminal regulators have a maximum input voltage of about 35 volts. Therefore, one might damage or destroy the regulator if it were connected directly to the rectifier output. The zener diode (Z) and the resistor (R) in the schematic take this into account. The zener was chosen from the junk box and almost any power-type zener can be used as long as the regulating voltage is below 35 volts.

The value of resistor R can be easily found. The current through the regulator is roughly the base current of the transistor which is roughly the collector-emitter current divided by the gain of the transistor. Since a typical power transistor has a gain of about 50 and our maximum output current is about 3.5 Amps, we see that the base current is about 70 mA. Since our lowest voltage across the capacitor is about 25 volts, we want something like an 8-volt drop with 70 mA or about 100 Ohms.

Although the drop across the resistor is constant, the actual voltage input to the regulator will vary from 17 to 27 volts. This can influence the choice of zeners since a 25-volt zener will only draw power when the voltage is above 25 volts and, therefore, has a smaller duty cycle than would a 20-volt one. Maximum heating on a 25-volt zener would occur with no current drawn by the regulator. In this case, it would be about 10 mA, so a 1-Watt zener should do. The resistor will dissipate 10 volts at 80 mA, so a 2-Watt one will be fine.

The final bit of analysis deals with the diode (D2) on the ground leg of the three-terminal regulator.

This is used to raise the regulator voltage up by .7 V so a "12-volt" regulator will give a 12-volt output.

No analysis will be given of the power transistor since my only suggestions are to heat-sink it well, choose one with a gain of about 50, and a power of about 75 Watts. A 2N3055 is an inexpensive and usually safe choice. The small capacitor across the output is used for protection from oscillation. Although I have never had a supply oscillate, the capacitor is cheap insurance.

Parts List

D1	10A, 60 piv silicon diode
D2	1A, 15 piv silicon diode
U1	7812, 12-volt positive voltage regulator
Q1	2N3055 transistor
R,Z	See text

The supply was constructed on a piece of particle board with plywood sides and a U-shaped cane metal cover for ventilation. A little decorative stain made the XYL joyfully approve of the supply for use in the den instead of being hidden away.

The design of this supply is neither unique nor innovative, but it shows that one can build a power supply from the junk box that really works.■

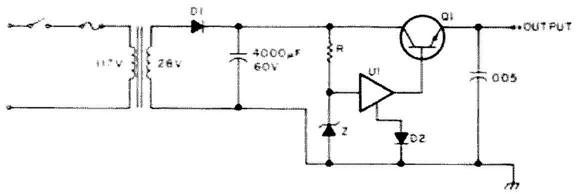

Fig. 1. Power supply schematic diagram.

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The Hardhearted Rf Detector

—insensitive to harmonics

Over the years, the thermal, or calorimetric, wattmeter has remained the standard for all measurements of radio frequency power. Unfortunately, calorimetric power meters are very expensive and, therefore, are found only in the laboratory. Almost without exception, the front panel "power" meter found on a radio transmitter is really a peak-reading voltmeter calibrated to approximate a reading in Watts. Any harmonic energy from the transmitter due to misalignment or component failure can cause this meter to soar to a reading much higher than the true rms power output. The obvious solution has been overlooked. Every radio transmitter can be equipped with a simple power metering circuit offering accuracy and insensitivity to harmonics approaching that of a thermal-type meter.

In place of the usual detector followed by a capacitor input filter, the improved circuit will employ a choke input filter. This circuit, properly designed, will develop an output equal to the average dc level of the half-wave pulsating dc from the detector (resemblance to the choke input power supply filter is not accidental). An average reading voltmeter may be calibrated to read the true average power dissipated by a load. The ratio of average power to rms power remains relatively constant for extreme distortions of the sine wave, while the power, computed by the square of the peak voltage divided by twice the load resistance, may vary several decibels.

This simple high-accuracy circuit has but one special requirement. The input inductor must be chosen so that its effective inductance remains above the critical value required for voltage regulation to the average level over the frequency band of interest. Therefore, a choke approaching self-resonance at the operating frequency would not be suitable. The critical value is computed by: $L_{min} = (0.060/F)R_L$ henrys.

A typical circuit for use at a 50-Ohm termination, where $X_{c1} \leq 5$ Ohms and $X_{c2} \leq R_L/10$, is shown in Fig. 1, and the results from low-frequency (F = 40 kHz) test circuits (Figs. 2 and 3) are shown in Table 1. ■

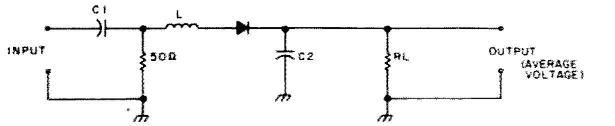

Fig. 1.

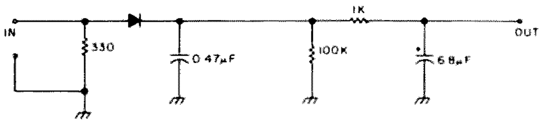

Fig. 3. Average detector.

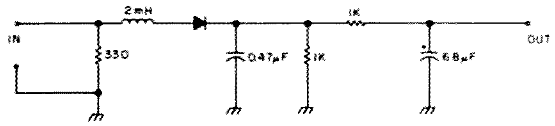

Fig. 2. Peak detector.

Input	Calculated rms power	$E_{Peak\ det.}$	$E_{Avg.\ det.}$
8.0 V p-p triangle	0.016 W	3.5 V	1.0 V
6.5 V p-p sine	0.016 W	2.9 V 4.4 dB	1.0 V
4.6 V p-p square	0.016 W	2.1 V	0.98 V

Table 1.

Custom-Designed Power Supplies

—try the 723

Bargain-basement fanatics will love this new approach.

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LSI, microcircuits, mass production, and high component costs are but a few of the many reasons that are leading to the demise of amateur radio home brewing. In spite of this, there are plenty of well-documented circuits for you to select from that will not wind up costing a fortune to build (see any issue of *73*). Unfortunately, most of them require a power supply which can wind up with a price tag as large or larger than the rest of the project.

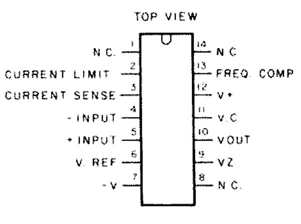


Fig. 1. Pin designation for the 723.

If you are considering bargain-basement electronics, you should also anticipate the problems associated with quality, reliability, and aesthetic appeal. There are precious few units I would let adorn my operating table.

This article will show you how to custom-design your next supply, featuring the widely used 723 IC regulator. This will allow you to have the supply best suited to your application and provide the quality, reliability, and features you desire. All this is at a surprisingly low cost. You should find the design calculations relatively easy and the assembly straightforward.

The 723 Chip

There are many features of the 723 IC, one of which is a temperature-compensated and amplified reference voltage output (Fig. 1, pin 6). This output voltage is typically 7.15 volts and capable of supplying up to 15 mA of current. Current-sense terminals (pins 2, 3) allow the user to select the upper current limit of the supply. Also, the 723 has a built-in error amplifier directly coupled to an "onboard" series pass transistor. This combination is capable of supplying up to 150 mA. The line and load regulation of the supply will be typically 0.1%. Some of the 723's other features are low current drain, low temperature

drift, and high ripple rejection. Another good feature is the $.35 to $.50 price tag in single quantities. It is, in fact, uncommon not to find a 723 stuck somewhere in an OEM industrial supply.

External Components

Before we get into the design calculations, take a look at Fig. 2. T1, C1, and Q1 (or Q1 alternate) are the only external components needed for this supply, the remainder of the components being mounted on the PC board. Looking at T1, you can see I have drawn a center-tapped transformer. If you have this type of transformer, diodes D1 and D2 are used in a full-wave, center-tapped configuration using pads C, D, and E on the PC board. If your transformer has no center tap, use diodes D1 through D4. Connect the transformer leads to pads C and D on the board and you have a full-wave bridge configuration. I have found that a 12-volt filament transformer with a bridge rectifier works extremely well for output voltages from 2 to 7 volts and a 24-volt control type transformer with a bridge rectifier is an excellent choice for output voltages of from 9 to 25 volts. Make sure the transformer secondary current rating is high enough for your supply design. There will be some more comments about T1 later on.

Diodes D1 through D4 must be chosen to handle the current you design the supply for. The popular 1N4000 series diodes are excellent for current levels of up to 1 Amp. The 3-Amp epoxy "bullet" rectifiers are so inexpensive that I try to keep some on hand all the time (MR 500 series). If you are fortunate enough to be able to obtain some Motorola MR 751s, a 6-Amp device, these also may be used on the board. The diodes should have a piv rating of at least 50 volts. By using a glass-epoxy board material with 2 oz. copperclad, the runs on the board are easily wide enough to handle 6 Amps with less than 10° C temperature rise. For design currents higher than 6 Amps, the rectifiers, filter capacitor (C1), series pass transistors (Q1, alt.), and C3 may be wired externally with heavy wire. The circuit board can then be wired in as a control system for the regulated supply. (See Fig. 3.) If you use the board in this manner, do not use R7, which is the current-sensing resistor. Mount the fuseholder for F2 externally, instead of in the hole provided on the PC board, and fuse for the design current. Although not shown in Fig. 2, it is a good idea to wire diode D6 at the output terminals of the supply. This is a "free-wheeling" diode that will protect the regulator board from any inductive transients coming back to the supply from the load (e.g., a T-R relay). A 3-Amp, 200-piv device is suitable for D6.

At this time, it is worth mentioning that Q2 (Fig. 2) will require some heat sinking at the higher current output levels. To do this, you might even wire an externally mounted 2N3053 or 2N3055 to the Q2 pads located on the PC board.

Unless you have a river flowing nearby to cool Q1, a bit of caution must be exercised in what is done here. A 2N3055 has a power dissipation specification of 115 Watts if you can keep the case temperature at 25° C (77° F). Following a derating curve for this transistor, Q1 can dissipate up to 63 Watts at a case temperature of 100° C (212° F). What this translates to is approximately 4 Amps of current with a 15-volt drop from collector to emitter. Allow one 2N3055 for every 4 Amps of output current and, by all means, heat-sink them! Also, if you sink Q2 well, it is capable of driving up to four 2N3055s connected as shown in Q1 (alt.). The other alternative, as previously mentioned, is to externally mount Q2 and wire it into the board. The bottom line here is to keep

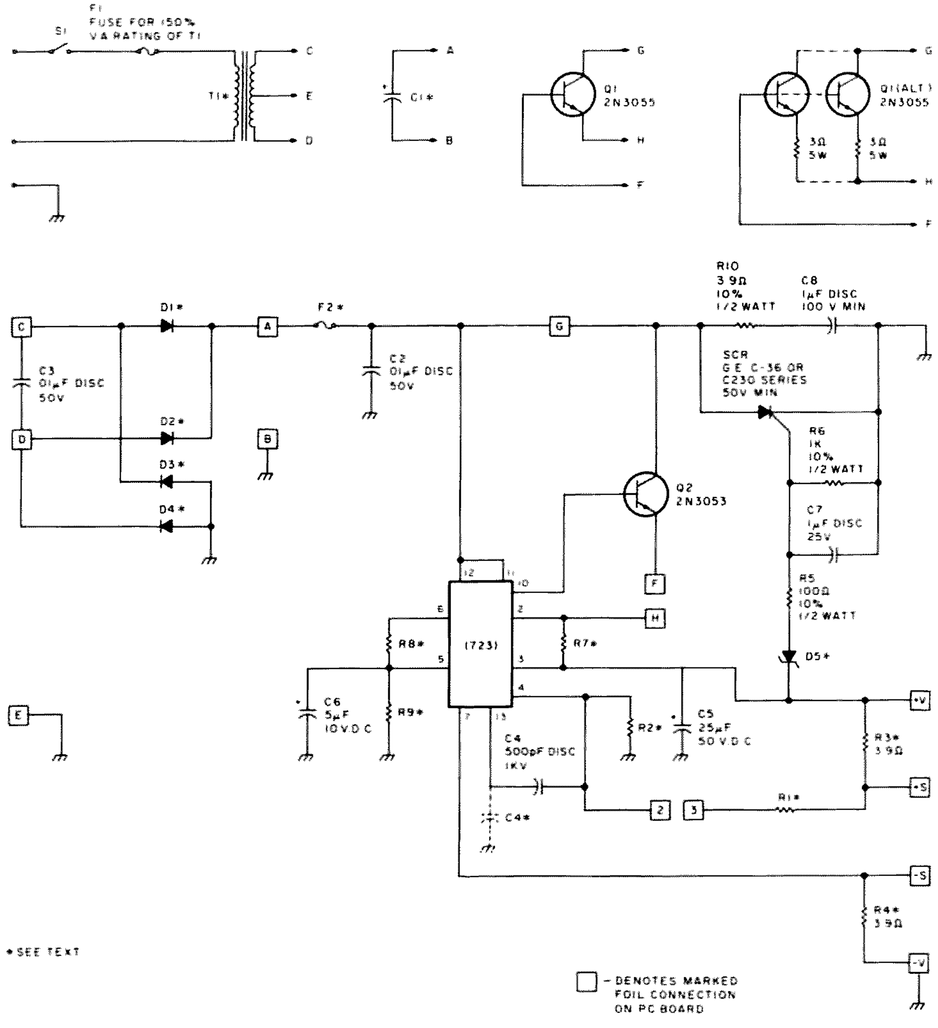


Fig. 2. Power supply schematic diagram.

the Q1 and Q2 case temperatures below 100° C to achieve the best reliability.

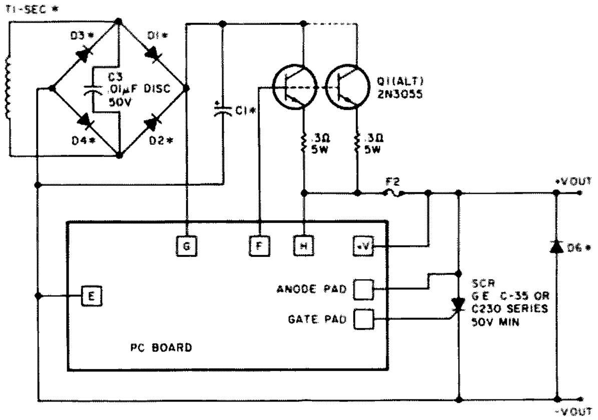
There will be a special section on C1 later on in this article.

Overvoltage Protection (ovp)

The ovp circuit, an SCR crowbar-type, is optional in that it has no effect on the operation of the regulator. If, in fact, you opt for a variable supply, it can be a nuisance. But, if you have a nice new SSB rig, it can save you a bundle. The circuit consists of an SCR, C8, R10, C7, R6, D5, and R5. The only variable in the circuit is zener diode D5. The zener should be rated 2 to 3 volts higher than the regulated output voltage and have a 5% tolerance. The ovp circuit operates as follows: Any rise in the output voltage above the rating of D5 will fire the SCR. After firing, it will remain in the on state until fuse F2 blows, thereby protecting the load from a gross overvoltage. Choose a rating for F2 approximately 20% above the design current. Resistor R6 prevents any anode-gate leakage current from inadvertently firing the SCR. Capacitor C7, along with R5, acts to prevent any power line switching transients from firing the SCR. This is especially true under no-load conditions. C8 and R10 form a dv/dt (voltage change to time change) network that prevents the SCR from turning itself on due to high rate-of-rise voltage excursions across the device. There are anode and gate pads for the SCR clearly marked on the board. Also, there is a hole drilled in the common foil, just below the SCR mounting hole, for the cathode connection. When mounting the SCR, use the insulating washer that usually comes with the device. The stud is the anode connection and, without the washer, the mounting nut will come in contact with the common foil. If there is no insulating washer with the SCR, one can be easily fabricated by peeling the copper from a small piece of circuit board material. The unclad material may then be used as the washer.

Remote Voltage Sensing (rvs)

Rvs, a feature of this supply, is seldom discussed in literature. To better understand the value of rvs, let's take a look at what can happen when it isn't used. All electrical connections are imperfect, as they have some resistance associated with them. The same holds true for wire. Consider a connector resistance of 50 milliohms and a power lead resistance of the same magnitude. That is like putting a resistor with a value of 0.15 Ohms (two terminations and a conductor) in each lead of the power cable. This comes to a total resistance of 0.3 Ohms. That doesn't sound like much, but, when multiplied by 10 Amps, the resultant voltage drop in the cable is 3 volts. Not good! Now, if we could sense voltage out at the load, the cable drop would still be there while the regulator is being "fooled" into putting out enough extra voltage to compensate for this drop. With this supply design, all that has to be done is to run two small wires in parallel with the power cable wires. Tie them together at the remote load location and you have rvs. (Connect the +S and the +V wires together, also the −S and the −V wires.) The reason you may use smaller wires is due to the fact that only a few milliamps of current are required to drive the error amplifier in the 723. Remember, the higher the current levels that you work with, the more important it becomes to use rvs. R3 and R4 are shown to be 3.9 Ohms. Any value you happen to have between 2 and 10 Ohms will be satisfactory here. If you do not wish to use remote sensing, a jumper may be installed in place of R3 and R4.



NOTES ☐ - INDICATES MARKED FOIL CONNECTION

*SEE TEXT

Fig. 3. Wiring arrangement when the 723 is used as a control system for an external regulated supply. Run rvs wires from PC board. Do not use jumper (Fig. 4).

Let's Regulate

The regulator portion of this supply consists of C2, R8, R9, C6, the 723 IC, C4,

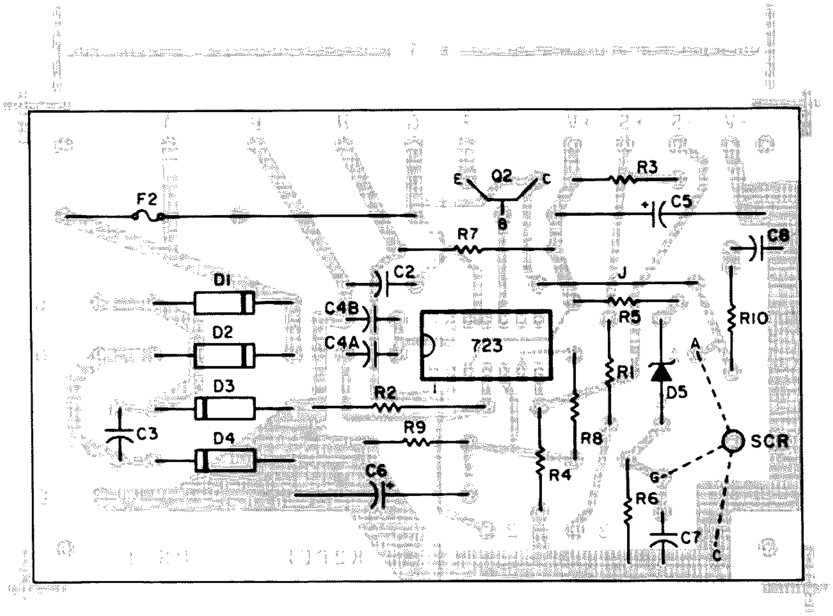


Fig. 4. Component layout.

Q2, Q1, R7, C5, R2 and R1 (Fig. 2). The circuit, when constructed with a jumper between pins 5 and 6 of the IC (in place of R8), is for output voltages of between 8 and 24 volts. Do not use R9 and C6 in this case. Remember our reference voltage (V_{ref}) output of 7.15 volts? In this connection, the reference voltage is applied directly to the (+) input of the error amplifier. Therefore, the (−) input of the error amplifier *must* be 7.15 volts in order for the 723 to be in a stable condition at V_{out}, pin 10. Let's go through a simple calculation and see how we can design for an output voltage of 13.5 V dc so that you can run your new 2 meter rig or maybe a mobile unit brought in for the winter. Looking at the schematic, we see that the voltage at pin 4 of the IC, the (−) input of the error amplifier, is derived from a voltage divider R3, R1, pads 2 and 3, and R2 and R4. R3 and R4 are very low value resistors that allow for rvs and, therefore, have no effect on our calculation. Pads 2 and 3 allow for an external voltage adjustment if desired. So now we're down to two resistors, R1 and R2. The value of R2 is not critical (somewhere between 1k and 3k is fine), but must be chosen first. Let's say a 2k resistor is handy for R2. The voltage across R2 must be equal to our reference supply, again 7.15 volts. Our supply is supposed to operate at 13.5 volts, so the voltage across R1 will be 13.5 volts minus the drop across R2 (7.15 volts). A proportion will give us the value for R1. The equation is as follows:

$$\frac{R1}{V\,R1} = \frac{R2}{V\,R2}$$

Solve:

$$\frac{R1}{13.5 - 7.15} = \frac{2k}{7.15}$$

$$7.15 \times R1 = 6.35 \times 2k$$

$$R1 = \frac{6.35 \times 2k}{7.15} =$$

1776 Ohms.

Use 1800 Ohms, 5% tolerance, 1/4- or 1/2-Watt.

This will give you an output voltage very close to 13.5 volts. If you would like to trim V_{out}, use a 1300-Ohm resistor for R1 and wire a 1k variable resistor to pads 2 and 3. This will give you 13.5 volts output at approximately 50% of pot rotation, giving you plenty of trim range. Otherwise, don't forget to jumper pads 2 and 3 if you use a 1.8k resistor for R1. When using the 8-through-24-volt connection, place C4 at C4A, Fig. 4. C4 is the compensation capacitor and provides a high-frequency breakpoint in the error-amplifier circuitry, preventing unwanted oscillations.

In order to use the supply for voltages of less than 7 volts, only minor changes need be made. Resistor R2 will *not* be used. Place a jumper in pads 2 and 3 and also in place of R1. In doing this, the output voltage will be placed directly on the (−) input of the error amplifier. Let's say we want 5 volts output for some TTL circuit we have or maybe that new microcomputer the UPS man just delivered. All that has to be done is to divide the 7.15-volt reference supply down to 5 volts. This calculation will be the same as the previous one. Choose R9 (any value from 1k to 3k). Let R9 = 1k. This time the equation is:

$$\frac{R9}{V\,R9} = \frac{R8}{V\,R8}$$

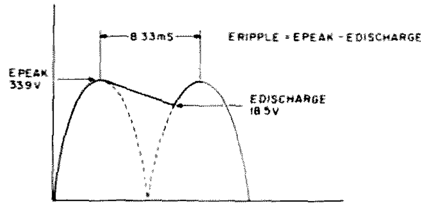
Solve:

$$\frac{1k}{5} = \frac{R8}{7.15 - 5}$$

$$R8 \times 5 = 1k \times 2.15$$

$$R8 = \frac{1k \times 2.15}{5} =$$

430 Ohms.



A

CAPACITOR DISCHARGE TABLE

% DISCHARGE	TIME
80	0 25 RC
60	0 50 RC
50	0 75 RC
37	1 00 RC

B

Fig. 5. C1 calculations.

Use a 5% tolerance, 1/4- or 1/2-Watt resistor. Now we have the R8 and R9 values we need for our 5-volt supply. Capacitor C6 is used to filter out any "white noise" present in the V_{ref} output and in R8. Also, place C4 at C4B, Fig. 4.

For output current levels of 6 Amps or less, R7 must also be calculated. R7 is the current-sense resistor and its value will set the *maximum* output current of the supply. When the R7 voltage reaches 0.6 volts, the 723 will start reducing the output voltage in an attempt to keep the output current constant. This calculation is the Ohm's Law relationship R = E/I, where R is the value of R7, E is 0.6 volts (the specified CL − CS voltage), and I is the supply current limit. The calculation for R7 is as follows: R = 0.6/2 Amps = 0.3 Ohms. Don't forget the power dissipation in R7. That calculation is as follows: P = E × I = 0.6 × 2 = 1.2 Watts. At the risk of not having current limiting, or waiting until you can procure this low value resistor, a jumper may be used in place of R7. As long as R7 is in place, the supply can even stand intermittent short-circuit conditions at the output terminals with no resulting damage.

If you've read this far, it's time to get a cup of coffee or maybe a nice cold 807. We still have a little more to go.

C1 Calculations

There are various ways to find a value to be used for C1; most of them use higher mathematics. To me, that is an exercise in futility. What I will explain here is a simple method that works very well, and can be easily verified if you have access to an oscilloscope. Again, for the sake of numbers, let's work on a 13.5-volt, 2-Amp supply design. I will assume you have found in your junkbox a 24-volt center-tapped transformer. The first step is to add 5 volts to your design output voltage. The reason for this is to make absolutely sure that there is enough voltage to overcome the base-emitter drops (V_{be}) in the regulator transistors, and give the series pass transistors some "operating room." Adding 5 to 13.5 volts gives us 18.5 volts. This value is placed at the point labeled E DISCHARGE, Fig. 5. Now, suppose you would like to use the full-wave, center-tapped connection as previously mentioned. Divide the 24-volt rating by two. The reason this is done is that you are only using half the transformer winding by connecting the center tap to common. This will give you 12 volts, which is an rms value. To find E PEAK, the value C1 will charge to, multiply 12 volts by 1.414 (E PEAK = E RMS × 1.414). This value, 16.97 volts, does not meet the minimum value of 18.5 volts required by the supply design. E PEAK should be a minimum of 5 volts higher than E DISCHARGE, or the filter capacitor (C1) will become very large (ex-

pensive). This dictates the use of the 24-volt transformer in a bridge rectifier configuration. It also means that you have to come up with two more diodes. The value for E PEAK will now be 24 × 1.414 or 33.9 volts. Now we have 15.4 volts before we're down to the E discharge value. The next step is to find out what percent 18.5 volts is of 33.9 volts. Divide E DISCHARGE by E PEAK. 18.5/33.9 = .5457 or 54.57%.

Now go to the capacitor discharge table in Fig. 5 and find a percentage value closest to the above calculation, in this case 50%. Across from this you will find 0.75 RC. What this means is that in the 0.75 time constant, the capacitor will discharge to 50% of its initial value, E PEAK. Now R × C is a formula we can work with to find the value for C1. Remember t = RC? To find a value for t to be used in this formula, solve the equation 8.33 milliseconds = 0.75t. The time value, 8.33 milliseconds, does not change, as it is the period between the pulsating dc peaks that charge C1 (60 Hz line frequency). 0.75 is the table value reached by the E PEAK, E DISCHARGE calculations. Solving the equation, we get: t = 8.33/0.75 = 11.1 milliseconds.

We now need a value for R to complete our C1 calculation. This value can be found from R = E/I where E is the E PEAK value and I is the supply current design value, or 2 Amps. Solving this equation, we get R = 33.9/2 = 17 Ohms.

To find the value of C1, use t = RC. Solving this, we get: 11.1 milliseconds = 17 Ohms × C. C = 11.1/17 = 0.652. To get uF, multiply 0.652 × 1000 = 652 uF for C1. Now 652 uF is the minimum value. Any capacitor of this value or larger is suitable. The voltage rating for C1 has to be greater than E PEAK. In this case, a 50 V dc unit should be used. This method is a bit arduous, but, nonetheless, it's a lot easier than some other methods.

Potpourri

I would like to make some more comments about T1 at this time. Transformers with secondary current ratings of two to three Amperes are very reasonable. If you would like to design a 12-volt, 10-Amp supply, the transformer cost may become quite high. Remember the older tube-type TV sets? The power transformer used in these sets is good for 350 Watts continuous duty. In the *Radio Amateur's Handbook*, in the power supply section, there are excellent instructions on rewinding transformers. Also, in the section on construction practices, you can find a copper wire table that will guide you in selecting the right size wire for your new secondary winding. Rewinding is not difficult and your efforts will be well rewarded. Another advantage is that rewinding enables you to keep the Q1 power dissipation down by reducing the E PEAK (Fig. 5) value to a reasonable level for your supply design.

At no place in this article have I mentioned tying common (−V) to the chassis. Also, on the PC board artwork (Fig. 6) you will not find any mounting holes in the common foil. This is done for two good reasons. The first is safety! Connect that third wire (green) in your power cord to the chassis. All of your equipment should be well grounded. The second reason is for convenience. With a floating supply, the positive and negative connections may be treated just like a battery. Remember that microprocessor the UPS man just delivered? Just found out you needed a negative supply for some PROMs? Build two of these supplies. Tie the positive output of one to the negative output of the other and you have a plus/minus supply. The applications are unending.

In Summary

I believe an outline of the steps you need to go through in designing this supply is in order. First, the regulated output voltage and rated current must be selected. If the voltage is above 8 volts, calculate the values for the R1 and R2 voltage divider. If the voltage is 7 volts or less, calculate the R8 and R9 voltage divider. If R7 is used, calculate that value. Select zener diode D5 in the ovp circuit if used. Select resistors R3 and R4 if rvs is to be used. Decide on the number of transistors to be used at Q1 or Q1 (alt.), and select the correct diodes for D1 through D4. Finally, run through the T1 and C1 calculations.

This sounds like a lot, but many of the above steps are quick and easy. The remainder of the components mounted on the PC board are common to all designs.

The 723 is a great IC. Give this supply your best shot and I'm sure you'll be very happy with the results. For those of you who wish, I can supply a high-quality predrilled circuit board for this article. The cost is $4.50 postpaid. An SASE will bring an answer to any questions you may have. ■

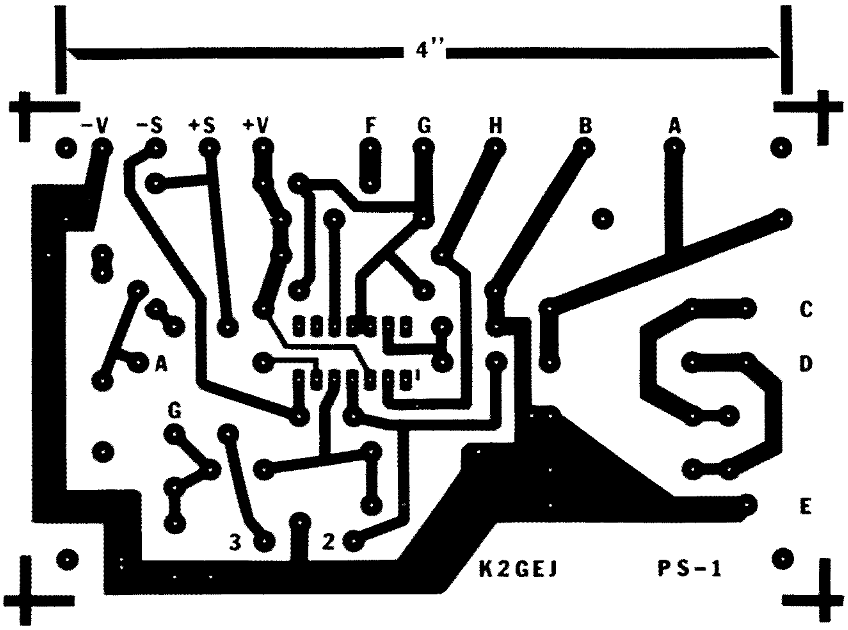


Fig. 6. PC board artwork.

A Touch of Class

—nifty $35 operating console

For comfort and convenience, this bench can't be beat.

Horace M. Lewey, Sr. WA4CUD
2405 Cyprus Street
Greensboro NC 27405

Console design can make a world of difference in your enjoyment of ham radio. Comfort, convenience, and ease of operation were the criteria set for the construction of this operating bench. The finished product provides all that and is very strudy as well.

Figs. 1, 2, and 3 show how everything goes together. The parts list gives all the materials you will need.

You should countersink all holes for the bolts and screws, fill them with plastic wood, and sand them smooth before painting or staining. This will give you an attractive finish. Leave a one-inch overhang on the sides of the top shelf and the desk-top, as you can see in the photo. ■

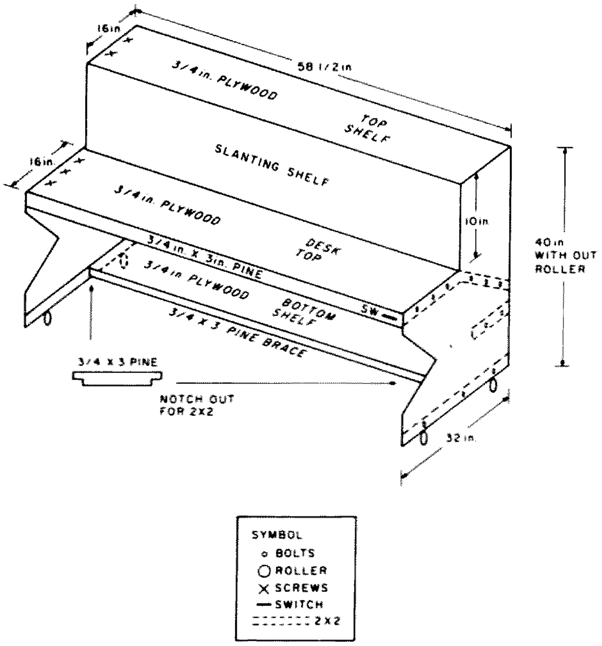


Fig. 1.

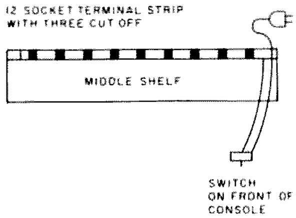


Fig. 2.

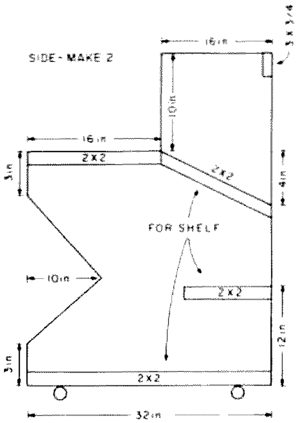


Fig. 3.

Parts List

two	¾" x 4' x 8' plywood
four	2" x 2" x 8' pine or oak
three	¾" x 3" x 6' pine (for front panel and shelf braces)
24	¼" x 2½"-long bolts
24	flat washers
four	roller casters
small can of plastic wood	

How To Bury Coax

—the garden cultivator technique

Ye keep what ye sow.

Max Holland W4MEA
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Madisonville TN 37354

A ground plow is often used to bury coax cable. This special device usually is attached to the rear of a tractor and can put the cable down 8-12 inches in the ground. See *Ham Radio*, May, 1970, page 66, for procedure.

Having no access to a ground plow, I had to use the Armstrong method. It is difficult to bury 100 feet of coax cable in this manner. Using the tip of a chain saw to cut a slot in the ground is dangerous and is hard on the chain.

My neighbor, WA4KJA, has a garden cultivator which has been in his family since the 1930s. By changing to a narrow plowshare which was made from a piece of band iron 1½ inches wide, we were able to make our own ground plow.

The work is still hard, but it is easier than using a shovel. The narrow cut in the lawn disappears after several weeks.

The garden cultivator is a Planet Jr. made about 1935. Over the past 50 years of amateur radio, people have operated mobile from cars, airplanes, boats, bicycles, balloons, lawn mowers, go-carts, and tractors. To the best of my knowledge, this is the first time anyone has operated from a garden cultivator. The rig is a TR-22 with 1-Watt output. The antenna is a 5/8-wave whip. The antenna pattern will change depending on the depth of the cut.■

Mobile Antenna Ingenuity

—cheap HF radiators

A Kool-Aid budget, a Champaign result.

George M. Ewing WA8WTE
P.O. Box 502
Cheboygan MI 49721

Four or five years ago, there was a terrific bargain at a northern Michigan hamfest. I unloaded a junky Hallicrafters S-38 for fifteen dollars, and spent the money immediately on a cardboard carton labeled "Mobile Stuff." Along with a lot of really useless junk, I found a Hustler mast, a bumper mount, three resonators for 80, 40, and 20, a desk mike, and twenty feet or so of good coax. The mobile antenna was bolted to the rear bumper of my trusty Barracuda right there in the hamfest parking lot, and, with an aging NCX-3 and a borrowed Heath HP-13 supply, I was on the air almost immediately and enjoyed several years of rewarding low-cost mobile operation.

Almost four years later to the day, while visiting some friends at a conference in Lansing, Michigan, I came out of a motel to behold a horrible sight: The mast, mount, and the eighty meter resonator had been ripped off, leaving the chrome bumper itself twisted like a pretzel! Fortunately, the rig itself was safe, still tucked under my pillow in the motel room, and I had purchased a spare resonator for a couple of dollars the year before. For the rest, I headed straight for my (former) auto insurance company, Divestiture & Bombast Mutual.

Following lengthy negotiations, I left the insurance office with ten measly dollars in search of a new antenna and insurance carrier. One look in a catalog, which listed the mast section itself for over twenty dollars, was so discouraging that I shelved the whole project, resolving to limit my mobiling to VHF until another hamfest bargain came along.

Several years more went by, and I replaced the venerable Barracuda with the bent bumper because I could no longer stand 10 miles per gallon on premium gas. A long Thanksgiving vacation trip to a science fiction conference in Champaign, Illinois, was coming, and, while I now had a good 2m FM rig, I would be out of range of repeaters for a good part of the journey. I decided to try and build a replacement for the missing Hustler. I had managed to come up with a spring similar to the one on the original bumper mount for a dollar from a CB friend. This left about nine bucks in the fund, no machine shop facilities at hand, and a few days left before Thanksgiving. Could it be done? Of course!

The Mast

After some thought about aluminum or steel conduit, a helically-wound PVC pipe, and other substitutes, I decided to go with a rigid copper pipe for the mast. It was sturdy, not too expensive, and an excellent conductor. Two sizes were available at the local hardware store, ½" and 3/4". The trick would be to come up with fittings to match the 3/8" × 24 threads on the remaining resonators, using only simple hand tools and hardware available in a small-town corner store the Wednesday before Thanksgiving.

The 3/4" tubing was sturdier, heavier, and required two fittings less than the ½" size. It would also have a slightly lower resistance loss at rf frequencies. On

Changing resonators.

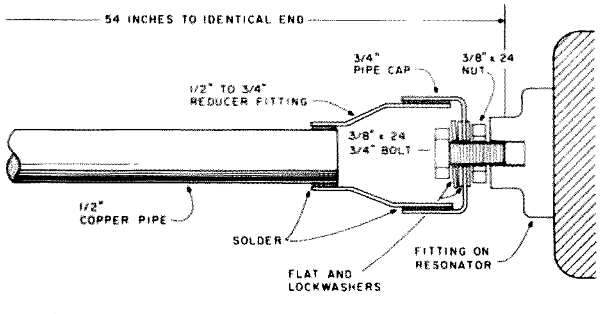


Fig. 1. ½"-pipe version. Mast-to-resonator fitting.

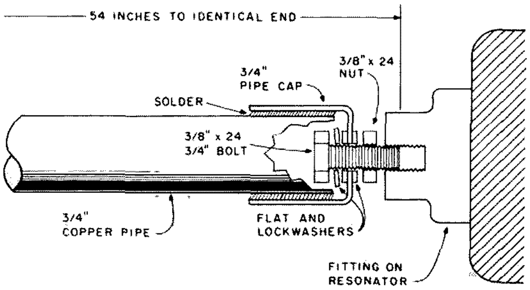


Fig. 2. 3/4"-pipe version. Mast-to-resonator fitting.

the other hand, its larger cross section and wind resistance might make it "whippier" in crosswinds on the freeway.

The ½" tubing was chosen because it was lighter, cheaper, and more closely matched the dimensions of the original Hustler chromed-brass mast. Cost was about 45 cents per foot, or close to $2.50 for a 54-inch length. Had time allowed, used copper pipe could have been obtained for about half this amount, but it would have required extensive cleaning.

Mast-to-resonator and mast-to-spring adapters were made up using store-bought plumbing parts (see Fig. 1). The same design would work for a 3/4" mast, simply by omitting the ½"-to-3/4" reducer fittings (see Fig. 2). The 3/4"-diameter ends are needed for clearance for the hardware.

Making the Adapters

Clean the tubing and fittings carefully with a rag and automotive rubbing compound or some other mild abrasive. Salt and vinegar will also clean the copper chemically, but I found the rubbing compound much faster. Clean the residual abrasive, fingerprints, etc., off the parts with a solvent like alcohol, acetone, or carburetor cleaner. Do this outdoors or in a well-ventilated area, and keep the solvent away from sparks and flames. Handle the parts with gloves or a clean rag, and you'll be able to solder them easily with ordinary rosin-core solder.

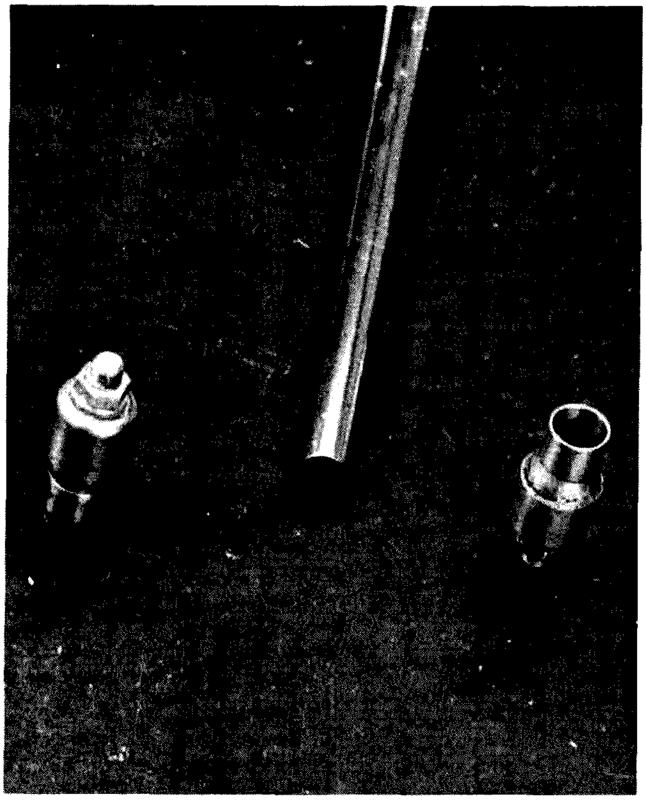
Center-punch the 3/4" end caps and drill them with 3/8" holes to assemble the fittings. Assemble the bolts, nuts, and lockwashers before you do the soldering. Assemble the hardware as per the diagram, and then solder with a small propane torch, gas stove burner, or large (250 W+) iron.

After you have assembled the mast, clean it again with the rubbing compound and the solvent, especially the areas discolored by soldering, and then give it several coats of clear spray lacquer or urethane varnish to protect it from corrosion.

The total cost for the pipe, hardware, and fittings was just under five dollars, well within my cost goal.

The One-Dollar Bumper Mount

Refer to Figs. 3 and 4. The trusty Barracuda had been replaced with a '75 Chevy Monza hatchback which got better gas mileage but featured an odd rubber-covered bumper that made mounting difficult. The base for the mount was made from a piece of ½" marine scrap plywood, but almost anything will do if it's sturdy —sheet metal, Masonite, etc. The brackets were sawed off of the front panel from a TD-2 microwave bay that happened to be lying in the station junk box. An aluminum channel from a busted storm door or more scrap plywood would be just as effective. The insulating plastic plate is the only tricky part, as it has to be very strong mechanically. I used a piece of heavy phenolic from the fuse block in a piece of surplus equipment. A scrap of heavy Plexiglas™ or several pieces of scrap circuit board epoxied togeth-



3/8" × 24 adapters for the ½" copper mast.

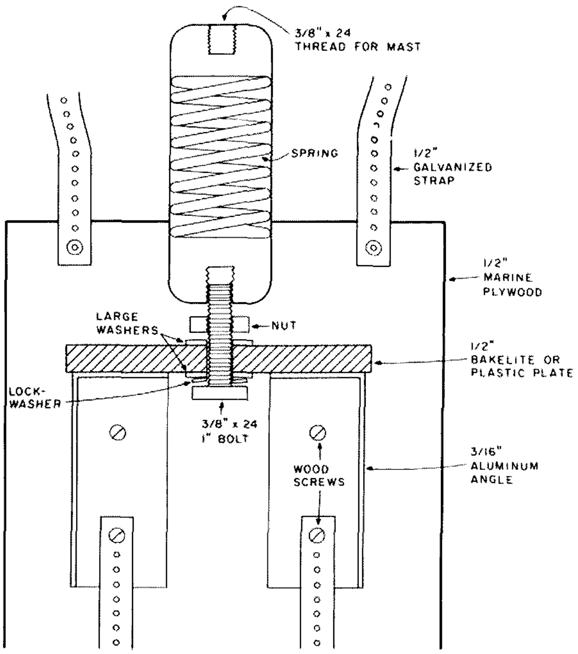


Fig. 3. $1.00 bumper mount—rear view.

73 Magazine Staff

Impedance and Other Ogres

—another look at swr

You will now understand standing wave ratio.

The subject of understanding the effects of swr (standing wave ratio) has been explained in various articles a dozen times over in recent years. Still, many amateurs look at the "percent power reflected" markings opposite the swr values on an swr meter and are confused. For instance, next to an swr value of 3:1 there is marked "25% power reflected." The usual belief is that 25% of the total power which the transmitter is groaning to put out never makes it to the antenna to be radiated. Instead, it is rejected (reflected at the transmission line/antenna junction) and goes bouncing endlessly back and forth between the transmission line/antenna and transmission line/transmitter junctions. In other words, it is consumed or lost in the transmission line and/or plays all sorts of havoc with the transmitter output stages. This is not the case, of course, but the "percent reflected" scale of an swr meter does produce an image in one's mind that is hard to alter.

Rather than start talking about transmission lines, mismatched loads, etc., there is something much more fundamental than that which one should understand to have swr become clear. It has nothing to do with electronics and just goes back to basic ac electrical circuits. Understanding it (and not just skimming over the idea) will make the whole subject of swr and its effects in radio applications clearer.

Normally one thinks of power as just being the product of voltage times current, and indeed it is, except that one has to put a little "extra" into the formula when speaking of ac circuits. In Fig. 1, a sine wave of voltage and current is shown as it appears across a resistor. The power dissipated at any *instant* is the product of the voltage and current at that *instant*. In the example, the voltage has a peak value of 30 volts, and the current a peak value of 20 Amperes, so the peak power is 600 Watts. When both the voltage and current go into the negative half of their cycles, you have -30×-20 (at the peak negative excursion), so the peak power is still a positive number. By going back to the ac textbooks, one can confirm that by multiplying the rms values of voltage and current, the resultant obtained is average power. But, that is not important at the moment; the only important point is that one multiplies the voltage and current at any instant to get instantaneous power.

In Fig. 2, the voltage and current waves have their same peak values, but because they appear across a reactive load, not a pure resistor, the waves are displaced in time. However, the power formula still holds true at any *instant* (voltage times current). So, if the voltage and current are multiplied at every instant, the dotted peak power line shown will result. The interesting thing about this power wave is that is goes negative. So, the actual overall power

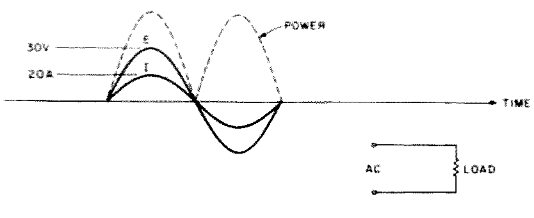


Fig. 1.

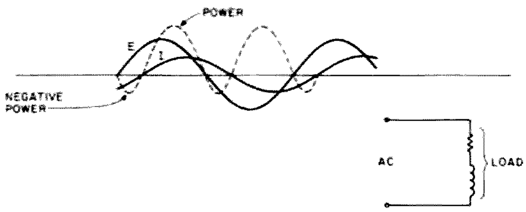


Fig. 2.

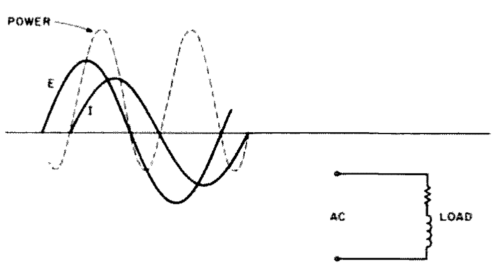


Fig. 3.

absorbed by the circuit is the net "positive" power minus the net "negative" power. This idea of negative power is where our little gremlin comes into play. The concept is that this negative or imaginary power represents power which the load will not accept. Therefore, although the source of power is able to supply power to the load as shown in Fig. 1, when the load is not purely resistive it cannot accept all of the power the source is capable of supplying. Said another way, during the portions of the voltage and current waves when they are both positive, the source is delivering power to the load. During the portions of the voltage and current waves when *either* one of them is negative, the load is returning power to the source that it could not absorb. Where is this power in between the time it is "offered" and then "rejected"? It's in the electromagnetic or electrostatic fields associated with reactive elements—inductors or capacitors. It doesn't bounce around like a Ping-Pong™ ball between the source and the load.

To obtain the net average power a load takes, one has to take into consideration not only the voltage and current values, but also the time displacement between the voltage and current waves. In basic ac circuits, the power formula then becomes $P_{AV} = E_{RMS} \times \cos \phi$. $\cos \phi$ is, of course, what electrical power people refer to as the "power factor."

There are three simple things one can learn from the simple ac circuit before going on to the radio applications of the idea presented. Note in Fig. 1 that the resistor absorbs a certain amount of power. Remember that only resistors can absorb and dissipate power. Now, if we have the load of Fig. 2 and we want the resistor part of the load to absorb the same amount of power as the resistor in Fig. 1, we have to do something. One thing we can do, so that the net power in Fig. 2 comes out the same as the net power in Fig. 1, is raise the voltage across the load and hence the power "offered" to the load. The load will reject the same proportion of the total power as before, but if we "pump" enough power into the load, we can get the resistive element of the load on Fig. 2 to absorb the same power as the load of Fig. 1. This means increased input power and greater voltages and currents in the circuit as shown in Fig. 3.

The other approach is to "match" the load. That is, if we cancel the inductive reactance in the load of Fig. 2 by a series capacitance reactance of the same value as shown in Fig. 4, the voltage and current wave across the combined resistor/capacitor/inductor load will again become as shown in Fig. 1. Since the reactive elements cannot dissipate power, the circuit becomes the equivalent of Fig. 1, and no extra power need be pumped into the load to have the resistor dissipate the same power as in Fig. 1. This is all true, however, only at one frequency.

The loads in Figs. 1-4 are shown as being connected directly to a source of power. However, what if the load is connected to the power source over a long pair of wires, each side of which has some resistance, as shown in Fig. 5? If the load is a resistor, it doesn't take too much exercise of Ohm's Law to see that the power available from the source will be divided between the resistance of the load and the resistance of the wire pair in a manner depending on the relative value of the resistances. Let's assume that the resistance of the wire pair is a small fraction of the resistance in the load. If the load now becomes a combination of resistance and reactance *and* the power source is increased to maintain the same power in the load resistor, the power lost in the wire resistance will also increase. But, this is only because more current must flow in the entire circuit as per Fig. 3. The wire resistances will absorb *slightly* more power, but they do not absorb the rejected or reflected power because of the combined resistive/reactive load. Again, only resistances can dissipate power. So, even if the load becomes reactive, as long as the resistance in the load is large in value compared to the resistance of the wire pair, the power lost in the wire pair is not going to become significant.

When the foregoing simple circuits are "elevated" to radio frequencies, none of the fundamentals described really changes. Some new elements are introduced, of course. The wire pair is now a transmission line with a characteristic called impedance, and a *time* element is introduced. That is, power cannot instantaneously go from the source (now a transmitter) to the load (the antenna). This time factor, of course, is very short, but, nonetheless, it does exist. That is why transmission lines have, besides impedance, a characteristic called velocity of propagation. So, one has to speak about power traveling along a transmission line. For instance, in Fig. 6(a) we will assume that we have a "matched" system. That is, the transmitter is designed for 50 Ohms output, the transmission line has 50 Ohms impedance, and the line is terminated in a 50-Ohm antenna. The transmitter is turned on only long enough to generate one cycle of sine wave current, which we'll call the incident, or forward, wave. Since everything is matched, the load completely accepts the power. If we leave the transmitter on continuously, we will have a continuous string of current waves traveling down the line and delivering power to the antenna. Note that although the current waves pass current down the line, when there is a continuing series of waves they will appear to stand still along the trans-

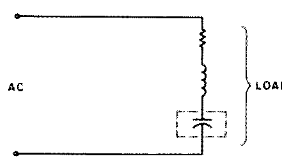


Fig. 4.

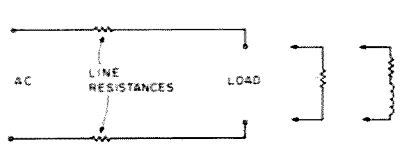


Fig. 5.

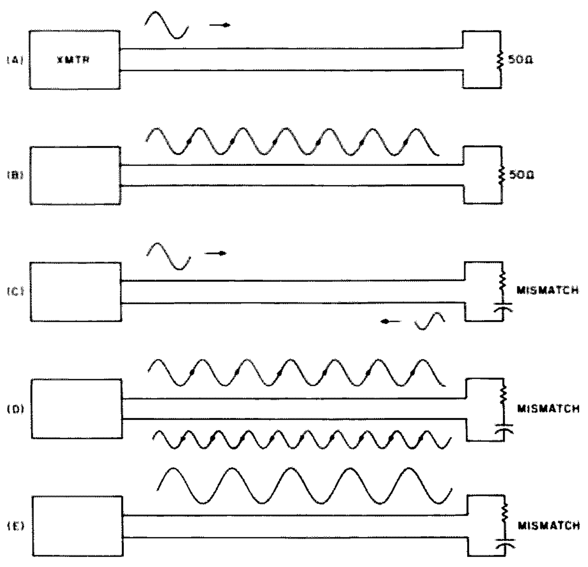


Fig. 6.

mission line.

If in Fig. 6(c) we have a mismatched load and again send a single current wave down the line, we are going to get back from the load a reflected wave. If continuous power is applied to the line, there will be continuous strings of incident and reflected waves. Since the strings are continuous, some incidental waves will always be present at any given point along the line. Therefore, at any given point and at any given instant, the resultant wave will be formed from the combination of the values of the two waves. At some points they will reinforce each other, and at some points they will subtract from each other. One probably thinks of various optical effects where two light sources interact to produce a seemingly stationary light interference pattern. Much the same thing happens on a transmission line. The result of the traveling incident and reflected wave is a resultant stationary wave. Stationary, that is, in respect to its position along the transmission line. Since the resultant stationary wave stands still, it is referred to as a "standing" wave. For example, the resultant of the wave shown in Fig. 6(d) might look something like the standing wave of current shown in Fig. 6(e).

If one can grasp this basic concept of a standing wave, the rest of the ideas surrounding standing waves, what to do about them, how to interpret swr meter readings, etc., will not be difficult. If the ideas presented so far seem a bit unclear, one might go back over them a few times. Particularly, one should understand the simple ac circuit mentioned at the start of the article and be sure that one understands what rms values mean for voltage or current values.

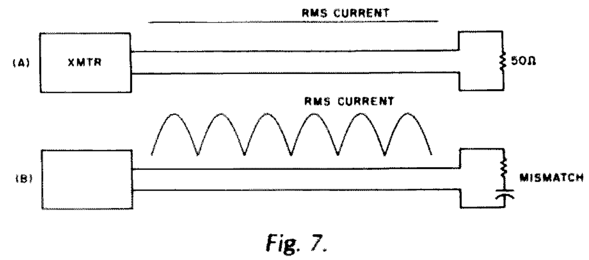


Fig. 7.

If one now feels comfortable about the basic idea of a standing wave, one can accept the information presented in Fig. 7. Instead of dealing with instantaneous values of a current wave, these figures represent the rms current, or the current that one would read along the line with a regular rf ammeter. In the case of Fig. 7(a), the current is the same at any point along the line since the system is matched throughout and there is no reflected current wave. In Fig. 7(b), where a mismatch exists, the current will be found to have different values at different points along the line. Depending on how bad the mismatch is, the current variation will be relatively small or the current variation pattern can approach the half sine wave shown. The swr on the line is defined as the ratio of the maximum current value to the minimum current value. In the case of Fig. 7(a), the ratio is 1:1 and the line is referred to as being "flat." In Fig. 7(b), if the maximum current were 3 Amperes and the minimum current 1 Ampere, the swr on the line would be 3:1.

One can actually measure the current along a line to determine swr. It is done this way in some high-power transmission lines. However, it is usually more convenient to measure voltages proportional to the value of the incident wave and to the value of the reflected wave. A directional coupler is used for this purpose, usually of the type shown in Fig. 8 (for a coaxial line). Two pickup wires are placed near the center conductor. One has a voltage inducted in proportion to the value of the incident wave, and the other a voltage proportional to the value of the reflected wave. The ratio of the two voltages is the swr, the same as the ratio of the currents previously described. As one might imagine, there is no perfect discrimination in the pickups between the incident and reflected waves. But, this type of instrument suffices for most needs. In a practical instrument, one usually "sets" the forward or incident voltage reading for full-scale deflection on a meter. Since the attenuation used remains in the circuit when the meter is switched to measure reflected voltage, the *ratio* of the two voltages is not upset. Therefore, the meter scale when reading reflected voltage can be calibrated in swr.

Since an swr greater than 1:1 indicates the load is taking less power than it could if it were matched, there is, as one might imagine, a mathematical relationship between swr and the percentage of power the load cannot accept. This formula is used to derive the "percent reflected power" one often sees marked along the swr scale on a meter.

How bad is it to have an swr of greater than unity on a line? What can one do about it? Part of the answer to the first question can be answered by going back to the simple ac circuit, and part of that answer requires a more careful look at the effects of a transmission line at radio frequencies. If the load is not matched to the line, maximum power will not be transferred to its resistive component, as in the case of the simple ac circuit. We can try to get more power out of the source (transmitter). This, of course, means loading the transmitter more heavily, with consequent heat dissipation problems, etc. But, it can be done if the transmitter can take it and if one is willing to waste input power. So, if the swr meter reads 3:1 (25% reflected power), it means that the

load could accept 25% more power if the system were matched. One could make up, approximately, for the swr by putting 25% more power into the system.

When dealing with a real transmission line, there are also a few other factors to be kept in mind, although their significance is usually a bit overstated for the normal HF installation. Any transmission line has an inherent loss due to its ohmic losses, and also rf losses, because of the dielectric material between the conductors. For instance, RG-58 coax might have a loss of about 1.2 dB for a 100-foot run on 20 meters. So, this means that even if the transmission line system were perfectly matched, a 100-Watt output from the transmitter would end up as about 78 Watts at the antenna. There is nothing that one can do about this except use a cable with a lower inherent loss at the frequency—such as RG-8. If the RG-58 line were now not "flat" but had an swr of 3:1, there would be some additional loss in this line. This is only because the reflected current wave travels along the line as well as the incident current wave. So, one suffers line losses coming and going. These losses can be obtained from a number of graphs in antenna manuals, but they are not as surprising as one might imagine. For instance, in the example given, the swr of 3:1 causes the *total* line loss to increase only to about 1.6 dB. Therefore, if we can still get 100 Watts into the line, the total loss would rise to about 31 Watts instead of the 22 Watts lost under matched conditions. Consequently, the swr has not caused any tremendous increase in the power lost in the transmission line. We are not burning up the transmission line because of the swr, but neither are we getting the available power where we would like to get it dissipated—in the antenna load. But, under some circumstances, one might accept the situation since even if a total of half the transmitter output power were not utilized due to a combination of line losses and inability of the load to accept a portion of the power, the radiated signal would only be 3 dB, or about one half an "S"-unit down. With a view toward doing something to overcome the effects of swr on a line, getting the power into the load may or may not involve doing anything about the swr. The cause of the swr on the line is the mismatch between the load and transmission line impedances. For instance, in Fig. 9(a) we have a 50-Ohm load and a 50-Ohm transmission line. No matter how long the line is, a transmitter is going to see 50 Ohms at the transmitter end of the line. In Fig.9(b), we have a complex load on the transmission line. At the junction of the line and the load there will be a mismatch. One cure for this problem is to do something at this juncture—insert an impedance matching device. This would eliminate the swr on the line, and the line would be "flat," with no more than its inherent losses.

This is usually the preferred solution, but not always a practical one. So, in lieu of this, we can tackle things from the transmitter output terminals. At this end of the transmission line there are two things we can do. One is to experiment with the length of the transmission line. A transmission line when it is not terminated in its characteristic impedance will present a complex impedance at its feed terminals. Depending on the frequency and length of the line, this complex impedance can be capacitive or inductive. So, by experimenting with the line or by doing some calculations, we can find a line length where a situation similar to Fig. 4 exists. The transmission line/load considered as a *whole* is matched. The only price we pay is the bit of increased loss on the line due to the swr. Of course, this sort of solution is only practical on one frequency. As the frequency changes, the antenna load impedance changes, the electrical length of the transmission line changes, etc. Therefore, the more common solution is to insert a tuning device at the transmitter end of the transmission line. The tuning device can handle the various complex impedances found at the end of the line on various frequencies and match the transmission line/load considered as *a whole*. It presents a constant 50-Ohm impedance to the transmitter output when properly adjusted. We haven't cured the cause of the swr, because the basic mismatch at the antenna terminals still exists. But, we will be able to get more power into the antenna and pay only a small price in terms of increased line loss due to the swr.

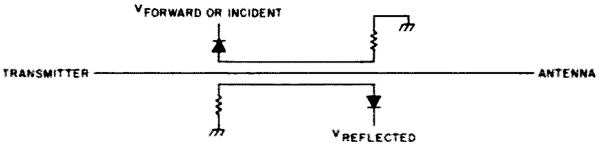


Fig. 8.

The foregoing was concerned with swr, its effects, and what may be done about it. But, to really "close the loop," we might consider if we are really getting anyplace by matching. That is, say we have the setup of Fig. 9(c). Our "super" tuning device is effective enough so that with the same antenna and transmission line on 80 through 10 meters, it presents a 50-Ohm impedance to the transmitter. The transmitter loads easily to produce a 100-Watt output, and an swr meter between the transmitter and tuner reads 1:1. The answer to whether we are getting anyplace depends upon whether we are trying to do something reasonable or not. Remember, in the discussion of the simple ac circuit it was mentioned that only resistances can dissipate power. So, if the resistance part of the antenna load is significantly higher than the rest of the resistive losses in the system (transmission line and tuner), we may be getting someplace. Most of the power will be dissipated in the higher value resistance. The resistance part of the antenna impedance is

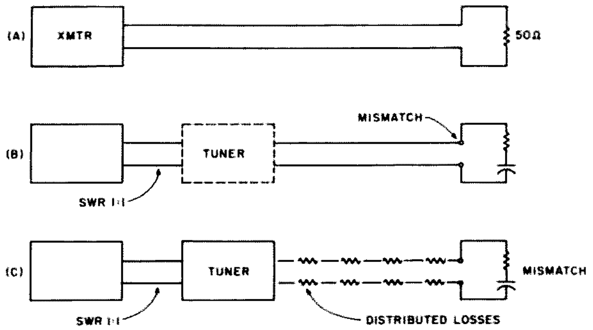


Fig. 9.

referred to as radiation resistance and can be found in antenna manuals for the usual types of antennas. For a ½λ dipole antenna, it might be on the order of 60 Ohms. So if the resistance losses in our matching system are just a few Ohms, essentially all of the power will be dissipated in the radiation resistance. Now, if we take that 10 meter ½λ dipole and try to operate it on 80 or 160 meters, the radiation resistance falls to around one Ohm or less. So, guess where all the power is going even though everything loads fine and the swr meter reading looks great? The use of tuning devices certainly has advantages in many applications. It provides more uniform loading to the transmitter across a band where the actual transmission line/antenna junction swr is changing. They also allow many amateurs to operate on bands they do not have proper antennas for by at least getting some power into the antenna for radiation. But, you can't beat the basics of power distribution in simple ac circuits, even when operating at rf!

This article has not tried to deal with every nuance of the swr question. Math has been completely avoided and a number of propositions have simply been presented without discussion, although they can be verified from antenna manuals. I feel, though, that if you try to relate the transfer of power in an rf application back, within reason, to the transfer of power in simple ac circuits, you will be able to feel more comfortable and understand more when looking at that swr meter. ■

The Active Filter Cookbook

—review of Lancaster's treatise

Canadian confirms composition's class.

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In the September, 1977, issue of *73*, there was an interesting article by Peter Stark using active filters. I was glad to see this because I feel that active filters have been rather neglected. *The Active Filter Cookbook* by Don Lancaster (Howard W. Sams & Co., 240 pp., $14.95) would seem to be the next step if you liked Peter's article and want to know more.

Although not a wide variety of filters are covered in this book, everything that you need to know is here. The sort of stuff which is missing is about the more exotic types, and most people would not have any use for them. Don starts the book off with some filter basics and some definitions of filter terms. He talks about active filter advantages and disadvantages and continues with a description of the rest of the book.

In chapter two, information on op amps, which form the backbone of active filters, is given. Described are integrators, summing blocks, and basic amplifiers. Also, there are some guidelines for selecting which device is useful for your application. Finally, basic information on some of the more widely used op amps is provided.

The next six chapters give theory on how the filters work, selecting which configuration (Bessel, Butterworth, or Chebyshev) to use, and what makes up each of these three types. Information on component tolerance is given here also. Don goes on further to discuss scaling, which is an easy way of taking the normalized filters given in this book from their regular frequency of 1 kHz and placing them at the frequency which you desire.

Chapter 9 is miscellany. It gives information on selecting resistors and capacitors. It talks about manual wide-range tuning along with some thoughts on voltage control. This chapter ends with the description of elliptical filters, which are somewhat unusual.

The tenth and final chapter, like all of Don's other cookbooks, goes into some applications for active filters, such as tone decoding, modems, quadrature art, and color organs. Finally, he hints at some uses which the reader can pursue himself.

Throughout this book, math is kept simple and is used sparingly. Instead, emphasis is placed on graphs and tables, which help the reader to better visualize what is going on. Examples of selecting a filter and putting it to use are given throughout the text. There are numerous pages on active filter theory, complete with math, but this is separate from the main text and can be completely ignored by those not interested.

While some may scoff at the idea of paying so much for a book on audio filters, I would recommend this book to those who have a lot of filtering needs. At audio frequencies, active filters are far better than coil and capacitor combinations and this book will open the door to their use. ■

A Rock-Solid AFSK Oscillator

—hooray for stability!

Economy and performance go digital.

Winford Rister WB4MBL
402 Allicia Street
Albertville AL 35950

After fighting the temperature drift problem with a 555-based audio frequency shift keyer, I decided to try crystal control. The design had three basic requirements: high performance, economy, and digital circuitry.

Making a few quick calculations, I found that I could obtain a 2125 Hz tone from an 8500 kHz military surplus crystal I had on hand by dividing by 4000. Likewise, the 2295 Hz tone would require a 9180 kHz crystal. Frequency tolerance is not critical in this application because a Hertz or two off in frequency is barely noticeable (I wish some of the guys could get within 10 or so), and the crystal would have to be off 8 kHz in order for the tone to be off by 2 Hertz.

The 8500 kHz crystal I used is a small type in an HC18-type holder, which is about 1/8 by 1/2 by 5/8 inches. The 9180 kHz crystal is in an FT-243-type holder and was originally at 8970 kHz. Fortunately, this type of holder is easily opened, and, also, the crystal can be etched rather easily.[1]

Circuit Details

The circuit uses eight inexpensive ICs, all of which can be purchased from several sources for less than four dollars. Each oscillator is free running. The oscillator circuit is the simplest one available,[2] but works well for crystals in the range from about 2 to 15 MHz of almost any type. Some higher frequency crystals of the overtone type will oscillate at the fundamental frequency with this circuit.

The output of each oscillator is fed into separate divide-by-ten counters (SN7490) to ensure isolation. Referring to Fig. 1, the output of each divider, now 850 and 918 kHz, respectively, is fed into a NAND gate, U7A-U7D (SN7400). The four gates in this chip are wired so that only one of the frequencies is passed at a time, depending upon whether the switching input is low or high. The signal is taken from the last section of the 7400 and divided by 10 twice more with U3 and U4 and then divided by 2 twice by U8, the SN7473 dual flip-flop. This results in a total division by 4000, which yields square waves of 2125 and 2295 Hz. The signal must consequently be passed through a low-pass filter in order to change it to a sine wave. I used a circuit similar to that in the AK-1[3] for the filter. Active low-pass filters could be designed for this job, but the main advantage to them is space savings, since no amplification is needed. The passive filter won out in my case for simplicity and eliminated the need for another power supply connection on the board. Some adjustment in the divider network may be necessary to suit individual transmitter requirements. Finally, this sine wave is fed into the microphone input of an SSB transmitter.

The keying circuit shown is designed to operate from the series loop in the printer and keyboard. The keying input is taken from the top of the emitter resistor of the loop switching transistor (27-Ohm resistor in my TU). If plus 5 volts is used for the switching input, resistor Rs should be increased to 15k Ohms. If separate keyboard and printer circuits are used, the input should be modified accordingly. If it's more convenient to have the mark condition low instead of high, the two crystals could be switched or another transistor configuration could

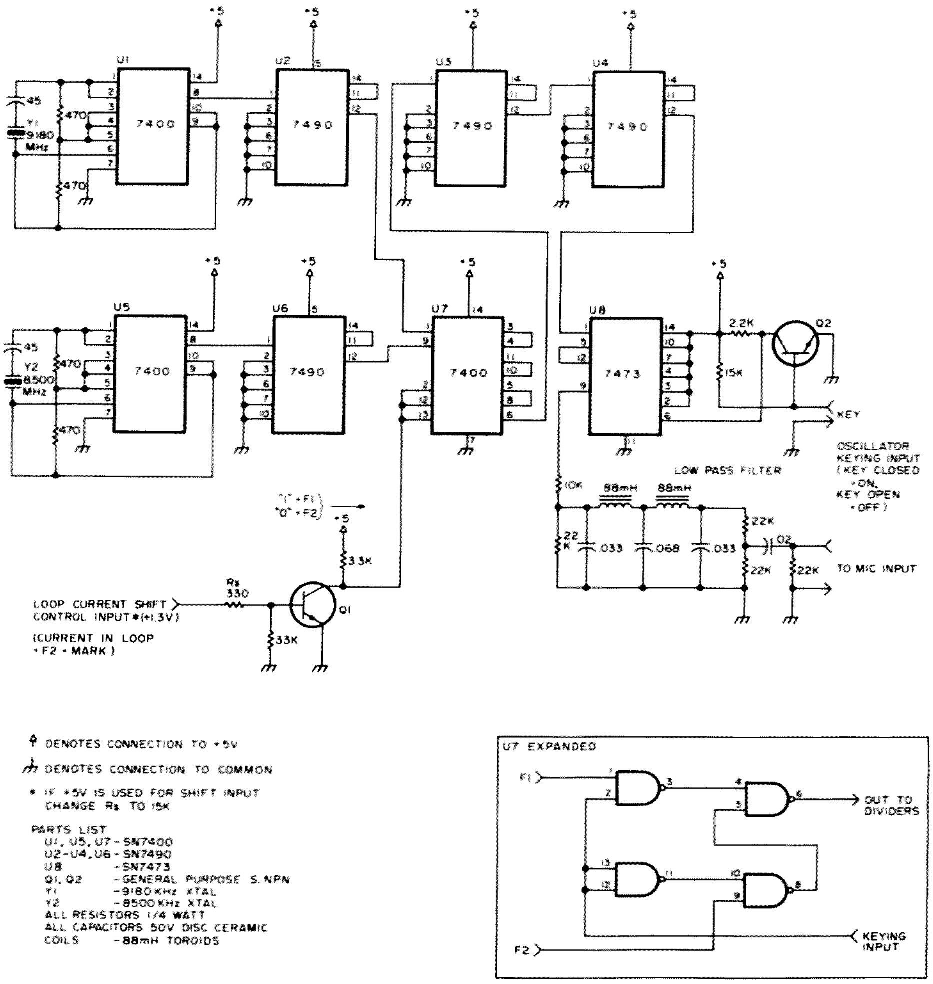

Fig. 1. TTL crystal AFSK oscillator.

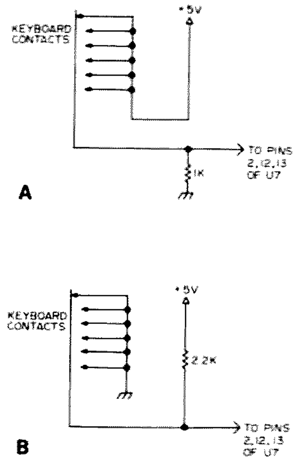

Fig. 2.(a) Separate keyboard normally high; (b) separate keyboard normally low (requires reversing crystals).

be used (see Fig. 2). For CW ID, on-off keying is used instead of narrow shift. The key thus also acts as a transmit-receive switch when using VOX with the transmitter.

Construction Details

The complete circuit, except for the power supply and the 88 mH toroids, is on a 2- by 4-inch circuit board using the layout shown in Fig. 3. Bypassing of all plus 5-volt leads with a .1 uF capacitor is recommended. Leads should be kept as short as possible, and all leads which leave the chassis should be bypassed to ground to prevent rf from activating the switching chip. Good filtering of the power supply is necessary for a clean output from the transmitter. The circuit draws about 180 mA.

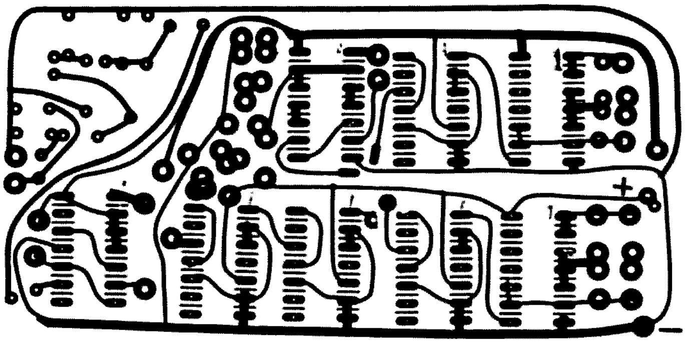

Fig. 3. PC board layout, foil side.

Conclusion

While not having the advantages of a single crystal synthesized unit, this one does have rock-solid stability, is relatively inexpensive, and is readily compatible with computer or TTL circuits. Several QSOs were made using this unit, and only favorable comments have been received.

Acknowledgements

I wish to express thanks to all the authors mentioned in the references and many others from whom I got ideas and circuit information before deciding to design and build this circuit. Also, I am grateful for much assistance from Jimmie Straughn K4COV who did the layout and helped with making the board.

I will be glad to answer any questions of design, availability, performance, etc., if inquiries are accompanied by an SASE.■

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1. Newland, "A Safe Method for Etching Crystals," *Single Sideband for the Radio Amateur*, ARRL.
2. "A TTL Crystal Oscillator," *QST*, Feb., 1974, p. 34.
3. "Audio Frequency-Shift Keying for RTTY," *Specialized Communications Techniques for the Radio Amateur*, ARRL.

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Pulser Plus

—a one-shot with more

This circuitry turns your single-shot multivibrator into a useful piece of test equipment.

This gadget is a combination of circuits from two previous articles. The first, in the October, 1974, issue of *73*,[1] described a wide-range repeating pulse generator using three 555s. The second article was in *73* for February, 1975,[2] and described a variable pulse width, single-shot generator using TTL devices. Both of these circuits were interesting and I hope that the circuit discussed here has kept all the good features of both.

The circuit of the pulser is shown in Fig. 1. Here, again, the circuit consists mainly of three 555s. Every time S1 is pressed, there is a pulse at the output, the length of which is variable over a wide range. Both positive- and negative-going pulses are available. The unit operates over a supply voltage range of 4.5 to 16 volts, which makes it usable with both TTL and CMOS, and even linear circuitry under certain conditions.

Here's how it works: U1 is connected as an RS flip-flop. I have not seen much on using the 555 in this way, but it is just right for our application. As long as pin 2 is low, the output is high. When S1 is pressed, pin 2 goes high, pin 4 goes low, and the output (pin 3) goes low. Since a 555 is negative-edge triggered, U2 will be triggered when pin 3 of U1 goes low. As U2 is connected as a single-shot multivibrator, there will be a pulse on pin 3 for a length of time determined by the equation $T = 1.1(R1 + R2)C1$. A positive-going pulse is available from pin 3 of U2. U3, connected as an inverter, provides a negative-going pulse. Note that the output pulse is somewhat less than the supply voltage and the pulse height varies directly with this voltage.

An interesting addition to this circuit is also shown in Fig. 1. This is nothing more than a diode bridge, but, when hooked up as shown, it allows you to get power from the circuit that you are testing without worrying about connecting the polarity wrong. This trick is not new, but it is a great addition to simple pieces of test equipment like this pulser and logic probes.

This circuit can easily be built using a minibox as an enclosure. Have R1, S2, and S1 mounted on the front. Put J1 in the back. Perhaps a rough calibration of R1 would be useful. In some applications, both output polarities may be required, in which case S2, the polarity selector, could be eliminated, and two output jacks used. Be sure to locate S1 so that it can be used without hitting any of the other controls.

This unit can be used anywhere that a variable width, single-pulse multivibrator is needed. While it is not very different from the average one-shot, the little extras make it a valuable addition to your lab. ■

References

1. Christer Falkenstrom SM4DZR, "A Simple Pulse Generator Using the Signetics 555 Timer," *73 Magazine*, October, 1974, p. 141.
2. Hank Olson W6GXN, "Further Adventures of the Bounceless Switch," *73 Magazine*, February, 1975, p. 111.

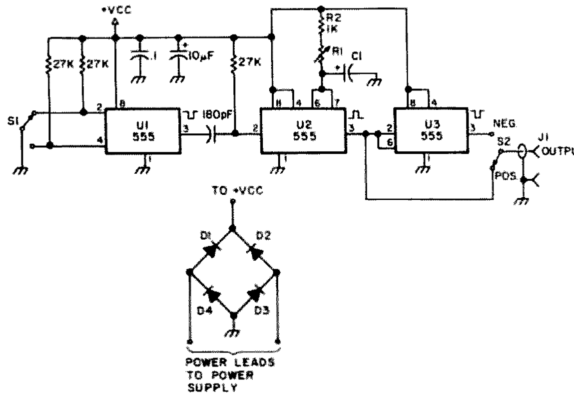

Fig. 1. Versatile single-shot schematic diagram. S1 = SPDT momentary contact. S2 = SPDT toggle switch. D1-D4 = 1N914 silicon diodes. J1 = phone jack or similar.

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Oh, My Poor Quad!

— measuring wind speed

L'Eggs are the legs.

Several *73 Magazine* articles on anemometers and weather indicating devices by W2AOO[1,2] and W9CGI[3] caught my interest and led to the construction of the anemometer shown in Photo A. I have been casually interested in wind speed and direction, particularly when going fishing or sailing or attempting to outguess the weatherman.

Several early construction attempts were unsuccessful due to the lack of a readily available, low-cost pivot point, and a method of trapping the wind (cutting Ping-Pong™ balls in half just didn't work).

After stacking a three-element 15 meter beam and a three-element 20 meter beam, I became even more interested in wind direction and wind speed. The wind surface area and resultant torque vary considerably depending on whether the wind blows against the elements broadside or against the boom length (element tips facing the observer). In my instance, the antenna surface area is approximately 9.5 square feet when viewed broadside and less than 5 square feet when facing the boom lengths. When you consider the combined antenna torque and wind loading on the antenna and tower, the resultant load on the rotor and tower is considerable.

Pointing the antenna boom lengths into the wind significantly reduces the wind loading and lengthens rotor life. If high winds should develop, an indicating device in a high-traffic area such as the kitchen would indicate wind speed and gusts. A wind vane mounted on the tower would serve to indicate the wind direction.

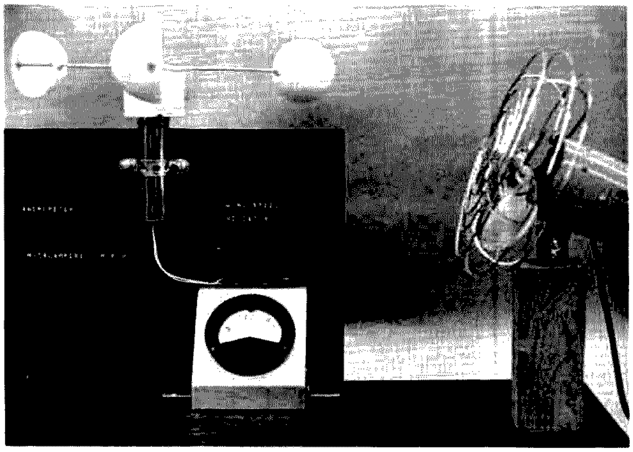


Photo A. *Complete anemometer system.*

The major items required to construct the anemometer are a bicycle front axle, three L'Eggs™ stocking containers, a slot-car motor or other permanent magnet dc motor (which will serve as a dc generator), a 0-50 microampere meter, a pipe or length of tubing, and the top from a spray paint can (Photo B).

The problem of finding a low resistance pivot point was solved by cutting in half the front axle of a discarded bicycle and using it as the pivot point. Most bicycle axles may have to be annealed before drilling a hole to accept the motor shaft. This shaft can be held in place with epoxy glue or setscrews (Photo C). I used setscrews to secure the motor shaft to the axle so that the motor could easily be changed, although this hasn't been necessary during two years of operation. Be sure the slot-car motor readily drives the 0-50 microampere meter when spun by hand.

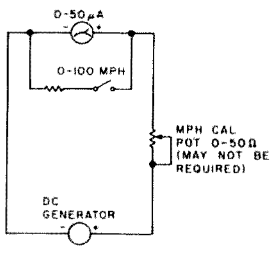


Fig. 1. Anemometer schematic.

A piece of tubing or pipe is selected so that the lip of the bicycle axle rests on the outside diameter of the tubing as shown in Photo D. An aluminum retainer bracket secures the axle to the tubing, and a piece of Romex insulation taped around the dc generator will prevent it from rotating inside the tubing.

In Photo E, three 1/8-inch diameter aluminum rods are cut into 7¼-inch lengths and threaded. The L'Eggs stocking containers are secured with nuts. Each rod is then threaded into a 1¼-inch diameter by ¼-inch thick aluminum disk. The threaded holes are spaced 120 degrees apart. The center of the disk should be drilled so that it will pass through the bicycle axle.

Locate a plastic aerosol spray can top which will be used as a rain shield. Cut, or burn out with a soldering iron, the internal

Photo B. Component parts of anemometer.

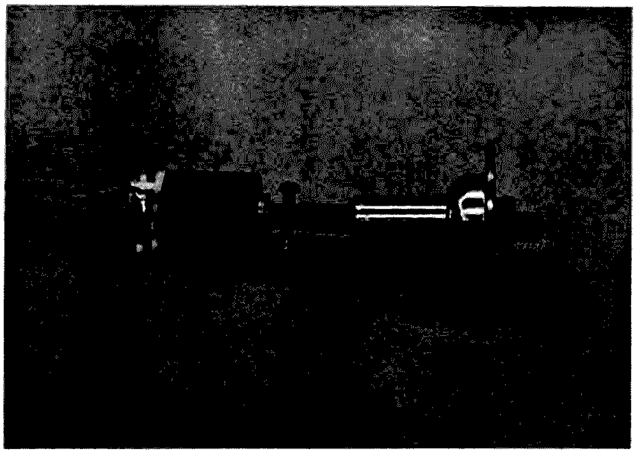


Photo C. Slot-car motor attached to bicycle axle by means of two setscrews.

plastic wall which is used to lock the cap on the can. A hole should be drilled in the center of the cap so that it will fit over the axle. The unit is assembled by placing the cap over the bicycle bearing nut, followed by the cup assembly (which is secured with the remaining axle nut). (Photo E.) A wooden plug may be inserted in the other end where the two wires come through.

It just so happened that three of the constructed anemometers indicated approximately one microampere per mph on the 0-50 microampere meter readout device. Depending on various motor/dc generator outputs, a small value of variable resistance (0-50 Ohms) may have to be inserted in series to calibrate the mph reading. A switchable shunt resistor should be installed across the meter movement. This will enable the meter to read 0-50 mph or 0-100 mph full scale. Refer to Fig. 1.

The internal resistance of the meter and the shunt value can easily be determined by using the formula or circuits found in the *ARRL Handbook*. In most cases, the shunt value will be the same as the meter's internal resistance. A typical shunt value would be 5 Ohms. I used common carbon resistors since extreme accuracy was not as important as the relative readings.

Frequent monitoring of a NOAA weather station indicated that the observed meter measurements were very close to local mph readings. Since I was only concerned with relative readings, no actual calibrating resistance was required.

If you are a purist, the easiest way to calibrate the anemometer is to compare the readings with an anemometer of known accuracy. An alternate method would be to mount the anemometer on the front of a car and adjust the calibration pot. An open field or vacant parking lot should be selected and all safety precautions and speed limits observed. A 10 mph reading should be sufficient for adequate calibration. The air-foiling effect of the car chassis will affect the readings if it is held outside a window. Also, be sure the wind is not blowing.

One word of caution: Provide some means of disconnecting and grounding the lead-in wire from the anemometer to prevent damage from lightning.

Mount the anemometer in a clear, unobstructed area and pay attention to Mother Nature! ■

References

1. "Digital Wind Direction Indicator," Warren MacDowell W2AOO, *73 Magazine*, November, 1974, pg. 40.
2. "Inherit the Wind," Warren MacDowell W2AOO, *73 Magazine*, March, 1976, pg. 72.
3. "The Wind Counter," Dave Brown W9CGI, *73 Magazine*, November, 1976, pg. 84.

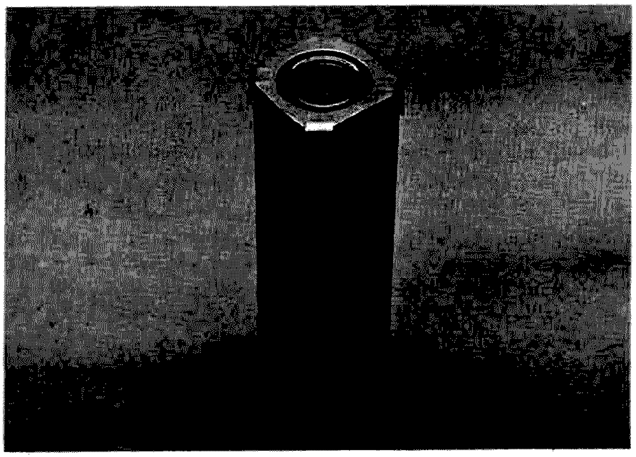


Photo D. Bicycle axle held in tubing by use of aluminum retainer.

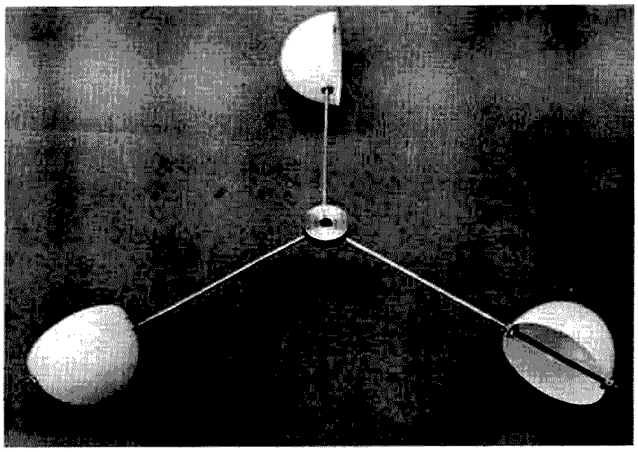


Photo E. Completed wind-catching assembly.

A Self-Contained, Fully-Automated, Transistorized Fuse Tester

—amaze your friends

Take a look at the English answer to the battery and bulb.

C.F.J. Ward G3TAI
50 Lakeside
Bracknell, Berkshire
England RG12 2LE

Here is a simple fuse tester for the shack which is quick and easy to build and use. Although it is only one step better than a battery and bulb, it does have an advantage in that it will test those low-current fuses that appear here and there. (And it is bound to impress your nontechnical friends!)

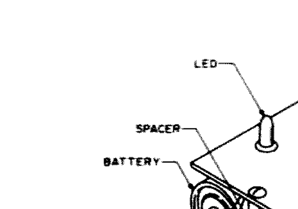


Fig. 1.

The circuit is shown in Fig. 1, and operation is as follows:

1. With no fuse connected, there is no base current and, hence, no collector current; the LED remains dark. Use of a silicon transistor ensures that the leakage current is negligible.

2. When a short circuit (good fuse) is placed across the test terminals, it completes the base drive line, and base current will flow. The resulting collector current will light the LED.

The base current will have a value of approximately 0.24 mA since the supply is 3 volts. The base-emitter drop is about 0.6 volts, and the base drive resistor is 10k Ohms. This will cause a collector current of HFE times 0.24 mA to flow, and, for a typical HFE spread of 50 to 150, this will be 12 to 36 mA, which will easily light the LED. With my unit, I used a low-gain transistor salvaged from a surplus computer board which gives a collector current of 16 mA. With a high-gain transistor, the collector current can be adjusted by increasing the value of the base drive resistor, but it is much better to use a low-gain transistor because leakage current through the fingers when using the tester can cause the LED to light even if the fuse is blown! This effect is much worse with high-gain transistors.

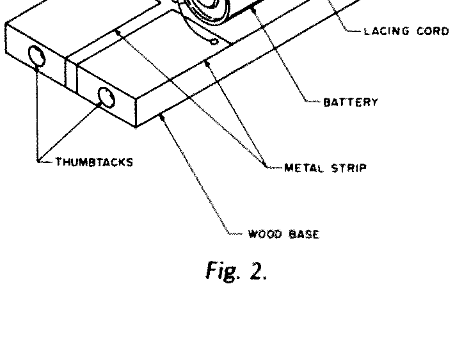


Fig. 2.

Construction

The tester can be made up as shown in Fig. 2. The components are mounted on a small piece of Veroboard. This is fixed to the wooden base plate with screws and spacers made from ball-point pen cases cut into ¼-inch-long tubes. The two AA-size batteries are tied together with lacing cord, which holds them against the spacers. The test terminals are made from some brass strip that I had in the junk box, but bits cut from an old can would do as well. The batteries are soldered into the circuit since no current flows unless a good fuse is tested. They should last a long time with the intermittent use expected of a fuse tester.

I have drilled a hole in the base of my tester so that it can be hung up when not in use. ■

Don't Get Burgled!

—build this simple alarm

Isn't security worth $10 or less?

William R. Fletcher, Jr.
2810 Riverview Drive
Fairbanks AK 99701

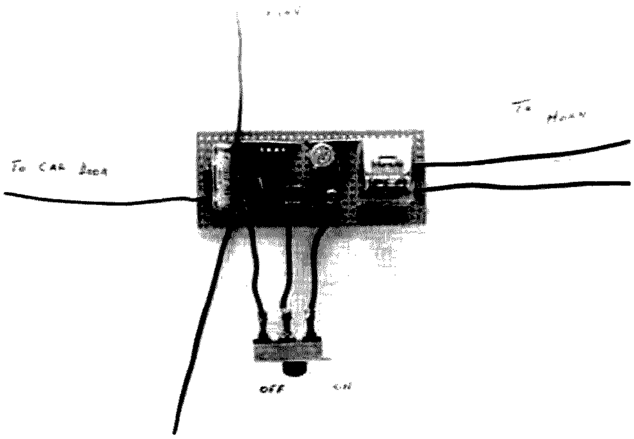
Here is a simple burglar alarm that makes an excellent one-evening project and can result in a safe car or shack. It is based on the fact that some thieves will not stop for anything except a good reliable alarm such as this one. There are no critical parts to find or adjustments to make with this alarm as with others I've seen (Jeffrey Pawlan WA6KBL, "The Smart Alarm," *73 Magazine*, June, 1975). The circuit allows safe exit and entry using a minimum of components. Most ham operators with a small junk box could probably build it for almost nothing. Even if you had to buy all the parts new, it should cost less than $10. Shopping in the back of *73 Magazine* could put it closer to $5. Not much for such a reliable source of protection.

Operational Description

All you have to do is park your car, open the door, set the alarm, and exit. Unlike other alarms I have read about, there is no minimum exit time on this one. For example, you can take as long as you want to unload groceries, kids, etc. This alarm is only activated and starts timing out the next time your door is opened, such as when you return or when a thief decides your car is next. You then have ten seconds to switch off the alarm. Once switched off, it will not sound the car horn.

Circuit Description

The circuit is inexpensive, reliable, and very easy to build. For active com-



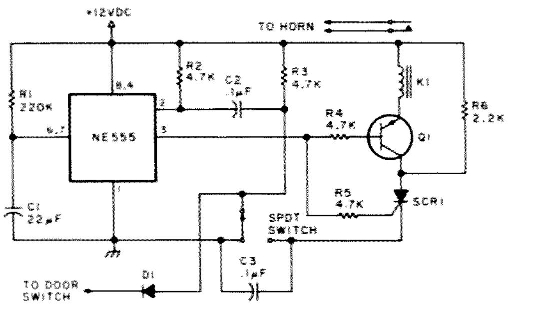


Fig. 1. Burglar alarm schematic diagram.

ponents, it uses a very common integrated circuit (NE555), one PNP transistor, and one SCR. See Fig. 1.

The timer circuit is designed to have 12 V dc applied at all times. If the circuit used a power switch, it would cause false triggering of the timer, and this would cause the horn to sound after time-out. It does, however, use a switch in the relay circuit. With the switch in the off position, it holds the input to pin 2 at ground, which also prevents false triggering of the timer. With the switch in the on position, it puts ground to the relay circuit so it can be switched in or out, to shut off the alarm, and removes the ground from the trigger input (pin 2). When pin 2 goes high (12 V dc), this arms the alarm.

When you open the door, the switch is in the off position and ground is applied to the trigger input (pin 2). If the door opens, the door switch puts ground on the trigger input wire. Now you can switch to the on position. This arms the circuit and the trigger input still sees ground (via the door switch). You can now close the door and lock it if you wish. This puts pin 2 at 12 V dc. The next time the door is opened, pin 2 receives a negative-going pulse which starts the time-out. When pin 2 goes low, pin 3 (output) goes high (12 V dc) and turns on the SCR. After the circuit times out, pin 3 drops back low again, which turns on Q1, and K1 energizes which sounds the alarm. Relay K1 can be connected to a horn, bell, lights, or any combination thereof. The alarm will continue to sound until you shut off the switch and, by then, the would-be thief should be long gone.

If for any reason you need to alter the entry time, it is easily accomplished by changing R1 or C1. Increasing either will lengthen entry time and decreasing either will decrease entry time. With the components shown, entry time is about 10 seconds. I find this to be just about right to comfortably enter and shut the alarm off.

If this alarm is to be used for shack protection, you must build an additional input circuit which is nothing more than a switch and resistor combination (Fig. 2). Also, if house current is preferred over a battery, Fig. 3 shows a power supply circuit that will work.

This alarm has already proven itself once for me! Since that one attempt on my car by a thief, I consider it to have paid for itself. If you value your possessions as I do, this alarm will give you peace of mind while away from your car or shack. ■

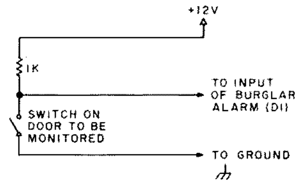


Fig. 2. Input circuit switch schematic diagram.

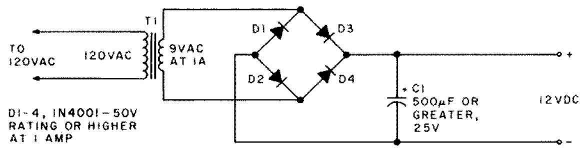


Fig. 3. Power supply schematic for burglar alarm.

Power x 2

—dual auto batteries

Your car will always start, and you can operate all you like.

Harry J. Miller
991 42nd Street
Sarasota FL 33580

If you'd like to install a second battery in your car to operate your radio, CB unit, ham setup, etc., and not worry about having enough current to operate your starter, use the device shown in Fig. 1.

Your car's alternator will charge both batteries, but operating your radio gear too long will only discharge one, leaving the regular vehicle battery fully charged for instant use.

D1 through D4 are stud-mounted silicon diodes rated at 60 piv and 25 Amps or more. Mount with the usual insulating washers on a heat sink. ■

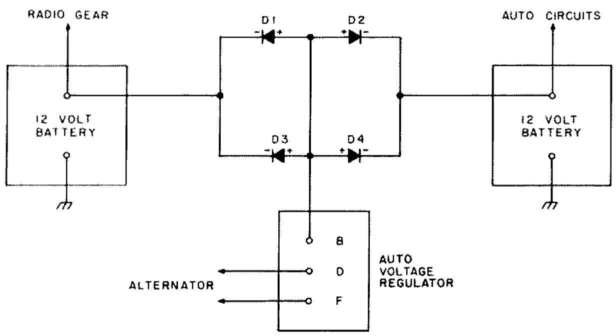


Fig. 1. Battery isolator schematic diagram.

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Experimenting with Tones

—fun with functions

Tone generation the foolproof way.

Tone generators, or audio oscillators as they are commonly called, are frequently used in amateur and commercial radio systems. They are used in touchtone™ pads, toneburst generators, subaudible generators, AFSK oscillators, and in remote station control systems. They have also been widely used for years in test generators for testing AM, SSB, and telephone equipment. While there are many ways to generate tones for these and other uses, most of the traditional methods have drawbacks of one sort or another. LC circuit oscillators, for example, are difficult to tune up, twin-T oscillators sometimes are reluctant to oscillate, and multivibrators aren't always as stable as required. The above problems are compounded when attempting to adapt these oscillators to frequency shift keying. While these drawbacks aren't too serious to an experienced experimenter or engineer, they sometimes prove to be major frustrations and obstacles to the average experimenter who needs a good audio oscillator quickly.

An easy and almost foolproof way to generate audio tones for a large variety of purposes is to use one of the IC function generators, readily available from most electronic supply houses. These function generators and a minimum number of external components will provide stable, low-distortion sine wave audio outputs. This article describes the operation and application of these IC function generators, and gives simple examples and circuits using an EXAR XR2206 function generator IC. The experiments require no test equipment other than a pair of earphones and a VOM. The total cost of these experiments should be under $10, provided that a source of 12V dc is available.

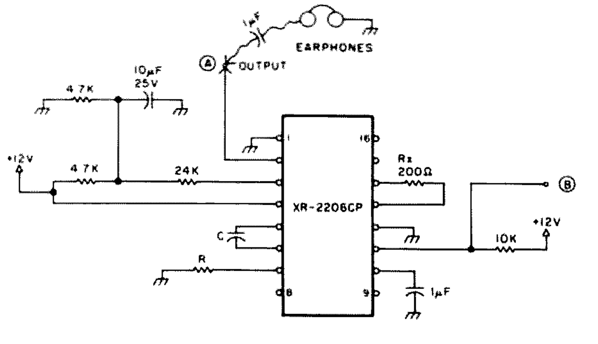


Fig. 1. Basic audio oscillator. All resistors are 1/4- or 1/8-Watt. For a frequency of 1 kHz, C = .1 uF, R = 10k.

The EXAR XR2206 IC Function Generator

Fig. 1 shows a basic audio oscillator using an XR2206 IC. None of the components is critical, and the circuit should work the first time it is turned on. R and C are the frequency determining components. With the values given for R and C, the function generator will produce an audio output of 1 kHz. Connect the earphones to point A through a .1-uF capacitor as shown. A clean sine wave of about 1 kHz will be heard. The output impedance is 600 Ohms, and the IC will drive earphones of 600 Ohms or higher impedance. It will not drive a 4- or 8-Ohm speaker. The rms audio output is about 1-2 V, which is more than enough for most purposes. For ease of construction, the circuit may be breadboarded on a Continental Specialties or similar breadboard.

With the earphones still connected to point A, remove Rx from the circuit. The output should become slightly richer in harmonics as the sine wave is changed to a triangle wave. If an oscilloscope is available, the waveforms should appear as shown in Fig. 2.

Connect the earphones to point B, the square wave output, through a .1-uF capacitor. A 1-kHz tone, rich in harmonics (square waves), should be heard. If an oscilloscope is available, the waveform should appear as shown in Fig. 3.

The output frequency of the function generator is determined by R and C, by the expression:

$$f = 1/RC.$$

Thus, in this case,

$$f = 1/[(1 \times 10^4)(1 \times 10^{-7})] = 1/10^{-3} = 10^3/1 = 1000 \text{ Hz}$$

Component tolerances are an important consideration if a precise frequency is desired. With average, run-of-the-mill

capacitors and resistors (20% tolerances), you can get near the desired frequency, but you won't get exactly on frequency. If a precise frequency is desired, then a trimming resistor should be inserted in the circuit as shown in Fig. 4.

Temperature Stability

The temperature stability of the XR2206 is about 15 parts per million per degree centigrade, or about .15% over the temperature range of 0 to 75 degrees C. This is very good temperature stability and probably better than needed for most purposes. Unfortunately, in practice, it is difficult to achieve this stability due to temperature tolerances of R and C, the frequency determining components. In the circuit given in Fig. 1, it is assumed that normal run-of-the-mill carbon composition resistors and disk ceramic capacitors will be used. Components of this variety exhibit very poor temperature stability, and will change in value from 10 to 20% from room temperature to freezing. This phenomenon can be verified by connecting the output of the tone generator to a counter, and then placing the tone generator in the refrigerator. A significant change in frequency will be noted.

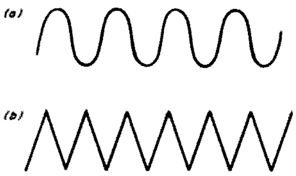


Fig. 2. (a) Waveform with Rx in circuit; (b) Waveform with Rx removed from circuit.

Fig. 3. Waveform at square wave output.

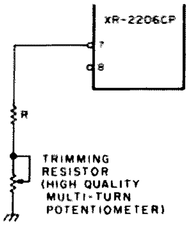


Fig. 4. Adding a trimming resistor to adjust frequency.

The temperature stability of the tone generator circuit can be improved considerably by using temperature-stable components for R and C. For C, mylar™ or silver mica capacitors should be used; for R, 1% resistors of the variety RN55 (an industry designation) should be used. These components exhibit good temperature stability, and are readily available from the supply houses listed at the end of the article. Fig. 5 shows a stable oscillator with a table of components for various frequency ranges.

The XR2206 IC is a unique chip in that it is designed for two-frequency or AFSK operation. If the circuit in Fig. 6 is used, the frequency will change from 1000 to 1170 by grounding pin 9. By adding a relay, as shown in Fig. 6, this circuit may be used for AFSK keying. The output of the oscillator is continuous when changing frequency, as shown in Fig. 7, and thus the oscillator may be used to modulate an SSB transmitter to produce FSK.

Tone-Burst Oscillator

Fig. 8 shows a simple tone-burst oscillator. Point C is connected to the push-to-talk line in the transmitter. When the transmitter is keyed, a short tone burst is generated and fed to the audio circuit of the transmitter. R_T adjusts the time duration of the tone burst, and R_A controls the output tone level. Choose C and R according to the formula shown for the desired frequency.

Subaudible Oscillator

A simple subaudible tone oscillator may be constructed by using the circuit in Fig. 8. In this case, omit the NE555V and its associated components, and connect pin 4 of the XR2206 to +12 V. The output of the subaudible generator should be connected to the high side of the modulation or deviation control in order to bypass audio speech filters that pass speech in the 300-3000-Hz range. This type of oscillator is called

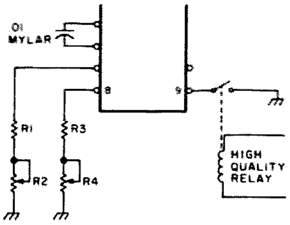


Fig. 6. AFSK oscillator. R1 = 90,900 RN55, 1%; R3 = 75,000 RN55, 1%; R2, R4 = multiturn miniature 20k pot, such as Beckman or Spectrol, which are used to trim the frequencies to 1000 Hz and 1170. Hz, respectively.

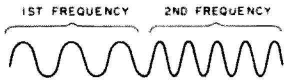
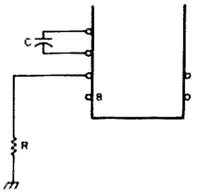


Fig. 7. Oscillator output when changing frequency.



Frequency	C	R
100 Hz	.01 mylar	1 meg
500 Hz	100 W V dc	200,000
1000 Hz		100,000
1500 Hz		66,500
2000 Hz		49,900
3000 Hz		33,200
5000 Hz		20,000

Fig. 5. Stable oscillator. Resistors are 1% tolerance MIL style, RN55D, RN55C, or RN55E. f = 1/RC.

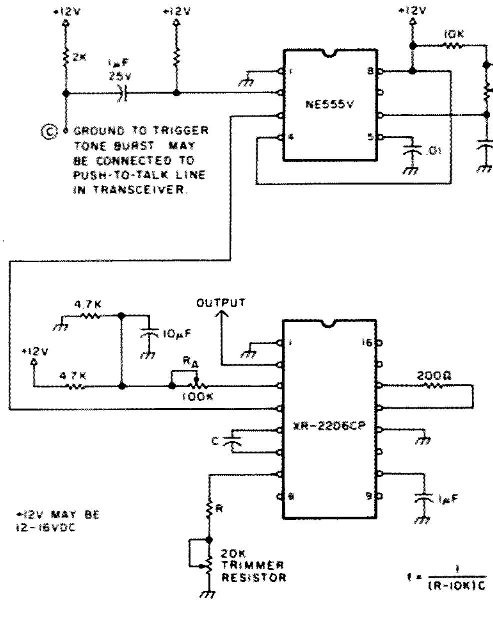


Fig. 8. Tone-burst oscillator.

subaudible since FM receivers with private line or tone squelch capability filter out frequencies below 300 Hz, and are not passed to the audio stages. Subaudible frequencies (frequencies below 300 Hz) are used to activate a private-access repeater or station.

Audio Test Generator/ Code-Practice Oscillator

A simple audio test generator may be constructed by using the circuit in Fig. 4. If R is 10k and the potentiometer is a 500k pot, the frequency may be varied over the range of about 200 Hz to 10 kHz. This simple generator may also be used as a code-practice oscillator by placing a key between +12 V and pin 4 of the XR2206.

Other Function Generators

The circuits given in this article were based on the XR2206, which was chosen because of its ease of use and availability. Other function generators, such as the XR2207 and the Intersil 8038, may also be used to generate audio frequencies. However, they are not the same as the XR2206 and lack some of its capabilities. If these other chips are to be used, a set of application notes should be obtained from your distributor. ■

Sources for Parts

XR2206CP, NE555V, .01 mylar (mylar film), nonprecision resistors and other parts—James Electronics.
Resistors, capacitors, and multiturn trimming pots—Poly Paks.
Precision 1% resistors—Harvy Electronics, Vestal Parkway E., Vestal NY 13850, or Cramer, Summitt, and other large distributors.

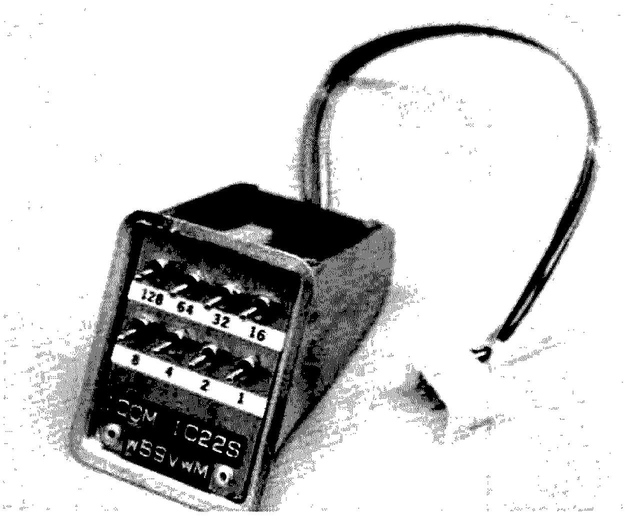
Synthesize Your Ashtray

—article for non-smokers

Let your dashboard do it for the 22S.

Hugh S. Pearl WB9VWM
2502 Oak Lane
Rolling Meadows IL 60008

Being a non-smoker and the owner of an Icom IC-22S provided me with a simple way to have a programmer built permanently into my car. The cup in the front ashtray is removable and has enough room in it for 8 miniature toggle switches and 8 diodes needed to program the 22S for any of its frequencies.



An aluminum plate was cut to fit the ashtray opening and drilled out for the switches and mounting holes. The back of the ashtray has a hole and rubber grommet in it to protect the connecting cable. A 9-conductor ribbon cable (10 conductor with one wire removed) was used with the accessory plug connected to one end. The photo shows a 24-pin Molex plug which my rig uses, but the 9-pin plug Icom provided works just as well. The switches, diodes, and ribbon cable were obtained from James Electronics.

I made a listing of the frequency conversion code and mounted it to my visor. When the ashtray cover is closed, the programmer is hidden in the dashboard. Best of all, now no one leaves old butts in my ashtray.

The connector in the radio is connected by the ribbon cable to the channel 22 switch position on the matrix board. The other 21 positions can be permanently programmed as you desire. ■

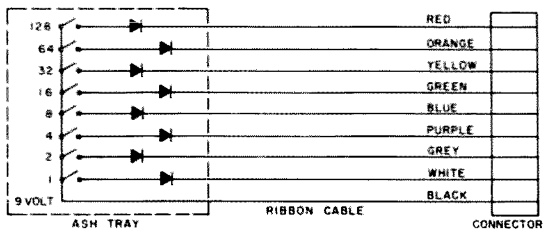


Fig. 1.

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Attention, Satellite Watchers!

—a solid-state monitor for GOES

The satellite doctor strikes again.

In a previous article in *73* (November, 1978), I described various approaches for reception of GOES (geostationary operational meteorological satellite) picture signals on S-band (1691 MHz). For the experienced satellite fanatic, the S-band conversion is the big snag to implementing GOES operations, since most have adequate display equipment to handle the APT mode pictures. For newcomers, however, the problem is more complex, particularly since many new converts to weather satellites have little experience in electronic construction. All things considered, the easiest approach for most is an integrated display monitor which permits photographs to be obtained from a TV-like display.

Photo A. The remote display terminal in the author's prototype. This used the cabinet, bezel, CRT, HV module, and yoke from a Robot fast-scan viewfinder. The cabinet contains these components and the relevant CRT circuits.

The *73 Weather Satellite Handbook* contains one such display unit that will do a fine job. This monitor is a multimode unit, however, and is designed to handle both geostationary and polar orbiting satellites. If geostationary spacecraft such as GOES are the major objective, there are several design simplifications which are possible. In addition, since designing the original unit, several new circuit ideas have been tried with good results. It seemed a good idea to present a circuit incorporating many of these ideas while, at the same time, getting at a unit that was designed strictly with GOES service in mind.

Before getting into a discussion of the unit, a short digression on design philosophy is in order. There is no single-circuit solution to any given problem. Some approaches are more complex than others, and each has its own unique tradeoff between simplicity and performance. As is always the case in my published circuits, I have taken the simplest approach that will yield quality results. If you think you have a better solution at one point or the other, feel free to modify the beast. If worse comes to worst, you can always put it back in its original state with assurance that it will do a good job.

The second problem facing the home constructor these days is the matter of obtaining parts. It gets hard enough to obtain garden-variety components at times, without trying to duplicate a circuit where the author had access to a one-of-a-kind part left over from the construction of the last lunar module! In that regard,

you can rest assured that all of the parts specified are widely available and a wide margin for substitution exists. In each case where this is possible, I will try to outline what you should look for in substitute parts. Virtually all of the specified components are available from local distributors, off the pegboard at your local Radio Shack, or from mail-order supply firms.

Finally, as an aid to those who are terrified of what looks like a complex project, virtually all of the active circuits for this monitor have been boiled down to single large plug-in circuit boards with only 14 connections to the outside world. For those without facilities for making PC boards, the boards are available, as I will note later.

Circuit Functions

In the broadest sense, the monitor has to take the satellite video signal and turn it into a meaningful image. To understand how it does this, we must first understand the satellite video format which is summarized in Fig. 1. GOES pictures are transmitted in the APT (automatic picture transmission) mode, and, for the sake of discussion, the overall circuit can be broken down into a number of fundamental subunits, each with its own function.

(1) Video circuits—These circuits must filter the signal to remove any components outside of the video passband and must demodulate it in such a way that maximum subcarrier amplitude (white) results in a bright trace on the screen, while minimal amplitude (black) causes the trace to be extinguished.

(2) Sync Circuits—Here we must maintain a precise 4 Hz trigger rate in order to display the picture properly. Since it is possible to record the satellite pictures on standard audio tape, it is most useful if the sync circuits will function even with the speed variations resulting from the recording and playback process, in addition to handling satellite signals in real time.

(3) Phase circuits—Although the sync circuits maintain the proper trigger rate, they cannot assure that the line trigger pulse that starts each display line corresponds precisely with the start of each line of satellite video. Without special provisions for phasing the picture, you are likely to get a display where the left edge of the actual picture falls somewhere inside the display frame, forcing you to cut and paste the picture to get the proper display.

(4) Horizontal deflection circuits—In this case, we want to generate a linear, 250 ms line each time a line trigger pulse is produced by the sync circuits.

(5) Vertical deflection circuits—Here we want to produce a linear vertical scan which requires 200 seconds for the trace to move from the top to the bottom of the screen. If 8-second frames in slow scan (SSTV) are actually slow scan, then APT pictures with their 200-second frame intervals are very slow scan indeed!

The remaining functional description will center around Fig. 2 (a system block diagram) and the schematics in Figs. 3-8.

Subcarrier frequency	2400 Hz
Subcarrier modulation	FM
White level	maximum amplitude (@ 96%)
Black level	minimum amplitude (@ 4%)
Dynamic range	@ 14 dB
Line rate	4 Hz (240 lines/min.)
Direction of horizontal scan	left to right
Frame rate	200 seconds
Direction of vertical scan	top to bottom
Number of scanning lines/frame	800
Aspect ratio	1:1 (square)
Baseband video bandwidth	1600 Hz

Fig. 1. Characteristics of the APT satellite video format.

Video circuits (Fig. 3). The video signal from the receiver or tape recorder enters the unit at J1 across the 10k CONTRAST control (Fig. 7). Since the gain of all circuits after the CONTRAST control is fixed, it is this control that determines the amplitude of the final processed signal and, hence, the contrast of the displayed pictures. From the CONTRAST control, the signal enters the main circuit board on pin 12 (Fig. 3) where it passes through an active filter (U1) set up for a center frequency of 2400 Hz, a bandwidth of 1600 Hz, and unity gain. The 2840-Ohm resistor in the input circuit sets the center frequency, and can be approximated closely enough by paralleling two 5600-Ohm resistors. From the filter, the signal is routed to U2, which is the video power amplifier. Here the signal gets a significant power boost. A part of the subcarrier signal is tapped off at "A" for the sync circuits which will be described shortly. The signal is also routed off the board at pin 15, where it goes to T1 to be stepped up in voltage in the high impedance secondary windings. Here it is detected by a bridge rectifier network. The output of the detector is a 4800 Hz waveform (positive going) whose amplitude is proportional to the instantaneous amplitude of the satellite subcarrier. This signal is applied to the CRT grid across a 10k load resistor (Fig. 7).

The CRT is biased by the BRIGHTNESS control in the cathode circuit so that the tube is just cut off (the trace is just extinguished when viewed in a dark room). Any positive excursions at the grid will cause the trace to brighten proportionally to the applied voltage which is precisely what APT display requires. About 5 V swing on the grid is all that is required for useful display. To prevent transients or other inputs from blooming the trace, a conventional silicon diode and zener are used across the grid resistor to provide peak white limiting by holding voltage at the grid to a maximum of a little over 5 V. Q1, the blanking transistor, is driven by the line trigger pulse, pulling the grid to near ground potential and blanking the trace during horizontal retrace.

Sync circuits (Fig. 4). The operation of the sync circuits is based on the fact that the 2400 Hz satellite subcarrier is locked to the same master frequency source as the 4 Hz line trigger generator. If we can lock a stable frequency source to the subcarrier signal, it is possible to derive the 4 Hz line trigger rate by digital frequency division. Our reference source in this case is a 565 phase locked loop. The internal voltage controlled oscillator (vco) of the loop is adjusted to free run very close to 2400 Hz by the 1k vco pot. When a sample of the subcarrier signal from "A" is applied to one input of the phase comparator, the vco is pulled onto the subcarrier frequency with the vco output providing a stable source for frequency division. The loop will follow any reasonable frequency changes caused by speed changes in the tape recorder, thus providing

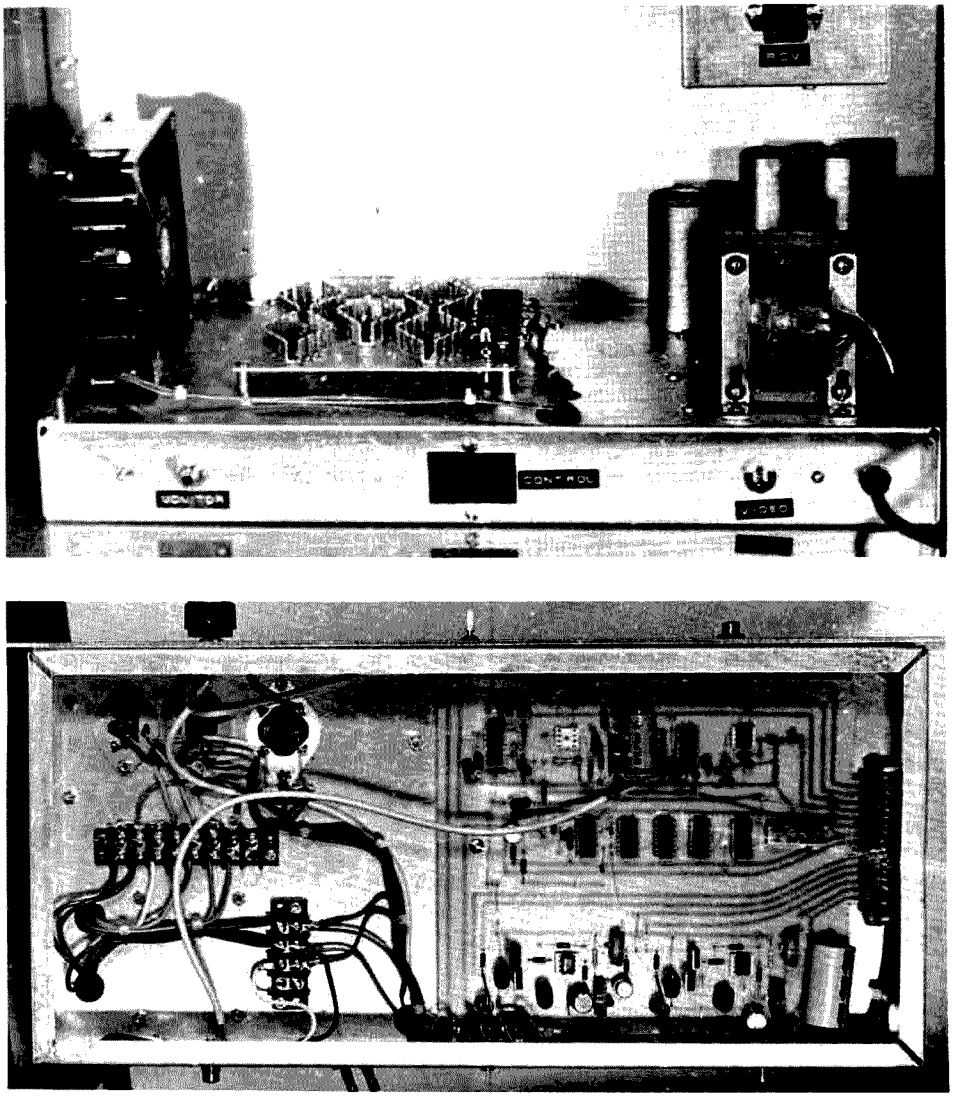


Photo B. Above chassis (top) and below chassis (bottom) views of the electronics assembly of the author's prototype. This unit contains the power supply and the main circuit board. A fan was required to compensate for inadequate heat sinking of the regulators (see text).

for display of recorded video as well. The vco signal from the PLL (U3) is routed through a series of gates in U4 to provide phasing, a function I will discuss shortly. The 2400 Hz output from U4 is then routed to a frequency divider chain composed of U5, U6, and U7, providing a total frequency division of 600. Since 2400/600 = 4, we have derived the proper line trigger rate. This 4 Hz signal is routed to a 12 ms single-shot (U8) which generates the required trigger pulse. A sample of this pulse is routed to board pin 10 for blanking, while another sample, "B", is used to actually trigger the horizontal deflection system.

Phase circuits (Fig. 4). Although the phase locked sync system does maintain the proper line rate, it cannot assure that the line triggering in the display coincides with the start of a line of video data. When it does not, which is likely to be the case most of the time, you get a situation where the left edge of the satellite picture is actually inside the frame. This condition is corrected by the phase circuits. To understand their function, it is necessary to redraw a portion of Fig. 4 to show the connections of the various gates. This is done in Fig. 4(a).

The PHASE switch, a normally-closed pushbutton, has one side grounded and the other connected to the phasing bus on the main board at pin 8. Since the phase bus is normally grounded, this low is inverted to a high by gate D, and this high is applied to one input of gate B with the other input to the 2400 Hz PLL signal that is buffered by gate A. The 2400 Hz signal is thus gated through gate B and then through C without interruption on its way to the sync divider chain. When a phase error exists, however, the switch is pressed (opened), and the status of the phase bus is now determined by the state of the collector of the phasing transistor (Q2). This transistor is driven by the $\overline{Q}$ output of U8, which is high except during the 12 ms trigger interval when it goes low. This results in the collector of Q2 remaining low except for a 12 ms high that is coincident with the trigger pulse. This high is inverted to a low by gate D, and this low at one input of gate B stops the 2400 Hz signal for 12 ms. This interruption, occurring once each line, represents a 12 ms counting error in the sync chain so that the next trigger pulse is delayed for 12 ms, causing the beginning of the next satellite video line to appear closer to the left edge of the display. The PHASE switch is held down until the edge of the satellite video signal moves over to the left edge, at which point the switch is released. This restores proper sync, but, this time, the picture is properly phased.

A worst-case phase error, where the left edge of the picture was all the way at the right end of the 250 ms line, would require 20 line pulses to correct (250/12). Since the line pulses occur 4 times each second, the phase switch would have to be held closed for only 5 seconds (20/4). This is entirely ample since about 20 seconds is actually available for phasing at the start of each APT frame. The action of the phase circuits in stepping the picture into place is shown in Fig. 11.

Horizontal deflection (Fig. 5). The 12 ms trigger pulse at "B" turns on Q3 for the duration of the pulse,

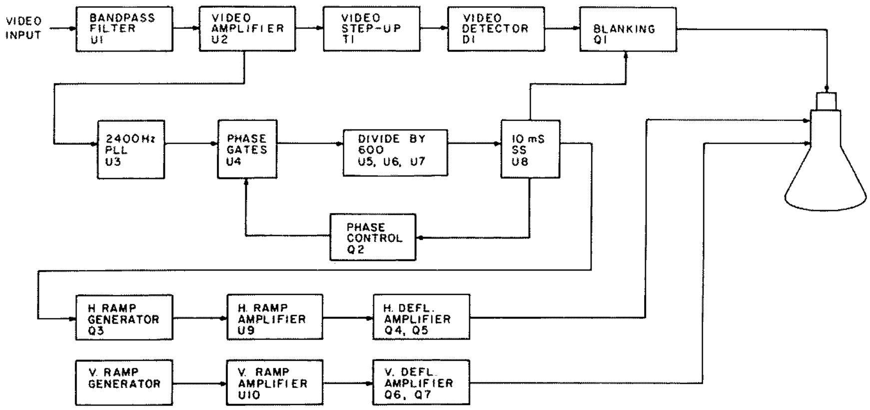


Fig. 2. A block diagram of the monitor signal processing circuits.

discharging the 4.7 uF capacitor in the collector circuit. When the trigger pulse is finished, this capacitor begins to charge through the HORIZONTAL SIZE control, producing a voltage ramp that is amplified by U9. The output of U9 drives the complementary output transistors (Q4 and Q5), which have the deflection windings in their emitter circuit (pins 5 and 6 of the main board). Feedback to the inverting input of U9 via the 100k resistors helps to linearize the deflection waveform. The HORIZONTAL CENTERING control feeds a voltage to the inverting input which provides centering of the trace.

Vertical deflection (Fig. 6). The vertical circuits, with a few exceptions, function much like the horizontal circuits, with the vertical deflection windings connected to pins 3 and 4 of the main board. The differences involve the use of a much larger discharge capacitor (2200 uF) to accommodate the 200-second sweep interval and the fact that the capacitor is cycled by a switch (the sweep switch) rather than a transistor. In the RUN position of the DPDT center-off sweep switch, a reed relay (K1) on the main board is pulled in, causing its contact (K1A) to short out the capacitor and reset the sweep at the top of the screen. When cycled to the center-off position (RUN), the contacts of K1 open, permitting the capacitor to charge and initiating the sweep down

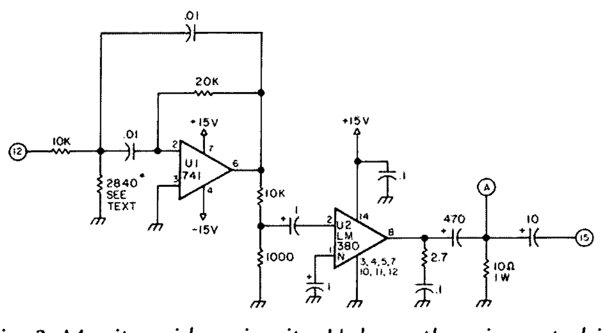


Fig. 3. Monitor video circuits. Unless otherwise noted in this and other schematics, all resistors are ¼ W, 5% carbon film, all decimal value capacitors are 50 or 100 V dipped mylar, all capacitors between 1 and 10 uF are 16 to 35 V tantalums, and all higher value capacitors are aluminum electrolytics rated at 16 V. All unmarked diodes are general-purpose switching types (1N457, 1N914, etc.). Circled numbers refer to board pinouts, while circled letters refer to interface points on other schematics.

the screen. The other position of the switch (FOCUS) grounds the bases of Q6 and Q7, centering the trace on the screen. This position is used to focus the CRT or the film camera and also serves as a standby position when the monitor is not displaying pictures. The low-resistance vertical windings would cause one or the other of the deflection transistors to draw excessive current if left for long periods in the RESET or RUN positions. In the FOCUS position, neither transistor is drawing current, and they will sit indefinitely without overheating.

Mainframe wiring (Fig. 7). Much of the mainframe wiring has been covered in previous circuit descriptions. In order to eliminate the chance that power transformers would cause unwanted deflection of the scanning beam, it is suggested that the power supply be remoted from the main cabinet. The mainframe does contain the +5, +15, and -15 V regulator ICs, driven from the unregulated voltage buses from the remote supply. If the regulators were mounted on the supply itself, you would get unwanted voltage drop in the connecting cable. In addition, the mainframe contains the high-voltage module for generating the +7-10 kV required for the CRT external anode. The high voltage module will be discussed in detail in the construction section. Regardless of the approach taken, however, it is desirable to power the module from its own regulators to minimize interaction with other circuit components.

Power supply (Fig. 8). This supply is one possibility for generating the required voltages. A low-voltage transformer (T3) provides the unregulated voltages via a bridge rectifier and filter capacitor network. The +350 volts required for the internal anode and focus grid of the CRT as well as the BRIGHTNESS network is obtained via a conventional power transformer (T2) and a full-wave rectifier assembly. T2 also provides the 6.3 V ac required by the CRT filament. The mainframe and power supply circuits are shown with Cinch Jones P-808-AB and S-308-AB connectors, respectively. An 8-conductor cable with an S-308-CCT on one end and a P-308-CCT on the other is used to interconnect the monitor and its supply. The power supply is turned on via an ac lead actuated by an SPST switch (S3) on the mainframe.

Construction

Main Circuit Board

Fig. 9 shows the land layout for the main circuit board which carries most of the active circuits. If you do not have facilities for making boards, this particular board is available—a point that will be covered at the end of the article. The component layout is shown in Fig. 10 as viewed from the component side of the board. The main puzzle in wiring the board is the cluster of unused holes between the LM380 and the LM565. These holes mark the demise of an idea that was better on paper than it was in prac-

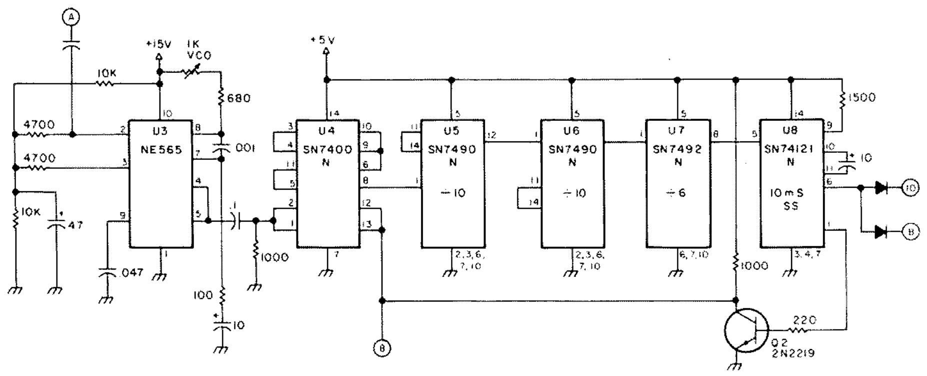


Fig. 4. Monitor sync and phasing circuits.

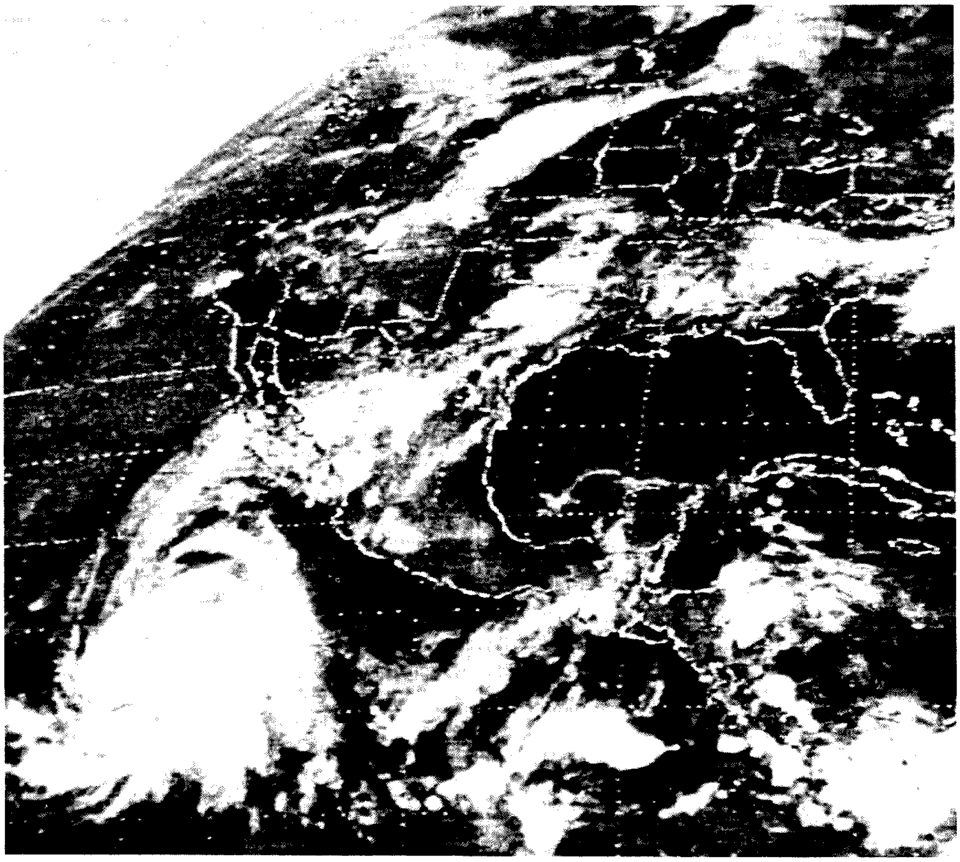


Photo C. An IR frame from GOES E displayed on the prototype monitor. Despite the small screen size, the picture is relatively clear, showing a major tropical storm off the west coast of Mexico. The IR format displays cold objects as white (space and high cloud tops), while warmer areas are darker. Note the warm surface temperatures in the southwestern US and northern Mexico in this frame. The use of a somewhat larger CRT would assure the full 800-line resolution in the APT pictures.

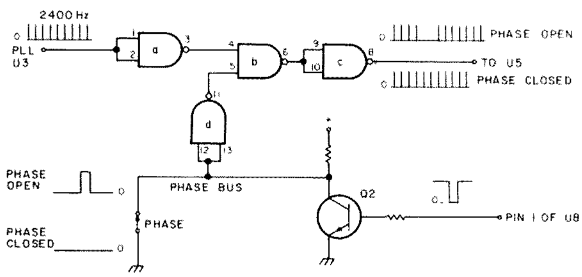


Fig. 4(a).

tice. The idea was to place a limiter in front of the PLL to remove any AM variations in the signal, thus improving the ability of the loop to lock on the subcarrier. That part worked, but the unforseen difficulty was that the limiter was quite sensitive to any noise, and, should it begin to limit on noise, much of the advantage of the PLL was lost. Out went the limiter notion!

In wiring the main board, sockets are suggested for all ICs. They do increase the cost of the project, but they suddenly seem worth it when you discover that you have a bad chip to replace! If you watch the polarity of tantalum and aluminum electrolytics and remember that all the ICs have the same orientation, you will not get into much trouble.

Mainframe

Once the board is finished, the remaining decisions revolve around the packaging style you want to use. The schematics of Figs. 7 and 8 assume that the monitor will go in one box with the power supply remoted on its own chassis. In terms of simplicity, this is probably the best approach to take. In the case of the prototype unit, I opted for a different scheme which got just a bit more complicated. I happened to have a Robot Research fast-scan viewfinder unit which had a suitable CRT, yoke, and HV module, so this was stripped and used as a remote display terminal. The power supplies and main circuit board assembly were mounted on a chassis behind a standard rack panel. Photo A shows the display terminal, and Photo B shows the rack-mounted electronics package. If I were doing the job over again, I would certainly follow the first route I suggested. No matter what scheme you employ, the power supply should be remote from the CRT circuits. It is virtually impossible to package everything in one cabinet and avoid unwanted deflection of the CRT trace by transformer fields. You can try if you want, but plan it so you can pull the transformers with minimal difficulty! When

you actually start to build the mainframe and power supply, you will run into situations where you may want to substitute, so let's look at some of those options.

CRT. The CRT used in the prototype was the original tube that came with the fast-scan viewfinder. It is a type 5M140P7M manufactured by Thomas Electronics, 100 Riverview Drive, Wayne NJ 07470. They made a larger tube for the Robot Model 70 SSTV monitor which is ideal for satellite display and has the same pinouts as the smaller tube used in the prototype. The latter measures only 4.25" × 3.25" (5 inches diagonally) and is really quite small for the display of an 800-line picture. Although the pictures are acceptable, you really can't get the full resolution unless you have a somewhat larger tube.

The one used in the Robot Model 70 is just about ideal. Both of these tubes have a P7 phosphor. This long-persistence phosphor is sufficient to let you see some aspects of the picture in real time in a dark room and therefore has some advantages. P4 phosphors of the type used in black and white TV sets will also work fine, although they do not have the long-persistence feature. If you have a Model 70 SSTV monitor on hand that is doing little these days with the advent of digital SSTV scan converters, you can use this as the basis for a conversion, as it will provide a cabinet, yoke, HV module, and a suitable power transformer. If you are building from scratch, I would suggest contacting Thomas and seeing what is available along the lines of the tubes they supplied to Robot. Their prices are quite reasonable compared to other sources. Failing this, you can check out various small black and white TV picture tubes at your local distributor. Many of these will work fine if you change the socket wiring to accommodate the pinouts. Many of these will have a 12 V filament which can be powered from another LM340T-12 regulator tied to the +LV bus.

HV Module. As mentioned above, the HV module for the prototype came from the Robot fast-scan viewfinder. Other Robot display equipment will furnish similar units. There are many designs available for such modules, and several alternatives are shown in references 1 and 2 and the SSTV section of reference 3. All of these are similar in that a power transistor is hooked up as an oscillator operating into the primary of a standard TV flyback transformer with the HV rectifiers and capacitors in the secondary circuit. The main difficulty with most is that the suggested feedback circuits to run the oscillator are highly dependent on the specific flyback which is specified in each case. Another approach worth checking, if you like to play on the bench, is to use a 555 timer chip as an oscillator at about 20-25 kHz and use this to drive the power transistor as a switch in the flyback primary circuit as shown in Fig. 11. This approach should work with just about any flyback, and you simply choose your primary taps to achieve the desired output voltage.

Transformers. T1 in the video circuits (Fig. 7) is a standard audio output transformer with an 8-Ohm secondary winding (actually used as the primary in this application), and primary windings can be anything from about 1k to 16k. Calectro and others make quite a few that will work just fine—simply look for a "universal" output transformer if you can find one that seems to be custom made for the application. Power transformers are comparatively noncritical as well. If you convert a Robot Model 70 monitor, the power transformer in that unit has all the proper windings in one package. If you go the route of separate transformers, as shown in Fig. 8, you can use the following guidelines in making substitutions.

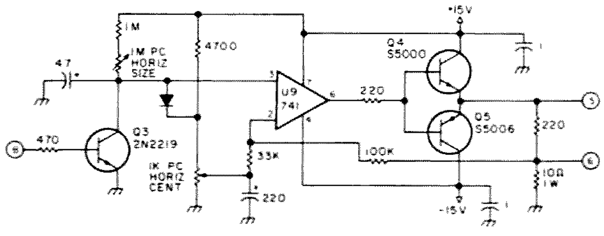


Fig. 5. Horizontal deflection circuits.

The LV circuit requires that the voltage on both the + and − buses be at least 17-18 V for the 15 V regulators to operate properly. The regulators themselves will take up to 30 V when properly heat sinked, so any transformer that will deliver between those dc limits will work fine. It should be capable of supplying at least 1 Amp, and 2 Amps is better yet. The HV supply is low current, and there are a variety of power transformers with 225 and 250 V c-t secondaries in the 25-50 mA range which will work fine. All of these have the required 6.3 V ac filament winding.

Deflection yokes. Any deflection yoke designed for a small solid-state black and white TV set will do the job here. If you have a choice, pick a yoke with higher resistance windings in preference to one with very low resistance.

Cabling. You can do anything you want in this area, from hardwiring the two units together to the use of exotic cable assemblies. Figs. 7 and 8 specify the use of a Cinch-Jones P-308-AB

Photo D. An example of an operational message. In this case, it is a system status announcement and part of the transmission schedule for GOES E. This example shows the old format with white letters on a black background. The current format uses black letters on white.

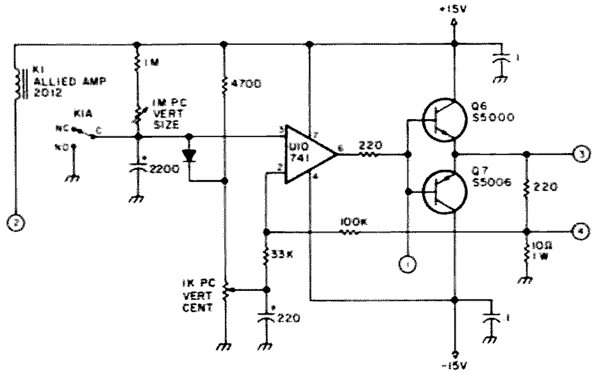


Fig. 6. Vertical deflection circuits.

on the mainframe and an S-308-AB on the power supply. An 8-conductor cable terminated with an S-308-CCT on one end and a P-308-CCT on the other connects the two units. These plugs and sockets are available from almost any distributor and are inexpensive compared to other options. Of course, octal plugs and sockets could be used if you can tolerate wiring the former—I can't! Just be sure to use a socket on the supply and a plug on the mainframe lest you electrocute yourself some evening while wrestling with cables!

General Notes

Only a few general guidelines are necessary in actually wiring up the mainframe and power supply. The first is to adequately heat sink the IC regulators. Dinky sheet aluminum sinks were used in the prototype, and this required the use of a cooling fan to stop them from shutting down when they got too hot. Generous extruded aluminum units are a good investment and will keep the regulators cool. Note that the positive regulators (LM340T series) have their cases at ground potential, so no insulation is required in mounting them to a grounded heat sink. The negative regulators are a different story (the LM320T series). Either use mica washers to isolate the cases from a grounded heat sink or mount them individually on smaller heat sinks, each of which is isolated from ground.

In hooking up the deflection yoke, first measure the resistance of the two windings. One is almost always higher than the other. Use the high resistance member of the pair for Y2 (vertical deflection) and the low resistance one for Y1 (horizontal deflection), and orient the yoke accordingly.

Ordinary hookup wire can be used in most interconnections, but you should use shielded wire in the CRT grid circuit and in the video input circuit to and from the CONTRAST control.

S3, the SPST POWER switch, is best incorporated on the BRIGHTNESS control, so choose a pot with a switch assembly. Wire the BRIGHTNESS pot so that, when the switch is off, the center arm of the pot is at ground potential. This will assure that CRT brightness is always minimum when the unit is first turned on.

The HV module should be mounted quite close to the external anode of the CRT so that only a short length of HV cable is required for the anode connection. The HV module should operate off its own regulators (as in Fig. 7) to minimize its effect on other circuits.

Setup and Operation

Preliminary Setup

By all means, check and recheck all connections prior to powering up. In particular, the +15, +5, and −15 V lines should be checked for proper voltages. To start with, remove U9 and U10 from their sockets and connect the board to the ground, +15, and +5 V lines with the board on the bench.

(1) Connect a frequency counter to the junction of the .1 uF capacitor and 1k resistor at the output of the 565 circuit. Adjust the vco control for a reading of 2400 Hz.

(2) A counter or logic probe should show a 4 Hz signal on pin 8 of U8. A short pulse should be observable on pin 6 of U9 using a logic probe or scope. This pulse should occur at the 4 Hz line rate.

(3) Connect a scope or logic probe to pin 8 of U4. Gaps in the output of 12 ms at the 4 Hz rate should be noted. Use a test lead to ground pin 8 of the main board, and the gaps should disappear.

You can now plug the main board into the powered down monitor. Preset all controls as follows:

CONTRAST (panel)	minimum (max. CCW)
H SIZE (board)	midrange
H CENTERING (board)	midrange
V SIZE (board)	midrange
V CENTERING (board)	midrange
SWEEP (panel)	FOCUS
FOCUS (panel)	midrange

(1) Advance the BRIGHTNESS control to

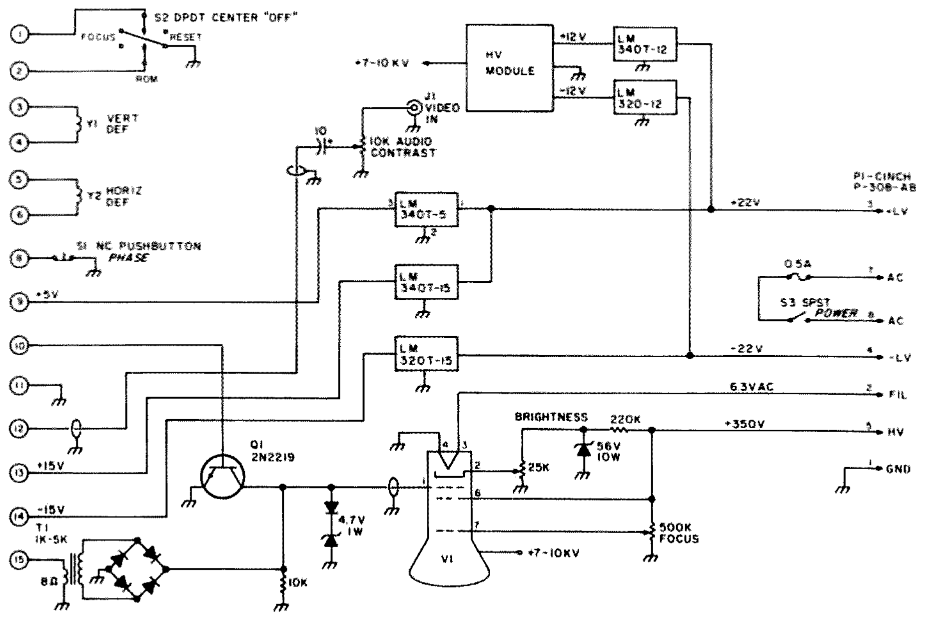


Fig. 7. Monitor mainframe wiring, assuming that all components, exclusive of power supplies, are in one cabinet.

engage the power switch but no further. Allow 5 minutes for the unit to warm up.

(2) Slowly advance the BRIGHTNESS control in a dimly-lit room until a trace is just visible. If the trace is not horizontal, loosen and rotate the yoke until it is. Sharpen the trace with the FOCUS control.

(3) Mask off the largest possible square area on your CRT. This will be referred to as the "viewing area."

(4) Adjust the HORIZONTAL SIZE and CENTERING controls on the main board so the trace extends from one side of the viewing area to the other. Momentarily ground the collector of Q3. The trace should jump to the left edge of the viewing area. If it jumps to the right, you should power down and reverse the connections to Y1 and then reapply power and repeat the size and centering adjustments.

(5) Cycle the SWEEP switch to RESET. The trace should move upward. If it goes down, you should power down and reverse the connections to Y2 and power up again.

(6) With the SWEEP switch in the RESET position, adjust the VERTICAL CENTERING so the trace is even with the upper margin of the viewing area.

(7) Cycle the SWEEP switch to RUN and adjust the VERTICAL SIZE control so that it requires 200 seconds for the trace to move from the top to the bottom of the viewing area. You will probably have to cycle between RESET and RUN several times to get this right, but it is critical if the pictures are to have the proper aspect ratio.

(8) Back the BRIGHTNESS down to the point where the trace is just extinguished in a dark room.

(9) Play a tape-recorded satellite signal into J1 starting somewhere in the middle of a frame transmission. Slowly advance the CONTRAST control to achieve the best swing between black and white. If you go too far, the screen will be completely white due to the action of the white limiting, and, if you don't go far enough, you will lose some information at the black end of the picture signal. At this point, you should see a picture, but it will probably be out of phase. Press the PHASE switch until the edge of the picture lines up with the left edge of the viewing area.

At this point, you have tested all of the elements of the monitor and are ready to display a picture. Generally, you will not have to alter the CONTRAST control settings unless you change the input level to the monitor.

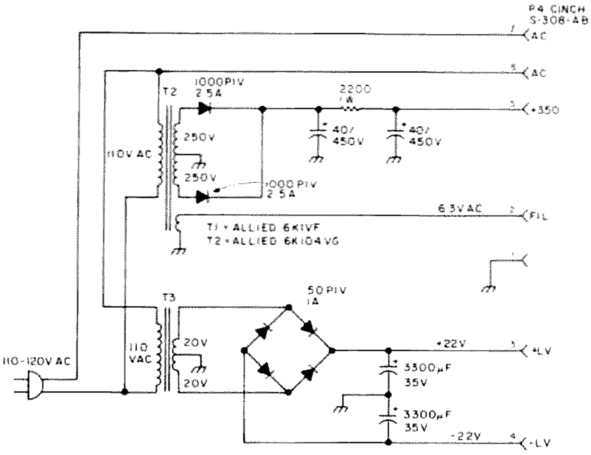


Fig. 8. Power supply circuits.

Operation

Either a Polaroid™ camera with a closeup lens or a conventional roll-film camera can be used to take pictures from the monitor. It should be firmly mounted at the proper distance from the monitor and ideally should employ a cable release to actuate the shutter. Reference 2

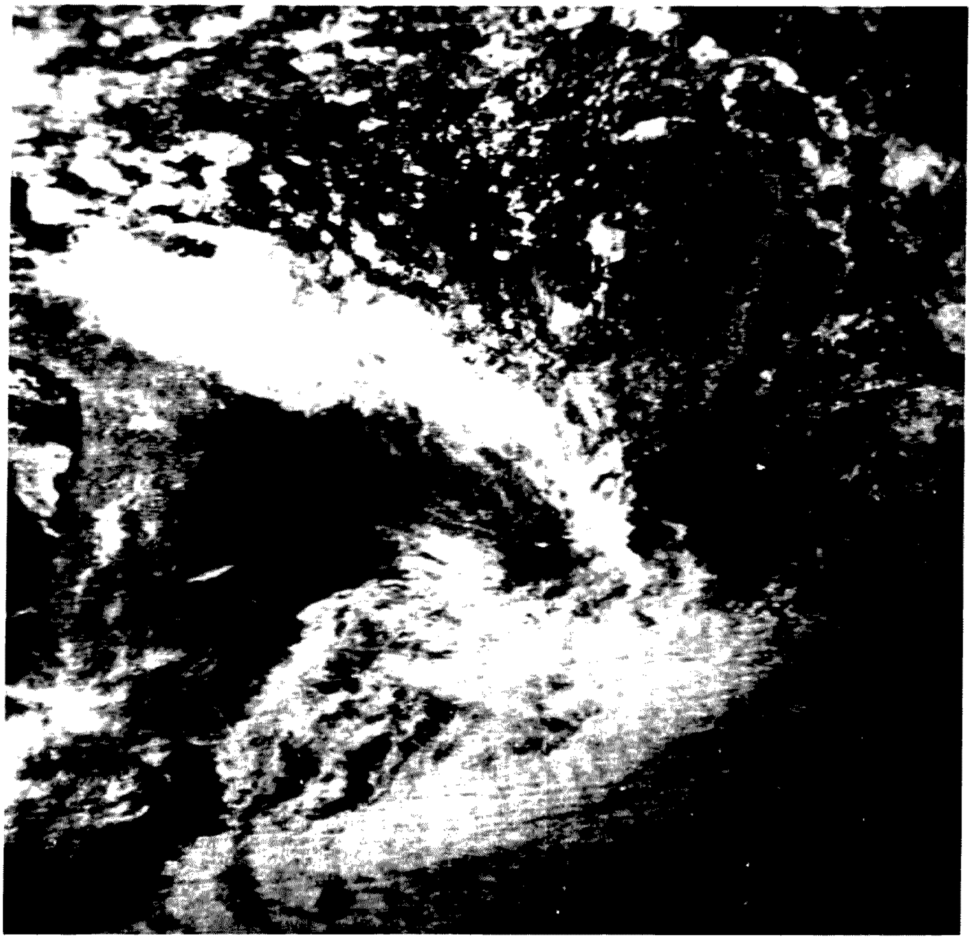


Photo E. A visible light frame of the SE quarter of the earth disk as seen by GOES E showing almost all of South America. This is an afternoon frame, so the eastern limb of the disk is already darkening as the terminator appears, marking local sunset in the South Atlantic.

contains a great deal of useful information about photography from CRT displays, and I won't repeat it here. In each case where the monitor is used, you should allow at least 5 minutes for warmup to get reproducible results. Whenever the monitor is on but not displaying pictures, the SWEEP switch should be in the FOCUS position. When you are ready to display a frame, it can be cycled to RESET.

The picture will begin with a few seconds of start tone—300 Hz modulation of the subcarrier which results in a distinct bar pattern on the trace. When the tone terminates, you should observe a black area somewhere along the trace. Press the PHASE switch to move this to the left edge of the viewing area. 20 seconds after the end of the start tone, cycle the SWEEP switch to RUN and the frame will begin to

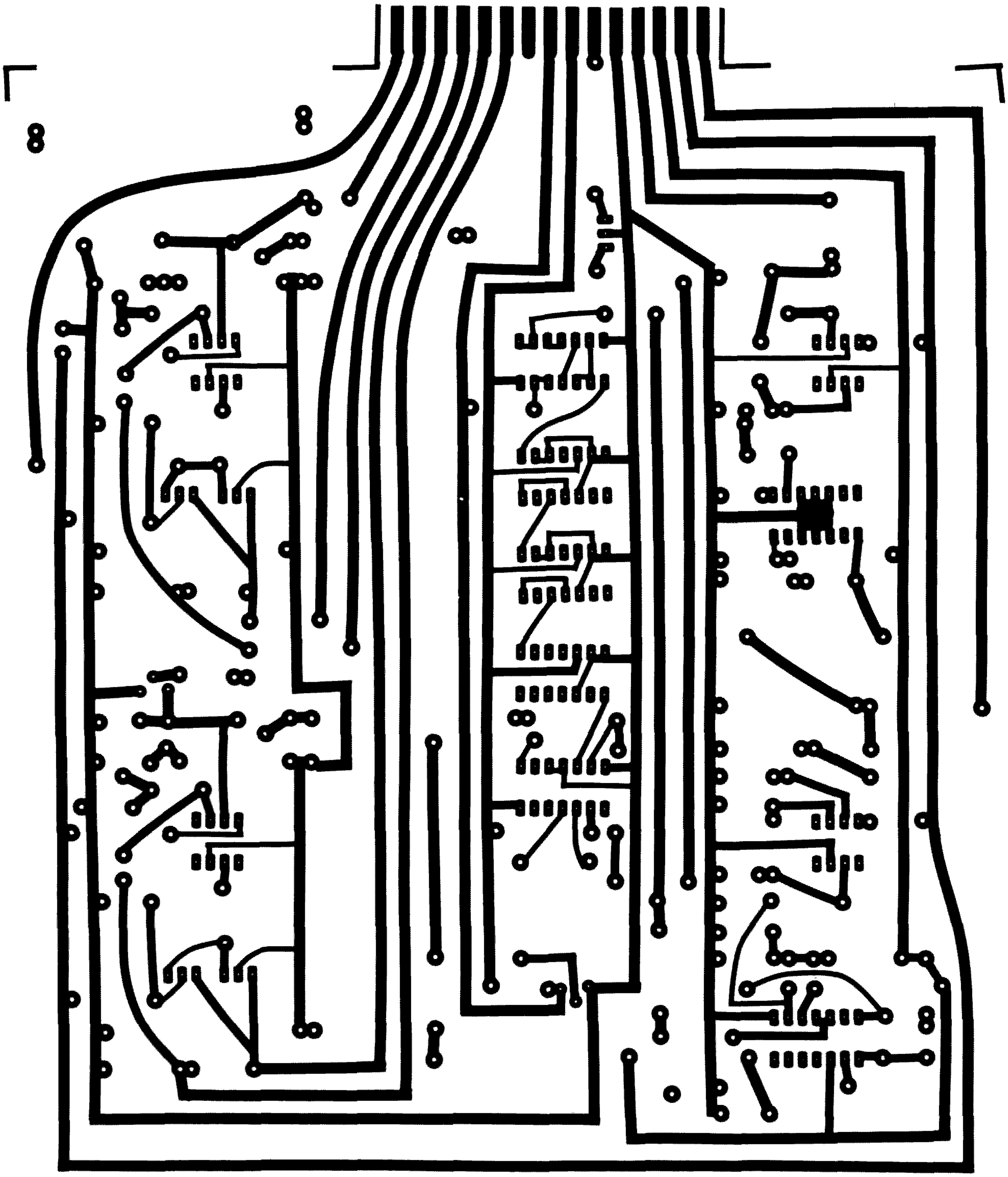


Fig. 9. PC board layout (foil side) for the main circuit board.

read out, beginning with the ID header, followed by the actual frame. About the time the scan reaches the bottom of the viewing area, you will hear a 450 Hz stop tone which tells you the picture is finished. In photographing the display, you should use a completely dark room unless you have a light hood assembly for the camera. The shutter should be opened as you cycle the SWEEP switch to RUN, and it should be closed when you hear the stop tone. If you want to copy another picture immediately, simply cycle to RESET and await the next start tone, otherwise set the switch to FOCUS until you are ready for the

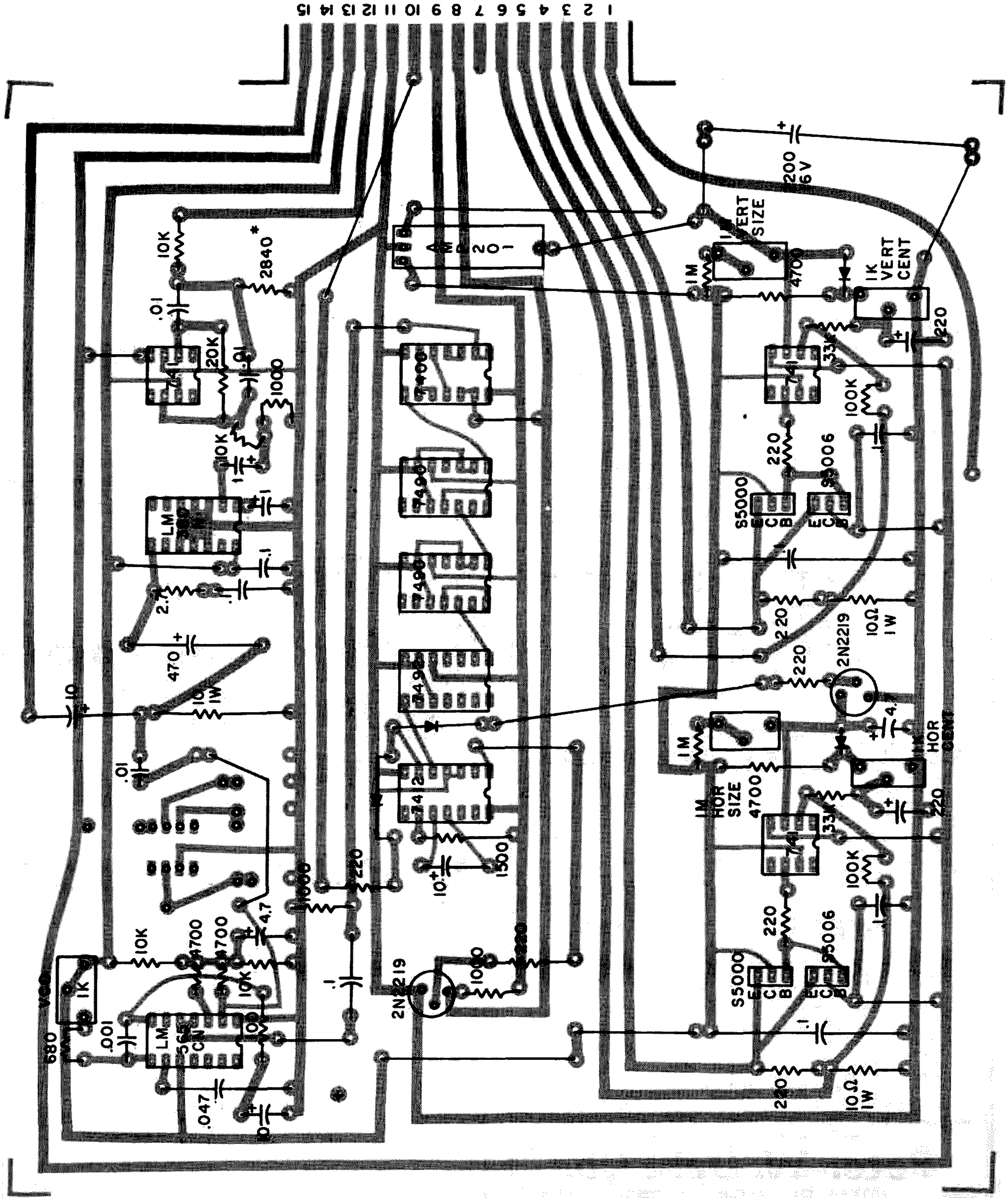


Fig. 10. Component side layout for the main circuit board.

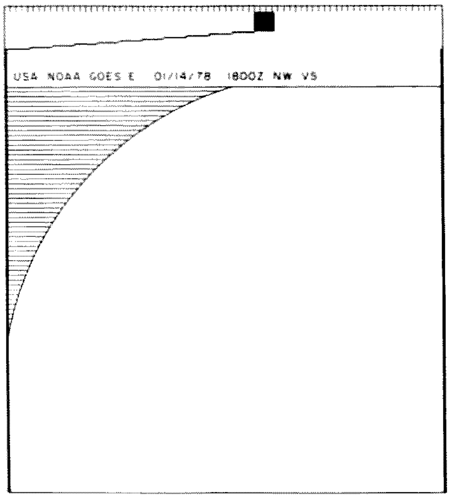


Fig. 11. Operation of the phasing circuits. The top of this segment is the start tone (300 Hz modulation of the subcarrier) where the PLL first locks on the signal. This is followed by a 25-second phasing interval. Note that the edge of the picture, marked by the black bar, is inside the viewing area. When the PHASE switch is pressed, the bar begins to move toward the left edge of the picture where it belongs. When it reaches the edge, the PHASE switch is released and the picture drops back into sync. Note that the last 5 seconds of the phasing interval is devoted to an ID header for the picture. Normally, phasing is done with the sweep switch in the RESET position and the switch is cycled to RUN about 20 seconds after the end of the start tone, permitting the ID header to be displayed.

next frame.

Summary

Photos C, D, and E show typical GOES APT frames displayed on the prototype monitor. Despite the small CRT size, the pictures are quite acceptable. The use of a larger CRT would sharpen them noticeably, however. With a larger CRT, the display can come quite close to the results achieved with a good photographic fax system with considerably less fuss. Polaroid film will give you almost instant prints with little bother, or the use of roll film will let you prepare enlargements at any size you desire.

This is actually an easy unit to build and operate and probably represents one of the easiest ways to get into GOES picture display. With a few modifications, the unit can also be used to display VHF pictures from the new series of polar orbiting satellites that became operational with the launch of TIROS N.

Circuit boards are available for this project from METSAT Products, Box 142, Mason MI 48854. The main circuit board, G-10 epoxy, drilled and plated, and a documentation pack costs $50. If you want to go this route, ask for minikit GM-1. ■

References

1. Taggart, R.E., *The Weather Satellite Handbook*, 73, Inc., Peterborough N.H
2. Miller, D. and R.E. Taggart, *The Slow-Scan Television Handbook*, 73, Inc., Peterborough NH.
3. ARRL, *Specialized Communications Techniques*, American Radio Relay League, Newington CT.

73 Magazine *Staff*

Batteries Dead?

— take preventative measures

Your worries are over if you use battery status indicators.

One of the problems associated with battery-operated equipment is knowing that the battery supply has been turned on and/or that the battery voltage is still within suitable limits. Suitable limits might mean the voltage range necessary for a circuit to perform properly, or the upper voltage limit that a rechargeable battery pack should have when it is properly charged and the lower voltage limit when discharged to the point where its usage should be discontinued before the battery pack is damaged by too deep a discharge.

Depending on the capacity of the battery used, one can "afford" only certain types of battery status indicating circuits. Obviously, for a small piece of test gear operated from a 9-volt transistor radio-type battery, even the use of an LED or the smallest incandescent lamp available will take too much current (15 to 20 mA) compared to the milliampere hours (mAh) rating of the battery (62 mAh for an inexpensive 9-volt type). On the other end of the scale, using a higher capacity battery source, one can "afford" even elaborate battery status circuits that provide detailed information regarding battery condition.

This article explores several interesting battery status circuits including ones that will work with even the lowest capacity battery source to more elaborate alphabetic indicators. Some of the circuits use discrete devices although ICs are available to do the job. Discrete device circuits don't take significantly more current and use commonly available components, whereas the ICs may not be readily available.

Before getting to the circuits, one might mention meters as battery status indicators. The availability of inexpensive, imported microampere meters might appear attractive to use because of the very low current drain. But, if one calculates the current change indicated by the meter as the battery voltage changes, it might not be very significant. The current change indicated depends on the internal resistance of the meter and any added series resistance. As an example, if a typical, inexpensive 500-microampere meter in series with a suitable resistor is placed across a 9-volt battery, the meter indication might only decrease by about 1/3 scale as the battery voltage sinks to 6 volts. This is not a very obvious indication that the battery voltage has fallen to the point where it will significantly affect the performance of many 9-volt circuits. Of course, there are often small battery status meters available during parts sales, but a true indication is obtained only when the meter is used for its designed purpose.

After having left many 9-volt-powered transistor checkers, bridges, and even portable receivers turned "on" instead of "off" after usage, with resultant battery loss, the circuit of Fig. 1 was finally discovered. It uses an LED as a battery "on" indicator, but the LED is flashed at a low duty cycle so the average current drain is only about 1 mA. The 2N4870 unijunction transistor forms a simple pulsed oscillator circuit which in turn drives a 2N2222

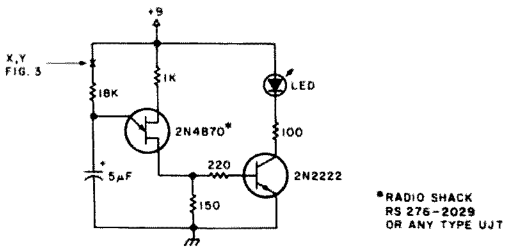


Fig. 1. Due to the low duty cycle of this flashing LED circuit, the average current drain is 1 mA or less.

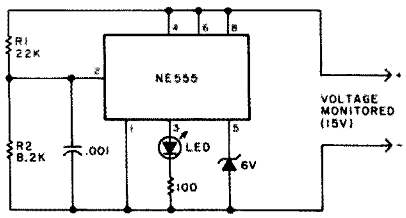


Fig. 2. The NE555 will trigger the LED on when the monitored voltage falls to 12 volts. The ratio of R1 to R2 only needs to be changed if it is desired to change the voltage point at which the LED is triggered.

switch that turns on the LED. The LED flashing rate and the battery voltage range which may be accommodated can vary over a wide range by the suitable choice of R1, R2, and C1. Flashing rates from 2 to 20 per second are the most attention-getting, while still keeping the average current consumption low. The battery voltage can be anything from 3 volts on up. The values in the circuit of Fig. 1 will produce a flashing rate of about 5 times a second from a 9-volt battery. A small amount of experimenting is necessary, particularly with R1 and R2, for other battery voltages. They should be raised in value for higher battery voltages and lowered in value for voltages below 9 volts, although their value is not at all critical. The cost of the batteries saved will rapidly repay the cost of the components for this circuit if you have any tendency at all to forget to turn off battery-powered equipment.

The circuit of Fig. 2 is an undervoltage indicator. It is particularly valuable when using nicad battery supplies since such batteries can be damaged if they are too deeply discharged. This circuit is useful only if there already is some sort of indicator on a piece of equipment informing the operator when it is turned "on," since this circuit will tell the operator when it is time to turn the equipment "off." As shown, the circuit is used to monitor a 15-volt battery source. The ratio of R1 to R2 is such that the LED will illuminate when the battery voltage falls to 12 volts, which is approximately 80 percent of the fully-charged voltage of the 15-volt nicad supply. The voltage value at which the circuit switches on can be controlled by changing the ratio of R1 to R2. The circuit can also be used on other supply voltages in approximately the 9- to 18-volt range. The circuit is quite sensitive and the turn-on of the LED when a low voltage condition is reached is distinct and sharp. If one wanted absolute protection, pin 3 of the IC can also be used to drive a small relay which would automatically turn off a piece of equipment. This might not be a bad idea for some operators who insist on a last transmission although their nicad battery packs are about to be damaged.

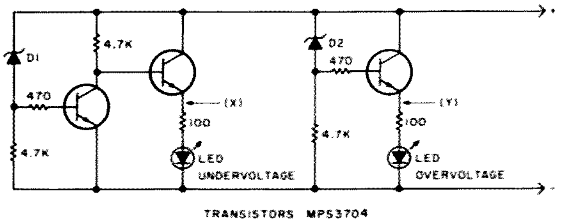


Fig. 3. This circuit will ignite the appropriate LED if the monitored voltage goes below or above the value determined by zener diodes D1 and D2.

The circuit of Fig. 3 does not indicate when a supply is on, but it can indicate both an undervoltage and an overvoltage condition. This may be useful when charging certain types of battery packs where a fully-charged condition is indicated by a specific voltage level. The circuit can also be a warning device to indicate that the output of some device, such as a portable generator, is not within acceptable lower and upper voltage limits. The circuit can be set up for completely independent lower and upper voltage limits and the limits can be as far apart or as close together as desired. The critical components are the two zener diodes: D1 to set the undervoltage indication value and D2 to set the overvoltage indication value. These diodes have to be fairly exact in value. For instance, if one wanted to set the upper voltage indication at 15 volts, one would have to use a 15-volt, 5% tolerance zener or test a bunch of 10 or 20% tolerance zeners until a suitable diode is found.

The circuit of Fig. 3 provides a steady LED display for low and high voltage. A more attention-getting display can be obtained by combining the circuits of Figs. 1 and 3 so a flashing LED display is obtained. In this case, the LEDs shown in Fig. 3 are not used and the points marked X and Y are connected to the similarly-noted points in Fig. 1. Note that two circuits of the type shown in Fig. 1 are necessary.

The circuit of Fig. 4 provides a battery status display using a 7-segment LED readout. A low voltage state is indicated by display of "L", a high voltage state by display of "H", and when any in-between voltage is sensed, the display is a constant "F". One can arrange the connections to the readout to display differently depending upon one's fancy. For instance, one could have the display read "1" for high, "2" for in-between voltages, and "3" for low voltage. Another idea might be to have all segments on the readout active for a high voltage state and then progressively switch off segments for lower voltage states. By studying the diagram and the logic states to get the L, F, and H display, one can arrange other displays on the readout. The zener diodes are, again, critical in value if the circuit is to react when specific voltage levels are sensed. ■

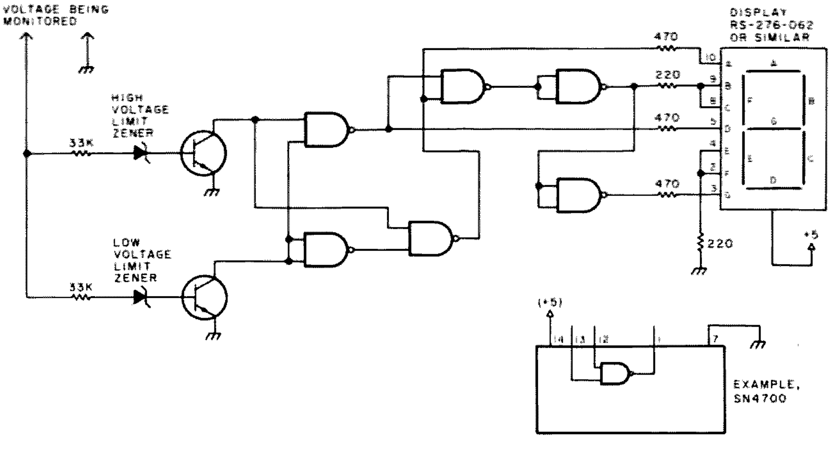
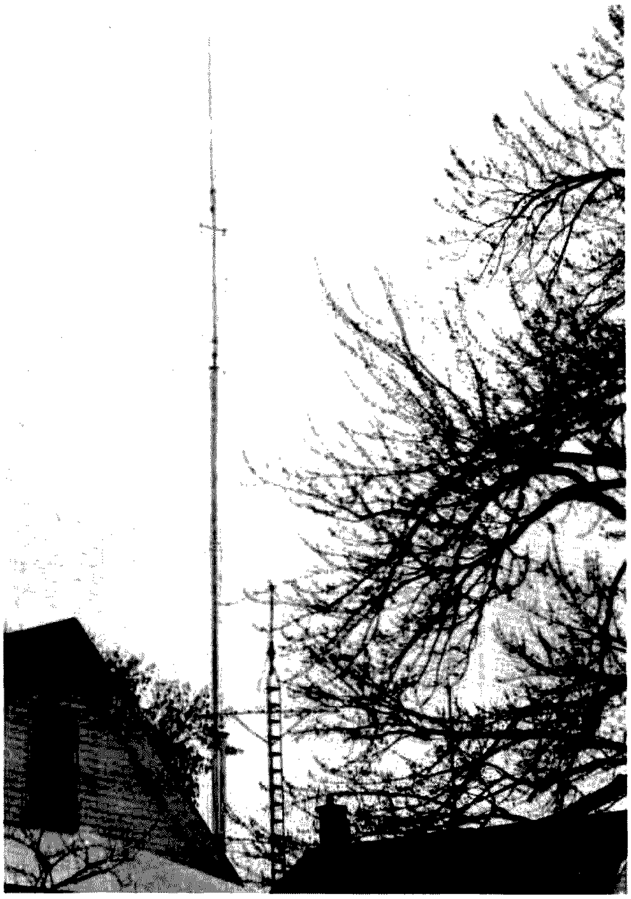


Fig. 4. This circuit uses an LED readout and displays an "L" when the monitored voltage is low, an "H" when the voltage is high, and an "F" when the voltage is between the low and high limits.

How to Nab a Jammer

—another use for 220

It's the Omaha VHF posse vs. the Red Rider.



This shows the 146.40/147 antenna with a 100′ tip and, more difficult to see, the 222.34/223,44 repeater antenna with an 85′ tip.

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It all started about a year ago when Omaha VHF was plagued by a character who went by the handle of "Red Rider." Every Saturday night without fail, for several weeks, he would come up on the 34-94 repeater: "Breaker one nine, this here's the Red Rider." Usually, no one would answer him (which was the best policy in the long run), and the first few weeks he shouted obscenities until he found out the repeater got shut off when he did. We would get fixes on him and close in "for the kill," and suddenly he would QRT for 15 minutes to a half hour and show up again on the other side of town.

After the 3rd week of this, it became obvious that he was listening to us on other 2m frequencies as we would track him. We used some very uncommon ones, but he obviously had a synthesized receiver. His transmitters were identified as a PLL type of moderate power (10-30 W) and also a low-power crystal, probably handheld, unit. (This was later verified.) The two transmitter fingerprints were watched for on legal transmissions, but never appeared until several months later.

One night, we used 5 or 6 ten meter mobiles and spotted his car, but he saw us about the same time and we didn't get a license number. We saw that evening that 10 meters would work, but to get enough 10 meter mobiles to do a good job proved a hassle, as did propagation.

A couple of days before, I had received a flyer from Clegg which offered ten 220 MHz radios for the price of eight. I asked the rest of the guys if they

would be interested in going together on this, and there seemed to be some interest. I took a chance and ordered ten. About ten days later they came, and, by nightfall, six had gone out the door. That was on Thursday night. By Saturday, the rest of them were in service and crystals were ordered for two repeater pairs and another simplex frequency. The following Monday, ten more Cleggs were on order, and two weeks later, there was a 220 repeater in Omaha with 19 users.

If one wonders what happened to the 20th radio, it is now the upper 34-94 repeater in north Omaha. The entire receiver lifted out of the case by loosening four screws and was put in a shielded box. The COR is a reed relay driven from the squelch circuit. R61 is removed from B+ and reconnected to the base of a PNP transistor, the emitter is connected to B+, and the collector goes through a relay coil to ground. A diode was hooked across the relay coil to reduce spikes (hysteresis diode). A 25 uF capacitor was later added to provide a short squelch tail. The LED was added as a cosmetic device.

Cavities were later made out of some 3" transmission line donated for the cause. A handful of "SMA" series connectors was used in the duplexer (because they were free) and a half pound of solder.

The repeater finished, we got permission from Motorola to put the thing up on the Woodmen Tower (300'+ above average terrain) for the weekend. The top of this building is a protected site and has what looks like a crewcut of top-quality commercial antennas — ATS, paging, business, railroad, and many others. I had managed to pack the entire repeater into a suitcase, duplexer and all, and we carried it up to the top, climbed out on the roof 425 feet above the street, and clamped a Ringo Ranger to a lightning rod. We took the repeater out of the suitcase, set it up, and put it on the air in about 15 minutes. The duplexer didn't need any retuning, and we were off to hunt Red Rider.

We had some success that night, but, unfortunately, Red didn't stay on too long and we didn't get him. For about four months, 220 was probably the best-kept secret in Omaha. And in those four months, we compiled a nice fat file including names, addresses, vehicle descriptions, footprints, and real dog smelling prints, and sent it to the FCC in Kansas City. The night that we got a positive ID on the Red Rider, the comments heard on the 2m 34-94 were, "This is the first Saturday night I'm gonna sleep soundly for a long time," and "Bad guys 31, good guys 1; that kind of evens up the score, doesn't it?"

The only thing that got on people's nerves after that was that it took the FCC about three months to do anything about it. Since the FCC came to town, though, there has been almost no deliberate interference or other flagrant rule violation.

By this time, it was obvious that 220 was here to stay, and there is now a second repeater here cross-linked with the 2m 40-00 machine, making possible, for many people, full duplex operation.

The second repeater is a Midland 13-509, which turned out to be the exact same radio as the Clegg, except for the case and name, right down to the Japanese fingerprints on the PC board. As it turns out, the Cobra 200 is also identical to the above two radios and is the cheapest

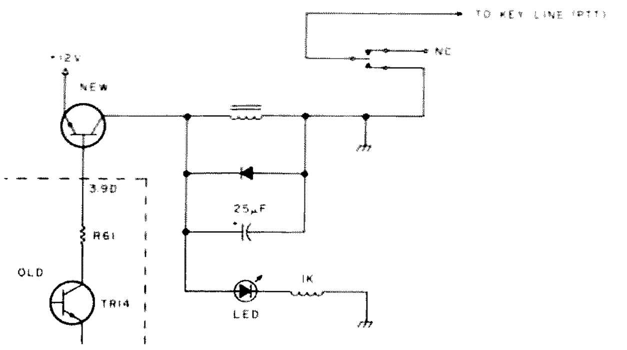

Fig. 1.

one on the market.

As with most ham gear, all three of these radios are imperfect and it is a lot of fun modifying them for various reasons.

Modification #1 eliminates the somewhat long squelch recovery time or reduces it to insignificance (with the squelch set near the edge of operation, it may take up to a full second for it to recover). By changing C89 and C91 from 4.7 uF each to 1 uF each, the recovery time is very fast without significantly impairing the operation.

Modification #2 removes the lamp behind the channel selector and replaces it with an LED. The LED is connected in series with R60 on the receiver board, and R60 is changed from 100 Ω, 1 W to 47 or 56 Ω, ½ Watt. The entire operation reduces receiver current from over 200 mA to about 140 mA. Modification #2(a) removes the meter lamp or puts a switch on it, reducing receiver current to around 60 mA, easily in the portable range.

Modification #3 removes the TX lamp and replaces it with an LED in series with the relay coil, reducing the low-power transmit current from 800 to 700 mA. The only degradation in performance this entails is that the transmitter must have 10.5 V minimum instead of 9.1 V to key properly. So, total low-power current drain is 1.1 A stock minus meter lamp minus channel lamp minus key lamps = 700 mA, clearly a significant saving. A 12 V gel cell will run the radio for a couple of days and still have power to spare (1.5 Ah).

Modifications #4 and #5 change the SO-239 to a BNC for quick disconnect, lower loss at this frequency, and the capability to use a rubber ducky. The power leads are removed and a quick disconnect plug and socket are installed.

Modification #6: The zener, D6, next to the 56 Ω resistor (in Mod. #2) is disconnected from the 9 V line as is the 9 V side of the LED/56 Ω network. An NPN 1 W resistor is put in as a series regulator, and a 1k resistor is added as shown in Fig. 2. This modification further reduces receiver current by 5 to 10 mA, and, as the zener is a ±5% device, the performance of the receiver is completely unchanged. The 9.1 V line should now be about 8.5 to 8.7 V.

I might at this point say that the part numbers above mentioned are the same for all three makes of radio. The instruction book that comes with the Cobra is far more complete than that with either the Clegg or Midland. It is a service manual, whereas the other two have only a schematic and block diagram.

I don't know when I've seen a radio that is more

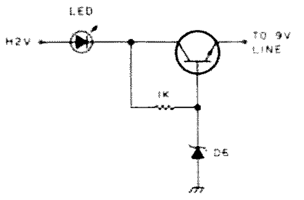

Fig. 2.

fun to play around with and tinker in and modify than these. They are very easy to work on, are laid out well, and come apart quickly.

The first two batches of Cleggs probably sparked the biggest antenna building boom Omaha has ever seen. The two amateur stores had nothing and the only antennas available for 220 were from the local Larsen rep, and they were for mobile only. For the base antennas, most built 5/8-wave or ¼-wave antennas, and a few cut down Ringo Rangers to the proper dimensions.

There are only two minor problems I have seen with these radios that are really in the problem category and they are: First, the mike hanger button on the back of the mike is riveted too tightly, and, if it is dropped, frequently a crack appears between the button and the PTT switch. The second is the tuning on the output of TR 21. If one is not careful in tuning it, it can create spurs due to oscillation of the stage. A simple verification can be made of this by keying the transmitter and pulling the crystal while keyed. If the power meter shows output, it's oscillating. If the meter goes instantly to zero, it's probably not and is set alright.

One might notice a much greater difference in antenna position compared to 2m; because of the shorter wavelength, moving the antenna 5 or 6 inches one way or the other may make as much difference as a 2/3-scale reading on the S-meter. Objects which only partially reflect and partially absorb on 2m become good reflectors on 220, and, consequently, the interference fringes are much more pronounced (see optical behavior in any general physics book).

Looking to the future, I see 220 as a band that will grow by leaps and bounds in the next 2 or 3 years. The 220 class E is dead, there is a vast empty space there now in most parts of the country, and, as 2 meters becomes more congested, 220 and 440 are the next logical places to go. I also think one of the reasons 440 is so much more popular than 220 is the availability of used VHF gear retired from commercial service at very low prices. But, as people are finding out, 220 seems to take the best of both 2m and 440 plus a few points all its own and offers the individual a new playground to do as he wishes on VHF.

As a footnote to this, one of the 220 repeaters has become an administrative frequency for ARES and other such activities because of the large and ever-growing number of people who have 2m crystals in their scanners. 146.94 is a hot-selling rock in Omaha Radio Shack stores. People are finding out that, for weather watch information, 146.94 is where it's at. Inasmuch as we have stations at NWS and a 3rd weather wing at Offut AFB during severe weather and tornado watches, there are a number of bits of information which should not be passed over 2m, so, rather than tie up telephones or take a chance on upsetting the nonamateur public on 2m, they go via 220 as there are no scanners made which will pick it up. ■

✓ Reader Service—see page 211

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This Station Plays Beautiful CW

—with a Morse keyboard

Roll over, Beethoven!

The international Morse code (CW) is a digital musical language. If you happen to be a straight-key master, such as K9ZTH, you can make music to rival that of Mantovani. If you happen to be blind, a talented pianist, composer, piano tuner, and a ham, you can even write a concerto using this musical language. Ol' Rip Snorter John (W9ORS) is such a person and is presently writing *The CQ Concerto*. The first few bars are great and I can hardly wait for the finished work, because it will include a CW message hidden within beautiful music.

Because timing is tricky, it is a challenge for a composer to work the unique rhythm of CW into conventional music. The dot is the basic unit of time in precise code. The syllable space between dots and dashes also requires one time unit. A dash is exactly three time units long and matches the letter space. The interword space is the mystical number 7.

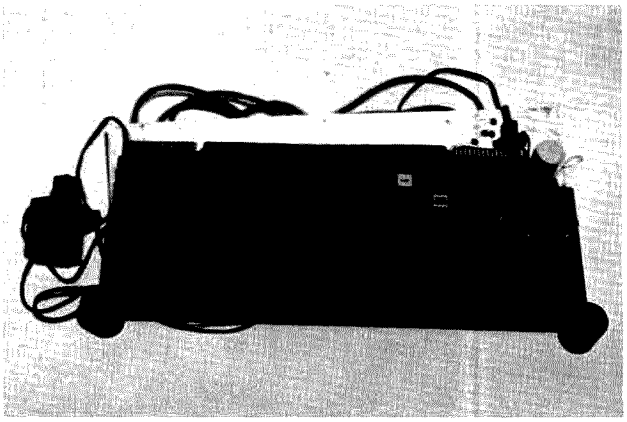

Photo A. Diode matrix (front) forms 8-bit binary code. The 13 ICs (back) provide logic to convert binary code to Morse code. Keying and VOX relays at lower right.

The digital aspect of CW makes ICs ideally suited for application in keyers, keyboards, and readers. In the CW language, spaces are as important as the dots and dashes. Often hams forget that spaces are important. At times, a ham will send, "my nag is . . ." It is easy to run the "m" and the "e" together so that instead of having a *name*, the ham is a *nag*. Even old-timers with bugs and weighted keyers have problems. With dots set for 40 words per minute and dashes at 20 words per minute, the sender speaks with an accent. He can communicate with his own kind who have the same accent, but others who prefer the musical rhythm of good code have difficulty copying 20 words per minute even though they are capable of handling 30 words per minute of perfect code.

The importance of spaces and the application of ICs has been recognized by others and many fine articles have been published (see references). The electronic keyer with its supervised dots and dashes has improved CW communications in recent years. However, proper operation of a keyer takes a certain amount of musical skill which many of us do not have. As a result, the average CW QSO is still well below 20 words per minute.

The keyboard encoder offers additional improvement in communications with the CW language. Good commercial equipment is available, but high prices discourage many potential users. Articles on home-brew projects are being published, and any ham who likes to solder (or wire-wrap) can have a keyboard.

My prototype keyboard used TTL and a 9-bit code. I

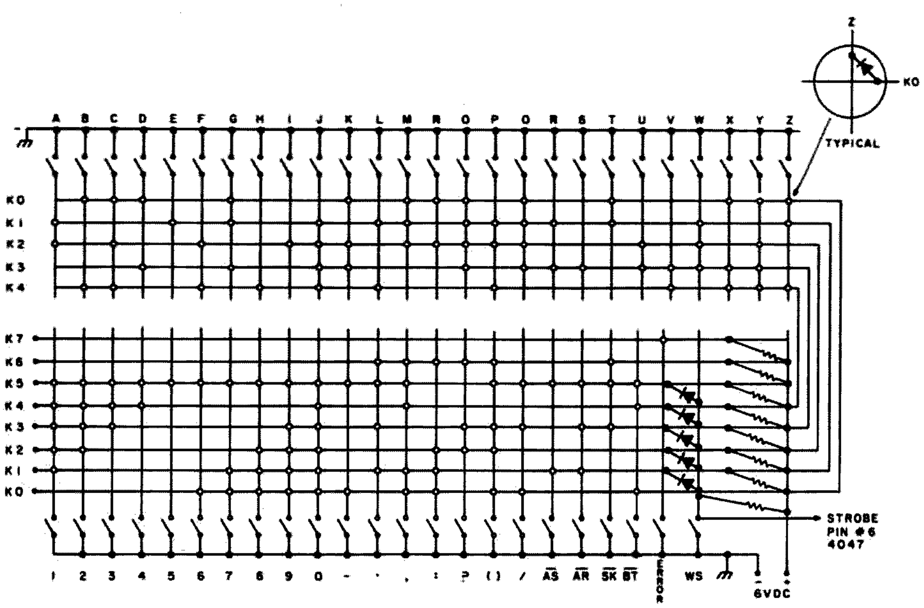

Fig. 1. Diode matrix for alphanumeric characters. All diodes are 1N4814 or equal. Resistors are 10k, ¼ Watt. Switches—typewriter keyboard.

used a diode matrix to generate a binary code and digital logic to convert it into dots and dashes. The TTL scheme worked fine, but as I was putting on the finishing touches, a regulator in the power supply failed and fried a $17.50 40 x 9 first-in, first-out (FIFO) memory chip. About the same time, K2BLA published a circuit that could be constructed using about $30 worth of parts. Also, WB5IRY wrote about the possibility of TTL becoming obsolete. Both of these writers were generous in their praise for CMOS and emphasized how easy it is to construct a power supply for CMOS. With this motivation, I switched to CMOS and an 8-bit code.

After trying high-frequency keyboard scanning, such as is used by K2BLA and in calculator keyboards, I have decided that diodes are still beautiful (Photo A). They are rugged, cheap ($2.84 for this circuit), and even though 142 diodes have 284 leads, the hookup is so simple that it can be made while the XYL is talking. There are no glitches, and troubleshooting is so easy that it can be done with a VOM.

Considering the possibility that some hams may not be any more advanced in the art of applying ICs than I am, some basic fundamentals about logic devices used in this circuit will be included for convenience. Being an electrical engineer specializing in power, I am more familiar with 500 MCM cables and 10,000 kV-A transformers than I am with the 14- and 16-legged bedbugs normally called ICs. If you happen to be a digital pro, skip a few paragraphs and go directly to the schematics. Before going into the details of how the circuit works, let's review a few basics concerning solid-state devices that are used in the system. Use Fig. 2 for reference.

Flip-flops can be considered remotely controlled switches which have several input control lines. Two 4013 ICs are used. The 4013 is a dual type D flip-flop. Each section has 6 terminals: a data terminal marked D, a clock input marked C, an output marked Q, the complement of the output marked $\overline{Q}$ (pronounced not Q), and set and reset terminals. Data is transferred from the input D to output Q on the positive transition of the clock, provided that both the set and reset pins are low. With a high on the reset pin, the Q output is zero, and the $\overline{Q}$ output is high regardless of clock status.

Those of you who have constructed the "contest keyer" by WA4KUO will recognize the dot-dash generator used in this keyboard. The CMOS 4027 is a dual J-K flip-flop equivalent to the TTL 7473. The J-K flip-flop is similar to the type D flip-flop, except that it has two input terminals labeled J and K. The 4027 also flip-flops on the positive transition of the clock. The J-K flip-flop is useful in this application because, with relatively simple connections, it can be made to toggle with clock transitions.

Logic gates OR, AND, NOR, and NAND behave just as their names would suggest. OR gates and AND gates have two or more inputs and normally have only one output. In the case of an OR gate, a high on any input terminal will produce a high at the output terminal. With the AND gate, all of the input terminals must be high in order to obtain an output. Then, with the NOR and the NAND, the operation is simply reversed.

The inverter is another useful logical device. It has one output and one input, and they always complement each other. The 4049 has six inverters in one chip.

Two 40105 4-bit chips are used to make up an 8-bit first-in, first-out (FIFO) memory. This provides 8 input data terminals and 8 output terminals. A binary code word of 8 digits is loaded into the FIFO each time that the strobe pin receives a positive pulse. The array will hold 16 words. Within a few nanoseconds after loading, code words bubble through the memory and queue up in order at the output terminals. When the output data is stable, a *data out ready* (DOR) flag goes high. Binary words can be clocked out of the memory by applying a negative-going pulse to the shift-out (SO) terminals. Loading is completely independent of the output. By using the FIFO as a buffer between the input keyboard and the reading logic, the operator is free to type at any speed. If he types below the output clock speed, the output will follow the hesitating typing strokes. If the operator types faster then the clock speed, output will be a smooth continuous stream. Of course, since the memory will only hold 16 binary words, the operator cannot go more than 16 letters ahead of the reading logic or some of the characters will be lost.

Two 4035 chips are used to make an 8-bit shift register which also has 8 input and 8 output terminals. The shift register operates in the parallel mode as well

as in the serial mode. With the parallel/series (P/S) control high, 8-bit words are parallel loaded into the register clock. Data at inputs are transferred to the outputs each time the clock is pulsed. With the P/S control low, digits are shifted serially toward the right with each positive-going clock transition. The shift register is also equipped with a truth/complement (T/C) control so that an inverted output can be obtained. That is, all of the outputs will be exactly opposite to the corresponding inputs. Thus, if the serial input terminals (J-K) are made permanently high, zeros will be clocked into the shift-register output. These zeros migrate toward the final output terminal with each positive-going clock pulse.

Binary-coded words are generated for each letter in the alphabet and special characters by a diode matrix in the keyboard. The circuit is simple, and examination of Fig. 1 will show that it is only the Morse code with a marker bit added to mark the end of the character. Once you recognize the pattern, assuming that you know the Morse code, you can wire up the matrix without referring to a diagram.

The buses K0-K7 are energized through 10k, ¼-Watt resistors from the positive terminal of the power supply. Keyboard keys ground out selected bits of the K0-K7 buses through diodes to form the 8-bit code words required for each character. As an example, the letter "A" would have the code word 00000110. Recall that the shift register inverts all digits. The inverted digits correspond to K7, K6, K5, K4, K3, K2, K1, K0, respectively.

In the Morse code, there are more dots than there are dashes; therefore, in order to minimize the number of diodes, one diode is used to generate each dash. Read the code word from right to left: "Dit, dah, marker." Meaningful digits are followed by a string of filler zeros.

For a closer look at the system, refer to Figs. 2 and 3 which show the general schematic and its companion timing diagram. The diagram assumes that the operator has turned on power and set the master clock to operate at a selected speed. At some random time later, he has typed the letters "AE" followed by a word space, then the letter "T" at a speed greater than the corresponding clock speed. After power has been turned on, the master clock runs at a frequency set by the operator. The instant that a key is struck is a random event with respect to the clock output. The FIFO is very fast and responds within nanoseconds after the operator strikes a key on the keyboard. The code words (one 8-bit word for each character) bubble through to the output terminals of the FIFO, queuing up in order. As soon as data is stable, the data out ready (DOR) goes high. Since there are two FIFO chips involved, the two DOR signals are combined by AND gate U8D into a single signal. This high passes through OR gate U7C and on the next positive transition of the master clock output causes U12B to flip, thereby starting the dot generator in synchronism with the master clock. (I learned the hard way that this flip-flop 12B was needed. Without it, sometimes the first syllable of a letter would be cut short or missed completely. The addition of the 12th IC had a bonus. The "Q" of 12B gives a signal to provide automatic receive/transmit switching.)

The dot generator, U6A, is clocked by divide-by-2 flip-flop U12A, which runs at one-half clock frequency. The combination of U12A and U12B ensures that the dots will have the

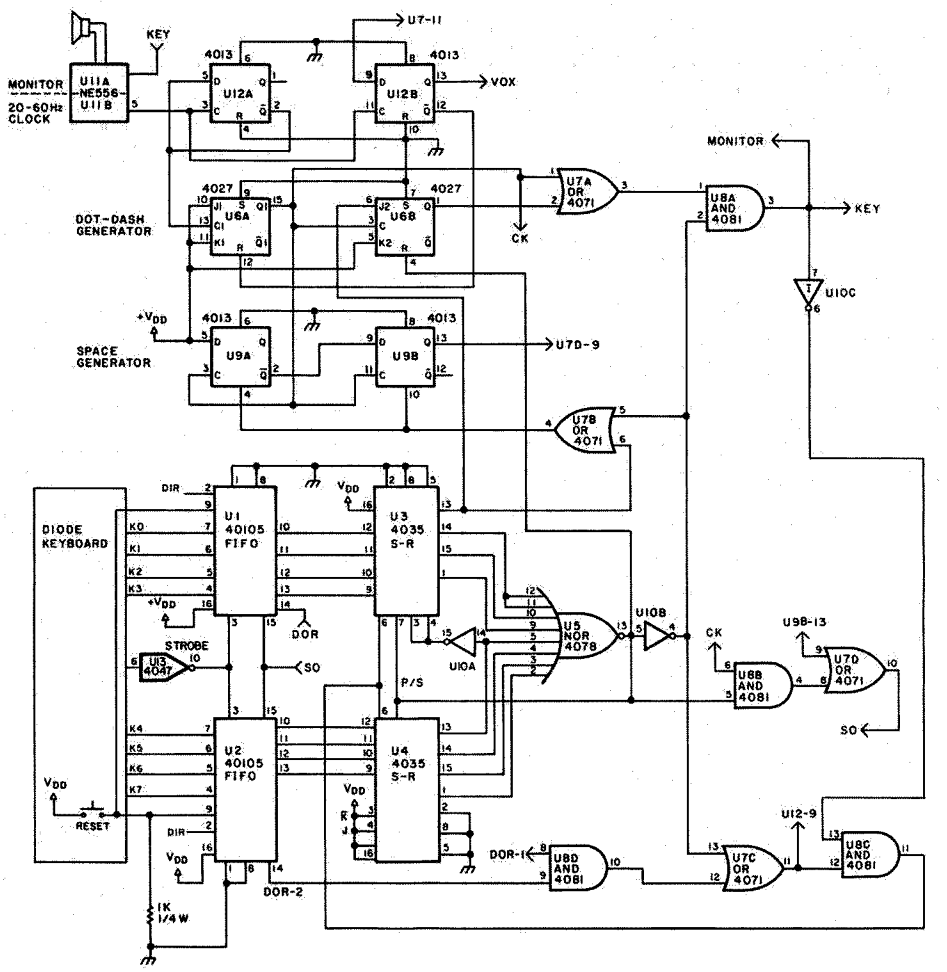

Fig. 2. CMOS Morse encoder schematic. U1, U2—40105 FIFO. U3, U4—4035 shift register. U5—4078 8-input NOR gate. U6—4027 dual J-K flip-flop. U7—4017 quad OR gate. U8—4081 quad AND gate. U9, U12—4013 dual type D flip-flop. U10—hex inverter. U11—NE556 dual timer. U13—4047 one-shot. Refer to spec sheets for power connections.

proper phase relationship with respect to the random loading of the FIFO.

Observe that the positive transition from DOR is passed through AND gate U8C to provide a positive-going clock pulse to clock the shift registers via pins 6-6. This causes the parallel-load feature to function because terminals 7-7 of the shift registers are already high (parallel mode) since at the time of starting, the outputs of the shift registers were all zero. Therefore, NOR gate U5 would have a high output.

Remember that the dot generator runs continuously once it is turned on by the synchronizer flip-flop. Each dot represents one time unit. This is also the fundamental time unit for dashes and spaces. The "CK" clock signal is generated by U6A, which is shown as line 6 of the timing diagram, Fig. 3. When required, U5 and U10B will silence the key by controlling pin 2 of AND gate U8A. Flip-flop U6B goes into operation any time that a dash is required. Examination of the timing diagram will show that both the dot generator and the dash generator are divide-by-2 counters. The OR gate, U7A, combines these outputs to produce a dash whenever U6B is active. Flip-flop U6B is turned off and on by commands from pin 13 of U3.

In the case of the letter "A", the first digit presented to terminal 13 is a zero. Consequently, the dash generator is restrained because there is a zero on the "J" input of U6B. Pin 2 of AND gate U8A is high because the signal from inverter U10B is the complement of NOR gate U5 output and all characters (except the word space) will have at least one "high" at the inputs of U5. The dot generated by U6A will be passed on to the keying circuit

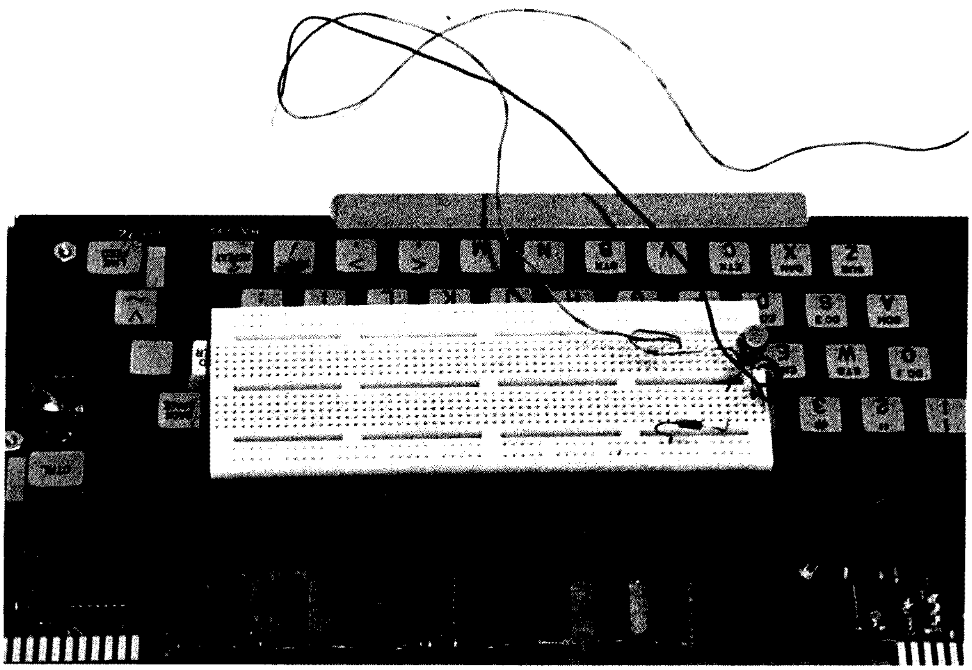

Photo B. A surplus NPN transistor, two current-limiting resistors, and an LED make a breadboard logic probe to debug circuit. Discrete components (lower right) are used for the clock and sidetone monitor.

through gates U7A and U8A. On the falling edge of the dot, the shift registers see a positive-going pulse on terminals 6-6 through AND gate U8C after it is inverted by U10C. This clocks the shift register one position to the right. Note that the shift register is in the serial mode because of the low on P/S. The next digit at terminal 13 of U3 is a one, representing the dash of the "A". This activates dash generator U6B, causing a dash to be dispatched. (See lines 6, 7, and 8 of Fig. 3.) On the falling edge of the dash, the shift register is pulsed again and another high moves to terminal 13 of U3. At this instant, all of the inputs to NOR gate 5 are low. This makes U5 output high and silences the key by causing pin 2 at U8A to be low. U5 output also resets dash generator U6B, changes the signal on P/S from high to low in preparation for a new character, and, at the same time, AND gate U8B is set up so that it will pass the next pulse from the dot generator.

The key is silent because of the low on pin 2 of U8A. The next pulse from the dot generator (see line 6, Fig. 3) is passed through U7D to shift out the next character. On the falling edge of the SO pulse, the FIFO dumps the old character and replaces it with a new one. During the dumping process, the DOR flag dips momentarily. This logic function is internal to the FIFO and the pulse is of only a few nanoseconds duration. (This is the only pulse in the system that is too short to be seen with a simple LED logic probe.) The short pulse is used to clock the shift register and parallel load the new character via gates U7C and U8C. This is more easily understood by referring to lines 13-15 of Fig. 3. This pulse is not to scale but illustrates the phase relationships. The process of dumping the old character and loading a new letter into the shift register has had the effect of silencing one dot. The dot requires one time unit; this, with the intervening spaces on either side, makes a total of 3, as is required by exact code for the inter-letter space. Some keyboards silence a "T", but this is not precise code because the "T" is 3 time units long, which, when added to the two intervening space units, totals 5 time units.

To continue the example, the letter "E" is dispatched next. Action would be similar to that described for the "A". The main difference is that following the "E" there is a word space. The code word for a word space is 00000000. With this code word loaded into the shift register, the key is silenced, as was the case with the inter-letter space, but pin 13 of U3 is also zero and this drops the reset signal of the space generator on U9. This is a mini shift register which counts the word space. Refer to the timing diagram and note that it has the effect of silencing a total of three dots. These dots plus the four intervening spaces total 7, as Mr. Morse specified for the word space.

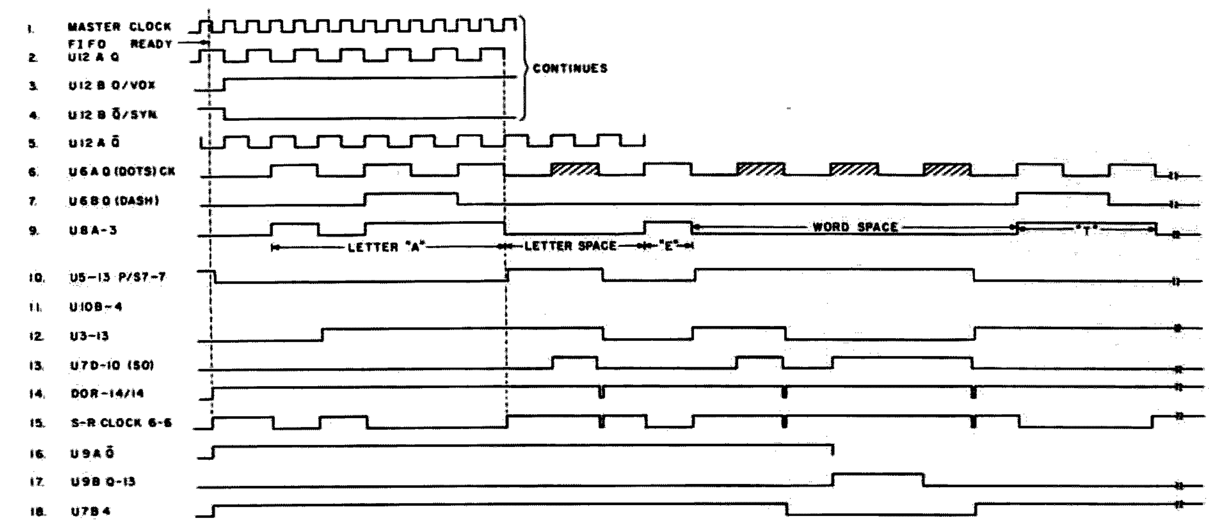

Fig. 3. Timing diagram.

The timing diagram shows the remaining letter "T" of the example. This is for illustration only and will not be described.

Circuit details for the sidetone oscillator, master clock, and the strobe have not been shown on the schematic because these are readily available from a number of existing publications. Manufacturers will supply chip specification sheets with this information.

The master clock and the sidetone oscillator (U11) are made from an NE556, which is simply two 555 timers in a single DIP package. A variety of capacitors and resistors are suitable. Just follow the graphs in the specification sheets. The master clock should have its frequency adjustable between 20 and 60 Hz for a speed range of about 5 to 50 wpm.

The sidetone oscillator can be made variable if desired. I used a fixed tone of about 440 Hz, which is the musical note "A". My rig has a sidetone oscillator, so I installed a switch to silence the monitor speaker while on the air. When not used for communications, the keyboard makes an excellent code teaching aid.

An additional switch can be installed to have a "send-store" feature. By stopping the master clock, the FIFO can be preloaded. A storage of sixteen characters is too short for anything more than a CQ. However, for those who would choose to have a longer message, the Fairchild FIFO 3351 is an excellent choice and holds 40 characters. One 3351 can be substituted for the two 40105 4-bit chips. Additional 40105 chips can also be cascaded to provide more storage.

A master reset button is needed for the FIFOs. Just after power up, random noise is loaded into the FIFOs, and, unless the M-R button is used, you will have a hard time recognizing the language that will be dispatched.

The choice of power supplies is almost unlimited. The CMOS and the NE556 can use anything between 5 and 15 volts. On my keyboard, I used a 50¢ surplus 6-volt, 200 mA calculator adapter. In order to improve the tone of the monitor, I did add a 25¢ electrolytic capacitor and a couple of resistors to provide filtering. To my surprise, even unfiltered full-wave dc can be used for the CMOS and still work. It must be that some of the claims about noise immunity by CMOS are valid.

As the numbering might suggest, U13 is an afterthought. At first I was determined to make a one-shot from the spare inverter gates in U10. According to RCA's ICAN 6267, three inverter gates will make a one-shot. The circuit worked most of the time, but occasionally a double pulse would be triggered, causing two letters to be loaded for one key stroke. I took the easy way out and cook-booked a 4047 one-shot and selected a capacitor/resistor combination to make a 2 millisecond pulse. This is a very versatile chip and does a good job of debouncing; it interlocks the keys so that only one letter will be dispatched even though two keys are struck simultaneously. This circuit will ignore all other strokes until keys are completely released.

The one-shot strobe (4047) is triggered by "wire-ORing" through diodes. The lower right of Fig. 1 shows this circuit. Note tht only buses K1, K2, K3, K4, and K5 are monitored. This is sufficient to cover all characters except the word space. A separate switch is used for the word space. The 4047 is connected to fire on a negative-going pulse which is obtained through 2 diodes in series for the normal characters and through a switch for the word space.

Experience with my Swan 700 CX has taught me that it eats expensive PNP transistors like a feathered swan eats corn. I took the coward's approach and used relays for both the VOX and key functions. This works very well except that if someday I am to give the "bionic brass pounder," WB2ZDF, his 1000 wpm, I may be forced to use a transistor. Is he kidding about 1000 wpm? Maybe not, or at least something that will approach that figure. Although no one can type 1000 wpm, a RAM can be interfaced in between the keyboard and the FIFOs to provide burst sending. Then, with the video readers, very high speed should be possible. This raises an interesting question. If TTL is on the verge of obsolescence, how about the RTTY bandwidth hog?

Parts for the final circuit cost about $40 (this does not include parts invested in the prototype which have been returned to the junk box). It does include

$10 for a surplus computer keyboard. This keyboard had good quality reed switches and a fiberglass PC board. None of the circuits on the PC board were salvaged but were removed from the old fiberglass board by using a wide-flame burner on a propane torch and a wood chisel. Holes for the diodes and the ICs were quickly drilled by using a standard piece of perforated board as a template and a Dremel tool. Interconnections were made with point-to-point wiring using standard wire-wrap wire. I use solder-tail sockets rather than conventional wire-wrap sockets because the long pins give my bifocals fits. A wire-wrap tool conveniently fastens connections to the solder-tail pins of the sockets and these can be quickly secured with a small dab of solder. This approach was used for all chips except No. 13. I ran out of sockets, so I simply wired this rascal in place. It worked so well that on the next circuit I build, I will not waste time with the sockets except for the two FIFOs. These are needed to provide a quick disconnect to simplify wire checking.

With 13 ICs, one can expect to make a few wiring errors. These can be readily detected by using a simple homemade logic probe that will cost less than $1.00. My breadboard probe is shown in Photo B parked on top of the keyboard. It is simply an LED driven by a small surplus NPN transistor with a length of No. 22 wire as a probe. By setting the clock at 5 wpm, the waveforms shown in Fig. 3 can be observed by simply watching the LED and counting flashes.

Should you decide to build a keyboard, be sure you understand the timing diagram. It is the key to troubleshooting. Also, recheck pin numbers against the IC manufacturer's specification sheet. Standardization is good, but there are some variations and it is possible that a typographical error exists. However, the diagram has been checked and rechecked to prevent the latter possibility.

The error signal has 8 time units; thus, it can be used as an aid in calibration: wpm = 192/T, where T = seconds (stopwatch) required to send 10 error signals.

A case was constructed from standard heating and ventilating sheet metal. While this is not as beautiful as some store-bought equipment, it is adequate.

If you are still not convinced that diodes are beautiful, you can use an ASCII keyboard, or, for that matter, any keyboard with an oddball code, as long as it does not exceed 8 bits. You can even use your home computer. An EPROM

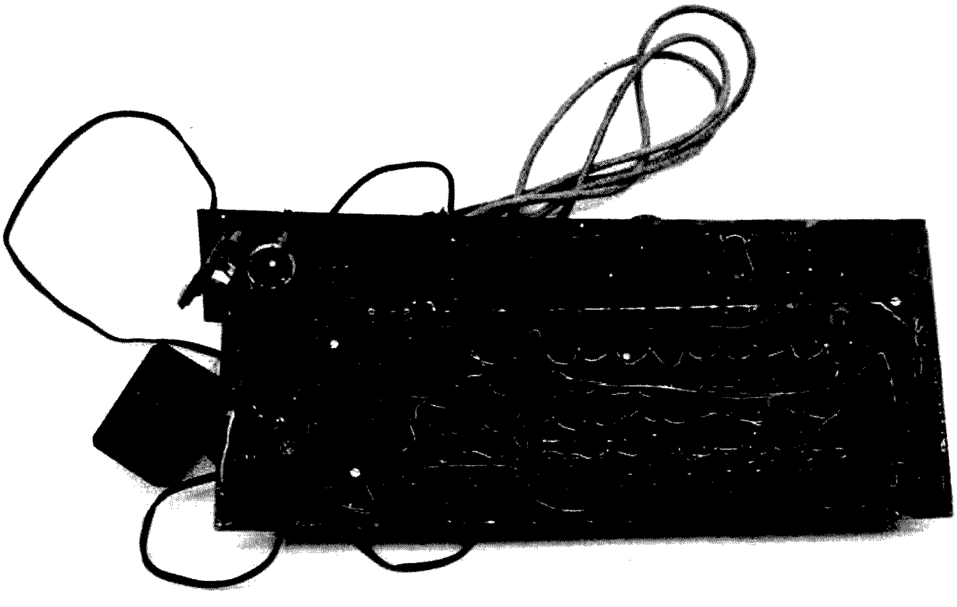

Photo C. This photo shows point-to-point wiring using wire-wrap wire for ICs and #22 telephone wire for keys and diode matrix buses.

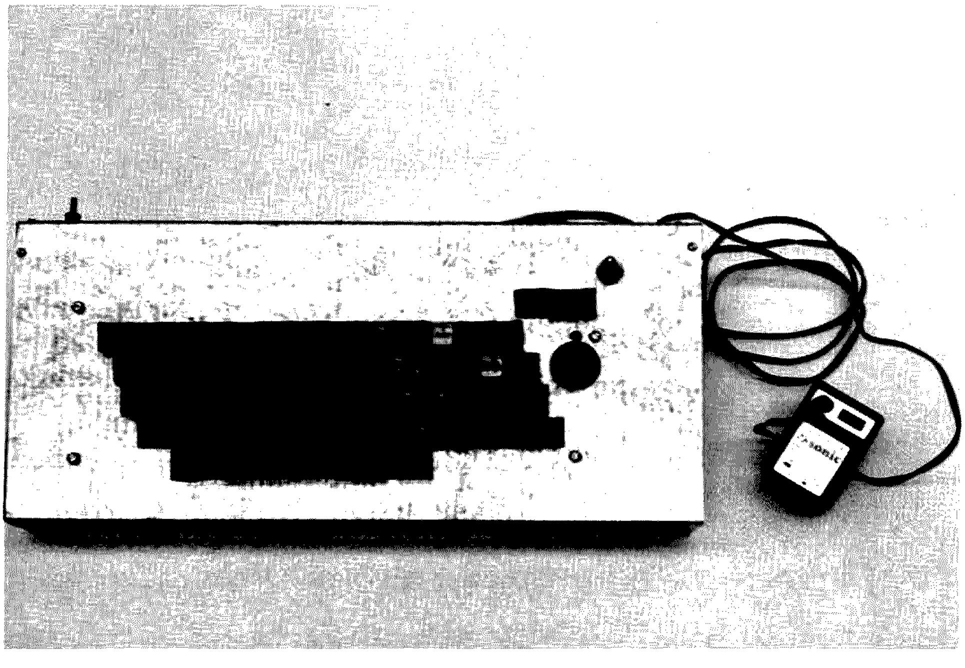

Photo D. Finished keyboard with surplus calculator power supply at right.

can be used to interface between the keyboard and the FIFOs.

In addition to all of the hams mentioned in the text and the references, I am indebted to the sales reps and tech-service engineers of both RCA and Fairchild. They patiently answered my numerous and sometimes frivolous questions. They not only made it possible for me to build a keyboard, but also helped me in my job as a power engineer to apply integrated circuits to industrial applications.

After a 30-year recess in radio, my straight-key sending was even worse than it was during World War II when I frequently would be interrogated with "INT LF" (modern translation, QLF?). Now, with my keyboard, I, too, can make good CW music and the high-speed boys will talk to me. Perhaps after a few more keyboards are on the air, the average QSO can be raised to 30 wpm.■

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✓ Reader Service—see page 211

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The Cure for Migraines

—a low-pass CW filter

In most receivers, the groundwork has already been laid.

Many hams copy CW by using an SSB receiver with an outboard CW filter consisting of 88-mH toroids or active filters, to obtain very narrow bandwidths and a beat note of about 1000 Hertz. Some have found that a couple of hours of this type of operating will bring on something resembling a migraine headache and a strong desire to go work SSB up the band.

A lower beat note and a bandwidth of a few hundred Hertz appear to alleviate CW fatigue. The lower tone is softer to the ear and a somewhat wider bandwidth allows the signal to be moved around slightly in the passband, which helps to avoid monotony.

One advantage of this approach is that one side of the needed filter response is already there in most receivers. The low frequency side of a typical communications receiver might appear as in Fig. 1. The audio section is designed to attenuate the very low audio frequencies, usually with the 3-dB point around 300 Hertz.

This allows you to build a simple, low-pass filter to get the desired attenuation on the high-frequency side. The filter is shown in Fig. 2. The .176-H inductors are made from two 88-mH toroids connected in series. It plugs into the speaker output, requires no power, uses common components, and will fit easily inside a small minibox. Its response is shown in Fig. 3.

Combined response is shown in Fig. 4. Bandwidth is about 300 Hertz at the 3-dB points, allowing for some variation of tone (and drift). There appears to be less ringing with this approach, as compared with one narrow filter.

This filter may solve your headache. See you on the low end, OM.■

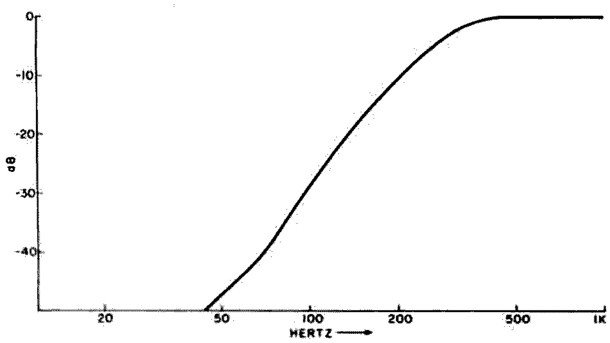

Fig. 1. Low frequency response of typical receiver.

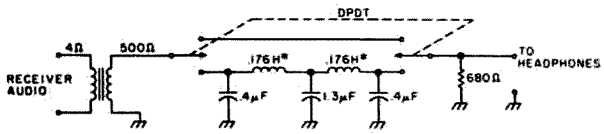

*Fig. 2. Low-pass filter schematic diagram. * = 2 88 mH in series.*

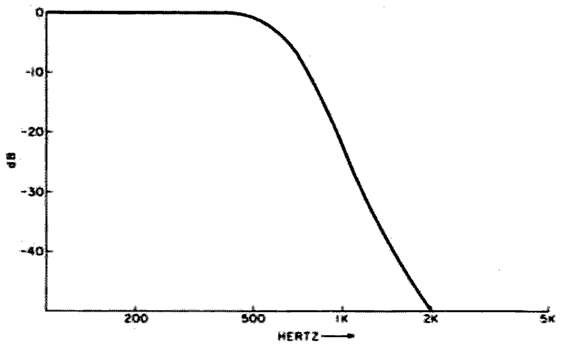

Fig. 3. Low-pass filter frequency response.

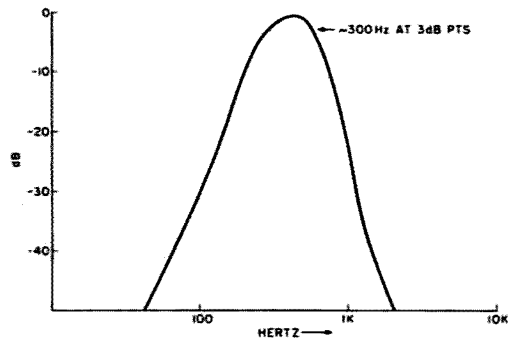

Fig. 4. Combined low-pass filter/receiver frequency response.

An 8080 Repeater Control System

—part I: an overview

This setup is the definition of "modern."

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When told I was going to install a microprocessor on our repeater as the controlling element, some felt, "A microprocessor on the repeater—what for?" After explaining that I would not add anything as complex as a microcomputer to the repeater unless there was good reason to do so, there was no vocal opposition. I suspect that it was not until the control system was placed into operation that everyone became in favor of it. The reason I mention these facts immediately is that a quick first impression of the control system could very well be that the system is too complicated for the resultant benefits. In fact, the opposite is true. The system is indeed much more complicated than what is normally encountered in similar applications. However, the operations it can perform are much greater than would be found were the benefits only proportionate to the system complexity. With an intelligent controller, functions can be done which could not possibly be done otherwise with a reasonable amount of hardware.

Originally, the major function of the control system, and the reason for implementation with a microprocessor, was to provide many on/off output lines controllable through multiple digit decoding of touchtone™ signals. The existing system, consisting mostly of relays, was capable of at

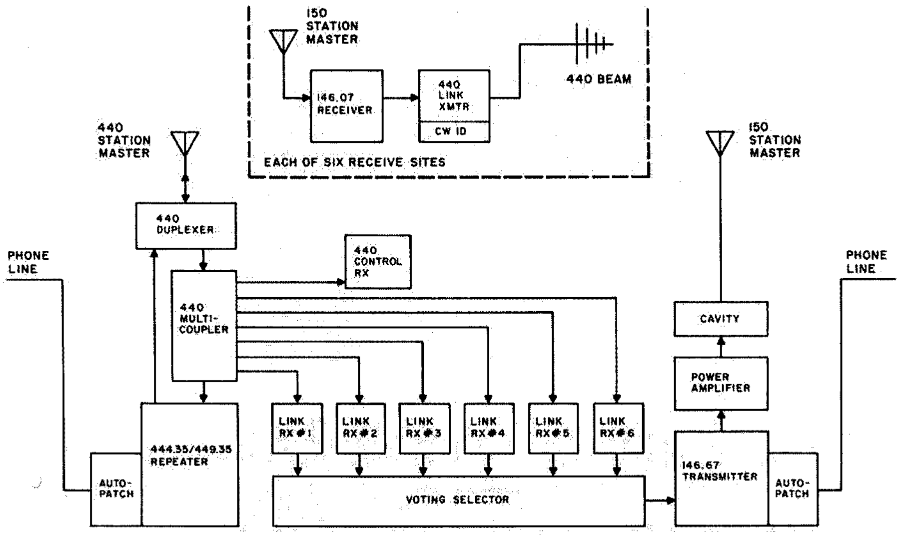
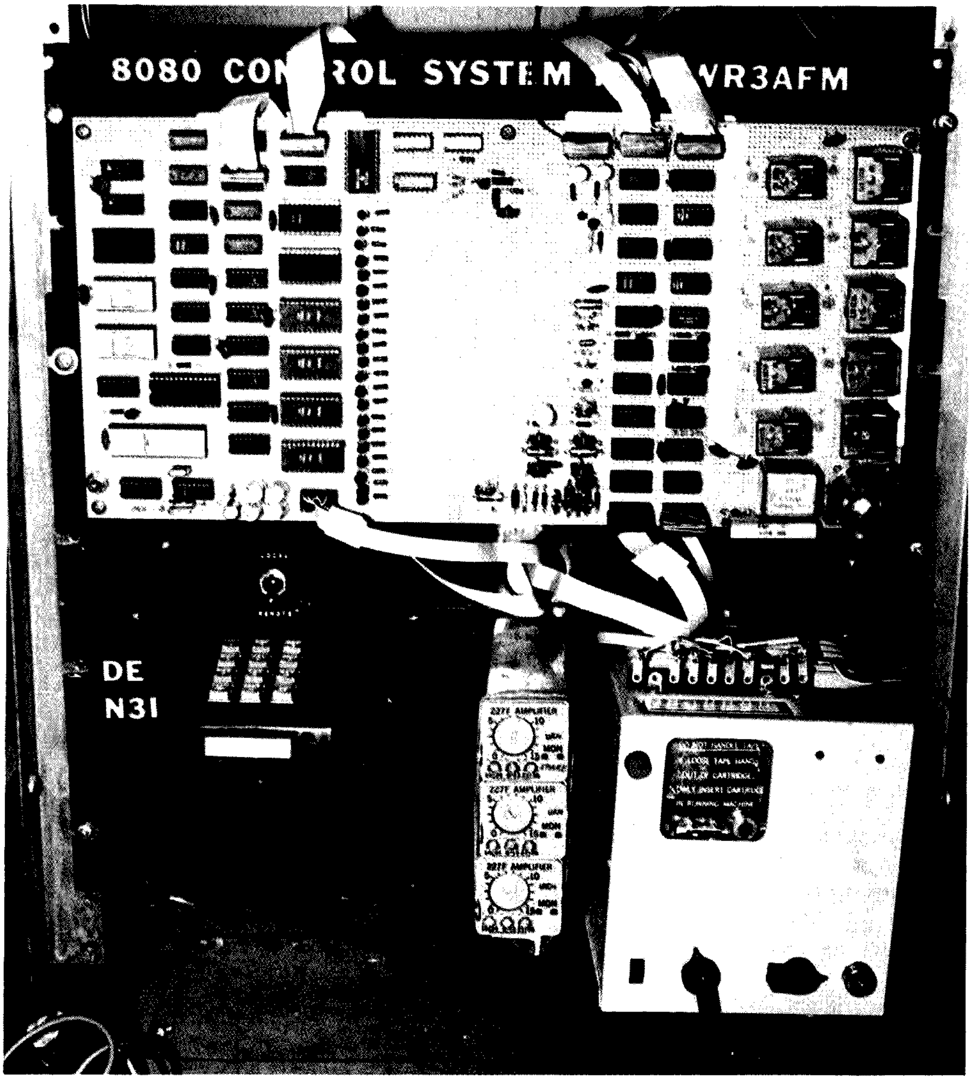


Fig. 1. WR3AFM equipment.

most six functions. We required several dozen functions, and simple expansion of the relay system would have made the repeater look and sound like a telephone company central office. After the new system was finished, the simple output functions took a back seat to the innovations which were not possible before.

In order to understand what the 8080 control system does, a brief description of the Baltimore Amateur Radio Club's repeater (WR3AFM) is necessary. Fig. 1 shows a block diagram of the repeater. There are actually two repeaters: a two meter repeater and a 440 MHz repeater. The 440 repeater is a simple duplexed one. It has an autopatch independent of the rest of the system. The two meter repeater is a multiple split site repeater. The two meter transmitter is located at the site of the 440 repeater. Spread around the city are up to six receive sites. Each receive site receives signals on the two meter input frequency and retransmits them on a 440 link frequency to the transmitter site. At the transmit site, signals are received from each of the links. Each link receiver feeds a voting selector, which continuously evaluates the signal-to-noise ratio of each signal and passes the best one on to the transmitter. The two meter repeater also has an autopatch. The repeaters can be controlled via the two meter repeater autopatch telephone line or a 440 receiver reserved for control. All told, there are eight 440 receivers; off the receive port of the 440 duplexer is a 440 multicoupler which splits and boosts the signals received from the 440 repeater antenna. As can be seen, we obtain maximum utilization (eight receivers and one transmitter) from the 440 antenna on the top of the tower (400 feet high)!



Control system connected to repeater.

The voting selector can be directed to pass only one of its inputs to the transmitter, or to ignore some of its input receivers. This is a major function of the control system. As our repeater gradually expanded, it became more difficult to diagnose problems. A week would go by before we even realized that one of the receive sites was inoperative. With the new system, it is easy to check all sites by commanding the voter to pass each receiver one at a time. During the summer months, we are plagued with skip signals from users of the two nearest repeaters on the same frequency: Hazelton PA and Trenton NJ. At times, our repeater is unusable due to constantly timing out from the extraneous signals. We can now command the voter to ignore our northeastern receiver, from which most of the interference arrives. These two basic functions provided the impetus for the construction of the 8080 system.

The system has other important functions. It allows the two meter and 440 repeaters to be linked when needed. A prerecorded tape loop can be activated on request, giving information about the repeater and the club. A feature is provided to test touchtone pads—the repeater tells the user in Morse code what it received. The processor controls the autopatch. Instead of the normal system, it gets the requested telephone number from the user and redials the number into the telephone system. If the proper number of digits is not received, it will not even access the telephone line. Single-digit codes permit dialing of emergency numbers. Non-collect toll calls are impossible. There

Using the System

The following text, after suitable modifications, is intended to be distributed to users of repeater systems using the 8080 control system. Use of the processor functions and the autopatch are described.

WR3AFM is now controlled by an 8080 microprocessor. The processor permits flexibility in the system as well as many functions which could not reasonably be implemented without a processor. There are five CW IDs; four are permanently stored, and one is remotely programmable via a touchtone pad. Any of the five IDs may be selected, or, as is often the case, the different IDs may be made to cycle. The programmable ID allows meeting announcements and anything else that could be useful to be placed on the repeater.

For testing and diagnosis, each of the individual receive sites on 07/67 may be either disabled or forced on through the voting selector. There are several modes of accessing the control system, so it is possible for control stations to work on the system without interfering with repeater users. For most functions, the 8080 responds to correct commands with an "R" in CW, so when "R"s are heard on 67 this means that someone is commanding it. Under such circumstances, be slow to pick up transmissions in case the control operator has any requests; if none are made, feel free to continue using the repeater and ignore the "R"s.

For those interested in the size of the 8080 system, it currently has about 2K of program in ROM, 256 bytes of RAM, seven eight-bit output ports, and three eight-bit input ports. The control program is about 1300 lines long, and the hardware consists of 57 integrated circuits.

The processor makes possible the redialing of telephone numbers, the virtual elimination of incorrect dialing for autopatches, and the prevention of toll-charge telephone calls. In addition to the control functions and the autopatch, the processor has five codes available for general use which are accessible via 146.07. Any ideas for additional functions will certainly be entertained. For each of the codes, it is necessary for the first digit to be held at least one full second. It doesn't hurt to hold any tone longer than required. With this in mind, here are the various codes:

1#1—Links the 146.07/146.67 repeater with the 444.35/449.35 repeater. The repeater answers with an "R" if the function is accepted. The linkup will remain up indefinitely until knocked down with a *. Signals on 146.07 will come out on both repeaters, and signals on 444.35 will come out on both repeaters. When disconnected, the repeater responds with an "R" as well. The intention of this function is for calling someone on the other repeater, not for extended rag chewing on both repeaters simultaneously. When transmitting on 444.35, 1#1 will also link up the repeaters. This function on the 440 end is not controlled by the microprocessor, and it does not acknowledge with an "R". The * on 444.35 will kill the linkup if it was initiated on 444.35; alternatively, on the 440 end the linkup will time out after three minutes. This is only true for linkups made from the 440 repeater. The two linkups are separate; if linked on 146.07 they must be killed on that frequency, and if linked on 444.35 they must be killed on that frequency.

2#2—Initiates a prerecorded tape message giving information about the repeater. The tape will disable itself upon completion.

3#3—Disables the blocking of touchtones. Any tones sent after the 3#3 before the carrier is dropped will not be blocked. Normally, upon recognition of valid tones, the repeater mutes them. This is done to protect the ears of those of us who monitor often. It is done on a tone-by-tone basis to facilitate diagnosing problems, since you can hear a short blip for every digit and can tell how many tones were sent. For those hams with selective call decoders, it is necessary for the tones to pass unimpeded, which is the reason for this function. If only short tones are required, the selective call function need not be used, as the repeater does not initiate tone blocking until a valid tone of about one second is received. This is to prevent blocking of voices.

4#4—Touchtone test. Any digits sent after the 4#4 before the carrier is dropped will be sent in Morse to tell the user what the repeater decoded the digits as. Any sequence up to 24 digits can be accommodated.

5#5—If preceded by a 4#4 test, will repeat what the 4#4 sent. If preceded by an autopatch, the telephone number entered will be sent in Morse. If an autopatch attempt fails, 5#5 will show what the number requested was (if the autopatch code was accepted). If, after making an autopatch, you wish to clear your telephone number from the machine, simply do a 4#4.

NOTE: The functions 1#1 through 5#5 are intended for use by anyone, club member or not. The autopatch is restricted to club members and transients. When performing any of these commands, be certain to identify your station first. The functions are there to be used, but not abused. This is somewhat of an experiment in the hope that our repeater users will use these functions wisely. We hope to be able to continue this free access. Should it become necessary, any of the functions may be disabled by remote control. Please do not force us to deactivate them.

are several different CW identifications which may be selected, and special IDs can be loaded in minutes remotely. For a number of years, we have had a reprogrammable CW identifier (*73 Magazine*, April, 1976). It was a great success, and the ability to program an ID remotely makes it more useful. Any of the functions can be disabled, and, of course, the repeaters can be turned off if necessary. A complete explanation of the user codes appears elsewhere in this article. A sample of what can be placed on the tape message loop is given. A complete description of the control functions, "Controlling the System," also appears elsewhere. It is more difficult to control the system than with a simple arrangement, but many times it is not even necessary to enter the control mode and forcefully disable functions. Merely by transmitting on the control frequency, everyone else loses access to the touchtone decoder. This is of great use when some user decides that he will execute some function without identifying himself, as required by FCC regulations. A simple transmission on the control frequency removes his access to the system, and it is not even obvious to those listening. With any amount of luck, these individuals adjust their touchtone pads attempting to bring up a function and throw their pads away in disgust after being unsuccessful.

We have been quite pleased with the overall operation of the control system. The user codes have given the repeater users some involvement with the repeater, and, after the initial adaptation period, general user sentiment has been quite positive. Although the control system is fairly complex, the reliability so far has been good. In the first two months of operation, the system crashed twice. In the software world, a computer "crash" refers to the occurrence of some error which causes a computer to ignore operator commands, necessitating a hardware restart. I added an error detection/recovery routine to the system, and there have been no crashes since. There have been no hardware failures.

In the following sections, I will show how you can duplicate the system, how the hardware and software functions are distributed, what the hardware components are, and provide explanations of how to use and control the

Autopatch Access Procedure

The following procedure is recommended for accessing the autopatch.

1) "N3ABC autopatch"
2) Send the autopatch code and the telephone number in one transmission. Remember to hold the first tone one second. It is imperative that the carrier continue throughout the entire operation of all ten digits. Upon the release of carrier, the repeater will determine if your number is valid. The number is valid if any one of the following conditions is met: exactly one digit which corresponds to a single digit emergency number; exactly seven digits, the first digit not a 1; exactly eight digits, the first number a 0; exactly eleven digits, the first number a 0. If the number is invalid, nothing will happen. It will act as though no autopatch code had been entered, and it is not necessary to send the knockdown digit. If the number is valid, the repeater will bring up the telephone line and redial your number.
3) After the number has been dialed, and the line has clicked over, "N3ABC".
4) Conversation
5) "N3ABC clear with John Doe at 12:37 PM on August 12."
6) Knockdown code. If the "beep" is heard, the patch has been killed.
7) "WR3AFM this is N3ABC clear."

If you have problems, remember the 5#5 code.

The repeater now has several single-digit special numbers. Make a note of these special codes:

2—Baltimore City Police
3—Baltimore City Transit and Traffic
4—Maryland State Police
5—Harbor Tunnel Information
6—Anne Arundel County Police
7—Coast Guard Search and Rescue
8—Baltimore County Police
9—Howard County Police

To use the single digit codes, send the autopatch code followed immediately by the single digit. The repeater will dial the proper number for you.

Half Duplex

The autopatch is half-duplex. This means that the audio from the telephone line is switched off when you push the PTT. This feature can be used to block obscene language, business communication, or whatever, if the called party gets carried away. However, "skip" or interfering signals also have the same effect. Therefore, it is not wise to initiate an autopatch under such conditions. If this problem occurs, remember that the party on the telephone can hear you perfectly—it is just that you cannot hear him whenever any signal is present on 146.07, be it yours or something else.

Autopatch Timer

The autopatch is to be used for short traffic only. A timer will automatically terminate the patch after three minutes. Once activated, the patch will stay up until terminated by the timer or the knockdown code. No kerchunking is needed to keep it up. Three minutes is more than adequate for most autopatches. However, sometimes when in communication with police regarding an emergency it is desirable to continue the autopatch past the three-minute limit. Because of this, the timer is automatically deactivated when a *single digit* emergency number is used. The patch will not time out for these calls. For normal calls, it is not possible to extend the three-minute limit. For all calls, think of what to say before calling.

Tape Massage Taxt
(Time: 2 minutes, 50 seconds)

Welcome to the Baltimore Amateur Radio Club's 07/67 repeater, WR3AFM. The transmitter is located at the old WBAL tower on Park Heights Ave., and drives a 250-Watt amplifier, though only a portion of that power reaches the antenna through about 500 feet of feedline. The repeater has receivers north of the beltway on Old Harford Road, at the WRBS tower near I-95 south and the beltway, downtown at 4000 North Charles Street, and at the QTH of K3VC and N3JC at the top of the Jones Falls Expressway. Each of these receivers drives a 440-MHz link transmitter. At the transmit site, there is a link receiver for each receive site. Each signal is fed to a voting selector, which continuously evaluates the signal-to-noise ratio of each receiver, the best of which goes to the transmitter. All of the repeater equipment is of the General Electric MASTR make.

At the transmit site, there is also a duplexed 440-MHz repeater, 444.35 in and 449.35 out.

You will note that a short click is heard after releasing your carrier. This signifies that the repeater timer has been reset, and leaves time for breakers. It is not necessary to let the repeater carrier drop. 07/67 has an autopatch, limited to travelers and club members, but open to anyone for emergency traffic.

The repeater is set up to block touchtone signals. After a long first tone of about one second, any further tones will be blocked from repeating, and only a short blip will be heard. There are several codes that anyone is welcome to use. One pound one links the 67 machine with the 440 repeater. To acknowledge that function, the repeater sends an "R" in Morse. The repeaters remain linked until a star is sent, again acknowledged with an "R". We do not desire to use this function for more than a calling mode. Two pound two gives this recorded message. Three pound three will disable the repeater's blocking function until the carrier is dropped, permitting the tones to be repeated. Any touchtone digits sent after four pound four will be verified in Morse after the carrier drop. Five pound five will repeat what was sent during a four pound four operation or the telephone number dialed during an autopatch, whichever was last.

The control system for the repeaters is an 8080-based microprocessor, which performs the various functions including multiple identifications, as well as redials telephone numbers for the autopatch.

The Baltimore Amateur Radio Club has another two meter repeater, 34/94, which is a duplexed repeater in the Towson area. We hope you enjoy the use of our repeaters, and would like to see you at our meetings on the first and third Wednesdays of the month at the Ames Methodist Church in Pikesville at 8:00 pm. Listen for interesting bulletins weekdays on 67 at 7:30 am and rebroadcast on 94 at 6:00 pm. Code practice can be heard Mondays at 9:00 pm on 34/94. Should you desire to contact the club, write the Baltimore Amateur Radio Club, PO Box 5344, Baltimore MD 21209.

system. The method of construction, a detailed circuit and program analysis, and some principles I learned in developing the project will be presented in subsequent parts.

Duplication

The 8080 control system can be duplicated for your repeater with few modifications. The control system supports some features of WR3AFM which may not be of use on an average repeater. If nothing but the basic user codes, the multiple IDs, the autopatch functions, and on/off control for a simple repeater is needed, the 8080 control system would still be worthwhile to construct. If the system is totally duplicated, and portions are left unconnected (due to having no voter, 440 repeater, etc.), the system will operate and leave room for expansion. Alternatively, the appropriate pieces could be left out easily. In either case, the program would remain the same. It may have codes which do nothing or do something different, but the program is the major work and is already done for you. If no changes are contemplated for the program, then it is not necessary to understand how it works. It is always informative to do so, but don't worry about it too much if you are not familiar with 8080 machine language. For those who wish to personalize the software, it can certainly

Feb - 1979

Controlling the System

The following text is intended for distribution to control operators of repeater systems utilizing the 8080 control system. The necessary codes will have to be changed.

The microprocessor control system is a complex but flexible and powerful system. It is of utmost importance to completely understand its operation before attempting to utilize it. Although at first the system may seem to be overly complicated, the structure of the control codes makes it easier to use than a first glance might show.

Basically, the system reads the output of the touchtone decoder to decipher the codes, and has 56 output lines which may be controlled by the proper input combinations. External to the processor itself is additional circuitry to perform the necessary functions, i.e., autopatch, remote base, control frequency repeat, and phone line control. User codes all operate on the outputs indirectly. The proper bits are set and reset to perform the desired function, but control codes are all direct changes of output lines which are assigned to control the various functions.

The basic decoding method used decodes three-digit codes. The first digit of the code must be held down for one second, or nothing will happen. After the release of the first digit, if three seconds elapse before another digit is received, the code will be canceled where it stands. After the release of the second tone, three seconds is likewise allowed to enter the third digit. During the time that the first tone exceeds the one second time period, and until the end of the digit sequence, the blocking relay will follow any valid touchtone signal. During an autopatch or remote base function, the blocking relay will follow the tones as well. At all other times the blocking relay is not activated. Due to this arrangement, in order to have voice signals blocked, the voice must be a valid touchtone signal for one second—certainly a rare if not impossible situation.

Telephone and Control Receiver Access

There are two modes for each of these devices: control and talk. The normal mode for both is control. For the control receiver, this means that the signal is not repeated on 67 but the control receiver grabs the touchtone decoder. The control receiver has highest priority, unless the control receiver touchtone bit is set, which effectively removes the control receiver from the system. If, while transmitting on the control frequency, a # is entered for five seconds, then the control receiver talk mode is entered. While in this mode, the control receiver is repeated on 67. The only way to exit this mode is to send a one-second * while on the control frequency. As long as the control receiver bit is not set, the control receiver always has the decoder. When in the non-talk mode, this allows control of repeater functions without bothering users of the repeater, except that they will not be able to access the touchtone decoder to make autopatches. For the telephone line, when a call-in is made, the mode is set to telephone control. You cannot hear anything. However, the touchtone decoder is listening only to the telephone line. In this manner, control can be exerted in the same way as with the control receiver. If you wish to hear the repeater on the phone line, a five-second # on the line will switch you out of the phone control mode, and the voter audio will be sent down the phone line when an incoming carrier is present. When a signal is present, it has the decoder, not the phone line. Otherwise, the phone line has the decoder. To return to the phone control mode, a * while on the telephone will do so, as will hanging up and redialing. If the telephone touchtone disable bit is set, it will be impossible to enter the phone control mode, and any touchtones received from the phone will be rejected.

Note that any of the three modes of control may be disabled: 150 input, control receiver, and telephone. *Beware:* If all bits are set, you go to the repeater and push the reset button (or wait for a power failure to reset it automatically). Naturally, it would be inconceivable to lock out all modes of control accidentally.

be done. If you do not have any support for the 8080, or for some other reason cannot program 2708 ROMs, I will provide the two ROMs for a cost of $50. Specify your choice for the following codes: 67#, 2*2, 9#5, 6*#, #*6, #48. The knockdown digit will be * unless requested otherwise. Codes may not start with whatever digit is chosen as the knockdown digit. Also specify the four IDs and the telephone numbers for the single-digit dialing. For obvious reasons, the above codes must be changed for each repeater.

This project is by no means a simple one, and it is not suitable for the beginner. Construction experience with integrated circuits and a basic understanding of the system are required. It is not an extremely difficult project as long as care is taken during assembly. Probably the most difficult part will be deciding how to interface a particular repeater to the system. The entire system can be constructed in one week (full-time) by a proficient builder. Do not shy away from the project if you have no prior experience with microprocessors. The "black box" approach is utilized, and detailed knowledge of the inner workings of microprocessors is not required. Total cost for the system is dependent upon how much peripheral equipment is available. The control system cost us about $225, exclusive of the touchtone decoder and pad, amplifiers, and tape loop.

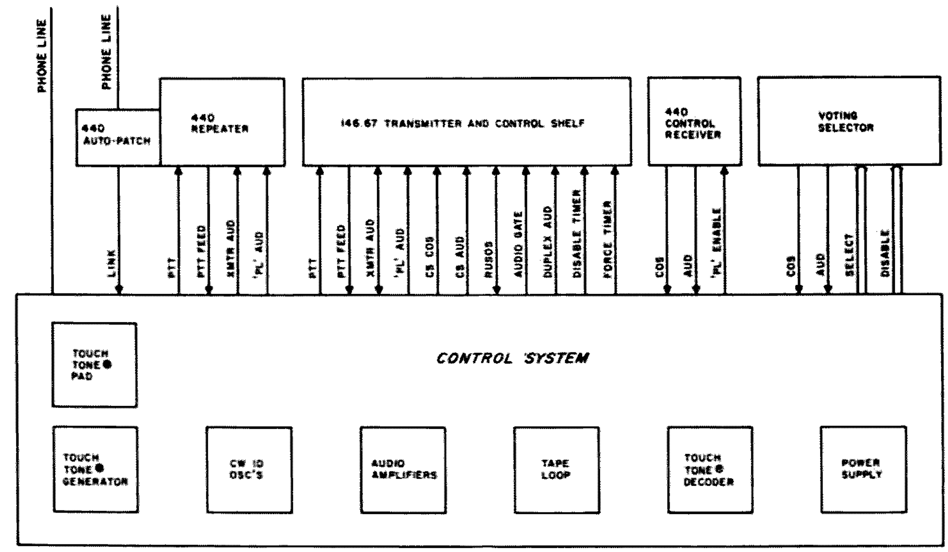


Fig. 2. Repeater/control system interface.

Hardware/Software Balance

Some of the control functions are implemented in software and some are implemented in special

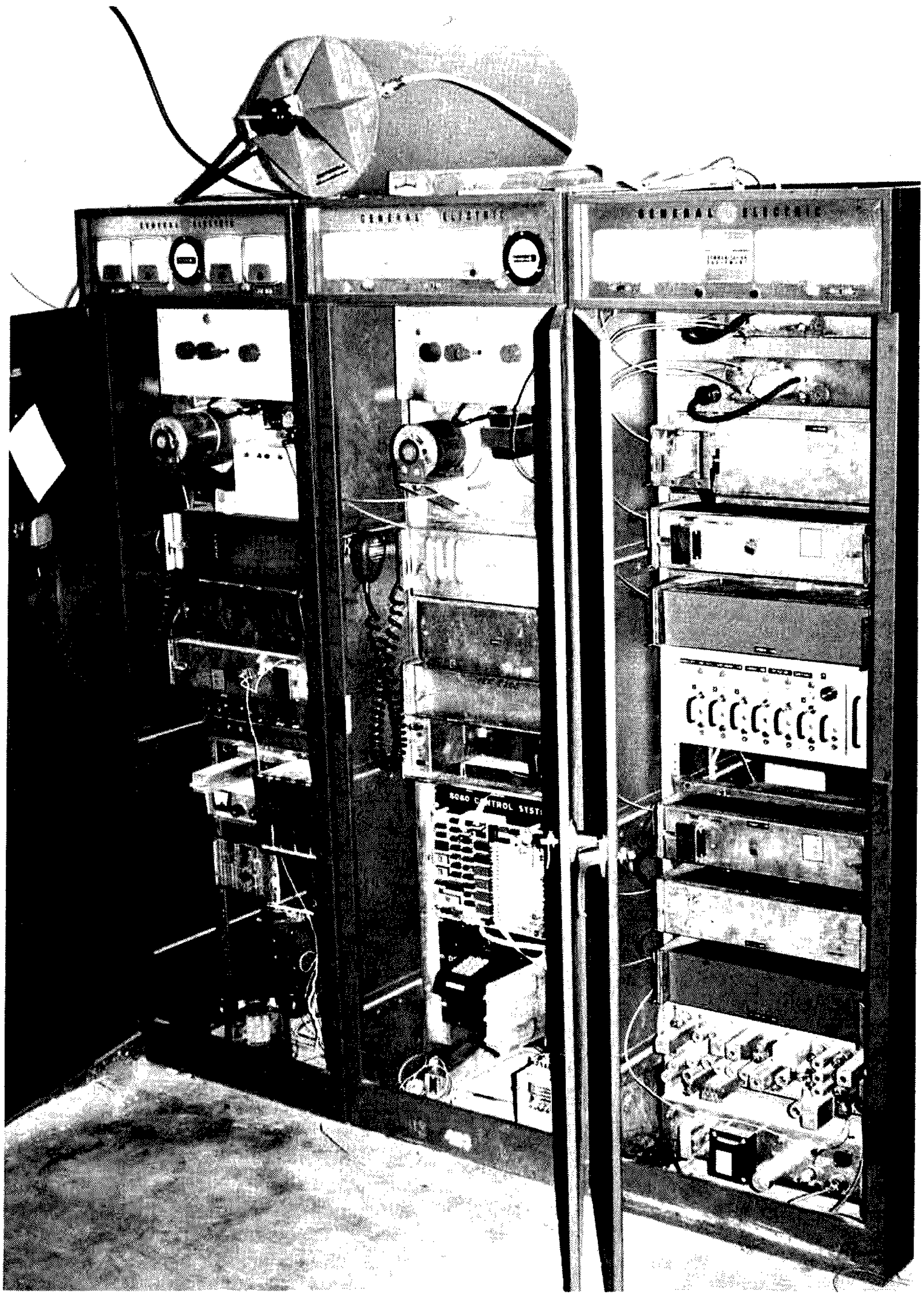
hardware. Deciding where to draw the line is an interesting problem. There are trade-offs which must be made. The major advantage of using a microprocessor is replacing hardware with software, so at first glance it may seem that everything that can be placed into software should be. However, I would rather add one flip-flop than add several hundred extra lines of program. Four years ago, I made the mistake of taking all possible hardware out of a system. My first attempt at computerizing WR3AFM started at that time when I constructed a system based on the 4004 CPU, a 4-bit machine. I designed the hardware, giving the software total control over the hardware. Everything was done with the software. At that time, being hardware oriented, I built the thing first and assumed that I would then write the program. The hardware functioned perfectly—unfortunately, I could not write the program. It could be done, but it was so complicated that it would have taken me several months of concentrated effort to accomplish the task. I effectively junked the project and am still trying to think up some possible use for the thing.

This time around I did not make the same mistake. There are four state flip-flops in the external hardware. These keep track of the autopatch, remote base, control receiver talk, and telephone control states. The processor does not know or need to know the current state to execute its functions. It basically acts as a CW identifier and a multiple digit decoder. It does keep track of many internal states, but these states are not needed until a function is called which needs them. The extra dozen ICs greatly simplify the software, and I believe that the hardware/software balance of this system is near optimal.

Hardware Description

The repeater block diagram shown in Fig. 1 was previously discussed. Fig. 2 shows how the control system interfaces with the repeater. Surely, each repeater will have to be reckoned with on an individual basis. Understanding how WR3AFM works should demonstrate how to interface the control system with any repeater.

The 146.07/146.67 MHz repeater is referred to as 150 and the 444.35/449.35 MHz repeater is referred to as either 440 or 450. The



WR3AFM. Left cabinet—444.35/449.35 repeater. Top to bottom: power amplifier, transmitter, receiver, control panel, autopatch circuitry. Center cabinet—146.67. Top to bottom: power amplifier, transmitter, control receiver, control shelf, 8080 control system. Right cabinet—link cabinet. Top to bottom: 440 multicouplers, power supply for receiver #6, 5 link receivers, voting selector. Tube receiver on bottom no longer in use. 146.67 pass cavity on top. 440 duplexer out of view in left cabinet.

User Codes

There are eight user codes. 1#1 links 67 and 449.35. The two repeaters remain linked until they are unlinked by a single *. The proper output line is automatically set and reset for the link and unlink commands. To tell the user that the link or unlink has been established, the repeater acknowledges with an "R" in Morse.

2#2 plays the prerecorded tape loop. Once it is started, there is no way to stop it short of shutting down the repeater.

3#3 is the disable blocking or selective call code. The blocking is disabled after the second three is received until the incoming carrier is dropped.

4#4 is the touchtone test function. Any tones up to a maximum of 24 will be played back on CW after carrier drop if preceded with the 4#4 code.

5#5 will repeat what was sent during a 4#4, or the telephone number requested in an autopatch, whichever was last.

67# is the autopatch code. In one transmission, the code plus the telephone number must be sent. The processor will not access the telephone line unless a valid telephone number is received. Normally this consists of exactly 7 digits, the first digit not a 1. Other valid numbers are 8 or 11 digits, with the first digit a 0 and the single digit codes. If the single digit code is correct, the proper emergency number will be found and sent. If an invalid number is attempted, nothing happens, exactly as if no autopatch attempt had been made. For valid numbers, the repeater will bring up the telephone line and redial the stored telephone number. This system prevents incorrect calls due to signal chopping which cause shotgunning of the touchtones (which result in more than 7 digits). When a single digit code is used, the three-minute timer is defeated automatically. If the 67# is sent by itself and the direct autopatch bit is set, then the repeater will bring up the telephone line and permit the user direct access to the telephone dialing system. This is not normally done, as it is not needed.

9#5 is the remote base code. The normal method is to use this by calling in on the phone line. However, nothing prevents its use on the air. All it does is connect the repeater to the phone lines, but it will not initiate a call. This is not strictly a user code, as the users should not know it, but there is no technical distinction between it and the other user codes. If the repeater times out during an autopatch or a remote base function, those functions will be canceled.

2*2 also performs the tape function. There is no distinction between this and the 2#2 except that the 2*2 is for control stations only. The two codes may be disabled separately. By using the 2*2 function, if it becomes necessary to disable 2#2, control operators may activate the tape upon request without needing to get into command mode and enable the 2#2 function.

In order to exert command on the repeater, it is necessary to enter the command mode. 6*# initiates the request. After entering this code, the carrier must be dropped. If the command is from the telephone line, the procedure may continue immediately. A confirmation code must be entered next. The confirm code is #*6. *Important:* Once the command code is issued, the system will wait for the confirm code forever. If no tone is given, the system will not be reset until it receives another touchtone. After the confirm code is entered, the carrier must be dropped again. Next, a single digit code is entered. If the single digit is a valid command, then the repeater will acknowledge with an "R". With the exception of three special single digit commands, the command mode is automatically left, and operation is again normal. A description of the single digit codes follows.

The system has five different messages. Four are permanently stored in the ROM. They are presently (1) "DE WR3AFM BARC," (2) "DE WR3AFM BALTIMORE," (3) "73 DE WR3AFM," and (4) "DE WR3AFM BALTO ARC." In addition to these four, there is a fifth which may be programmed through another command.

Commands one through five select that number ID to be used always. Command six rotates through 1,2,3,4,1,2,3,4, etc., each time the repeater identifies. Command seven rotates through all five IDs.

Command nine resets all functions to the normal state. Normal is both repeaters enabled, ID #1 selected, and all other outputs ungrounded. This is the same thing as pushing the reset button on the control system.

Command * resets the ID timer. The next time one of the repeaters is kerchunked, that repeater will identify. A word here about the timing of IDs is in order. In the rest mode, as after the * command, the first repeater used identifies. If, in the subsequent three minutes, one or both of the repeaters is used, then one or both of the repeaters will identify three minutes later. In this manner, the repeater is a "tail-ender," and always gets in the last word (something that is very difficult for one of us mortals to do on the repeater).

Commands 8, 0, and # are the commands which do not exit the command mode immediately. Command eight is the ID load command. This loads ID #5 into memory. It does not change the specification of which ID is to be used. After entering the eight, and dropping carrier to hear the "R", the load program is waiting for further instructions. The ID is loaded in a character-by-character fashion. Dits are zero, dahs are one. The characters are loaded in the same as they are in Morse. For instance, take the letter "F". This is di-di-dah-dit, corresponding to 0,0,1,0. To enter "F", then the sequence should be 0,0,1,0. When the letter is entered, enter a 2 to signify that that letter is done. Continue loading characters in this manner. A 2 entered with no zeroes or ones will automatically be translated into a space. When the entire message has been entered, a 3 signifies that you are

equipment is General Electric MASTR. This includes the voting selector, receivers, transmitters, and control shelves. The voter has two outputs: the COS line and the audio output. The COS (carrier operated switch) is low when an incoming signal is present. This is at a transistor level, and, actually, we added single transistor inverters in several places throughout the system to interface the various components exclusive of the control system. All audio lines in the system are balanced. The control system is designed for balanced lines; therefore, it will work with both balanced and unbalanced lines. If you use unbalanced lines, be certain to keep track of the hot and cold ends so that they match up. There are select and disable lines driving the voter. These lines are active low. The control system provides a ground when commanded; otherwise, the select and disable lines are open.

The 440 control receiver has the COS and audio lines the same as the voter. Additionally, Private Line™ or Channel Guard™ subaudible tones may be required to unsquelch it. This "PL" enable line requires a ground when it is desired to place the receiver into the PL mode.

The two meter repeater is connected to its control shelf (standard MASTR equipment) in the ordinary fashion. The PTT (push-to-talk) line is just that. The PTT interfaces with the rest of the system only through the control system. It is used for two purposes: to keep the transmitter on the air during IDs and to see if the repeater has timed out. The control shelf provides the three-minute timer and drop delay timer. The PTT line is disconnected from its normal feed. During normal operation, the control system reconnects the PTT and feed. The transmitter audio pair is the audio input to the transmitter. This is shorted out to block repeating of touchtones and is shorted with the same lines from the 440 transmitter for linkups. The "PL" audio input is any audio input

Command Codes

done. The repeater acknowledges this with an "R", and the ID load and command commands are exited. Normally, place a space at the beginning and at the end to make the IDs uniform. Always be certain that the ID load mode is left, or the controller will be waiting to receive a "3" before it resumes its normal functions. After loading a message, you should select ID #5 and either wait to hear it or reset the ID timer to hear it to verify that it received what you think it did. After loading and verification, the desired ID mode can be set (either 5 or 7).

Command zero is the most powerful command, and it is through it that positive control is established. After releasing carrier and hearing the "R", the output mode is entered. In this mode, the repeater is waiting for three digit codes specifying which output bit to change. There are 64 bits arranged as eight eight-bit ports. Port 0 is a dummy port; it has no output lines and is used to disable the user functions. Port #1 is used by the indirect commands and is not normally used in the output mode. Ports #2 and #3 are enable functions. Port #4 is completely spare, port #5 is voter receiver disable, port #6 is voter receiver enable, and port #7 controls the touchtone generator. For ports #5 and #6, the bit number is the receiver number. This leaves room for eight receivers with no changes necessary. The normal configuration is all ports zero. This gives an ungrounded condition on the voter and spare ports. The three digit sequence for the output mode is XYZ, where X is the port number, Y is the bit number, and Z is either 0 (normal) or 1 (asserted). After each output sequence, the output routine acknowledges with an "R" if the command is valid. Invalid commands would be 831, 690, 300, 236, for obvious reasons. After each sequence, the output routine waits for further commands until a * is sent. The repeater sends an "R" to this and output and command modes are exited. For example, to turn off 67: enter command mode (6*#, #*6), 0, (output mode), 281 (turn it off), * (exit command).

Command # permits loading of the telephone number stored for the single digit #1. Simply send the telephone number followed by a *. An "R" acknowledges loading and exits command mode.

Always be sure that you have left the ID load, output, and load telephone number modes. If the repeater IDs, you have. This is true for all commands. A useful command to execute before ending a control session is the reset timer command, to hear the ID which guarantees that all is OK.

```
1#1 - 150/450 link
2#2 - Tape loop
3#3 - Disable blocking until carrier drop
4#4 - Touch Tone(R) Test
5#5 - Repeat 4#4 or autopatch number
67# - Autopatch

2*2 - Tape
9#5 - Remote base
```

```
6*# - Command mode
#*6 - Confirm command mode

After in command mode:
1 - Select ID #1: * DE WR3AFM BARC *
2 - Select ID #2: * DE WR3AFM BALTIMORE *
3 - Select ID #3: * 73 DE WR3AFM *
4 - Select ID #4: * DE WR3AFM BALTO ARC *
5 - Select ID #5: programmable through command 8
6 - Rotate through IDs 1 through 4
7 - Rotate through IDs 1 through 5
8 - Load ID #5:
        0 - Dit
        1 - Dah
        2 - End character
        3 - End load mode
9 - Reset all outputs and modes to normal operation
0 - Output mode:
        XYZ - Port X, Bit Y, Output Z (exit output mode with *)
* - Reset ID timer (first repeater up IDs)
# - Load single digit #1 telephone number (exit with a *)

Output Ports:
Port #0
1 - 1#1 disable
2 - 2#2 disable
3 - Direct autopatch enable
4 - 4#4 disable
5 - 5#5 disable
6 -
7 -
8 - 2*2 disable

Port #1 - DO NOT USE

Port #2
1 - Beep disable
2 - Control receiver PL enable
3 - 150 Touch Tone (R) disable
4 - Telephone Touch Tone (R) disable
5 - Control Touch Tone (R) disable (when absolutely necessary)
6 - Autopatch disable
7 - 450 Repeater disable
8 - 150 Repeater disable

Port #3
1 -
2 -
3 -
4 -
5 - DO NOT USE
6 - Timer disable
7 - DO NOT USE
8 - DO NOT USE

Port #4
1 -
2 -
3 -
4 -
5 -
6 -
7 -
8 -

Port #5 - Voter disable
1 - Receiver #1 (Charles Street)
2 - Receiver #2 (Cub Hill)
3 - Receiver #3 (K3VC)
4 - Receiver #4 (WRDS)
5 - Receiver #5
6 - Receiver #6
7 - Receiver #7
8 - Receiver #8

Port #6 - Voter select, bits same as port #5

Port #7 - DO NOT USE
```

which is not affected by the normal talk audio. It is used for the CW ID tone. The CS COS (control shelf COS) will key the transmitter when grounded. This goes through the two timers in the control shelf and drives the PTT feed. The CS AUD (control shelf audio) pair goes through line amplifiers and compressors to drive the transmitter. This is normally connected to the voter audio output. The RUSOS lead is a lead which, when grounded, keeps the transmitter on through the timers. A ground on the RUSOS lead will not feed back on the CS COS lead. The RUSOS lead is grounded for autopatches. The DUPLEX AUD is a bidirectional audio path. It is labeled "AUD" on the rear of the control shelf. When the CS COS is low, audio exits from the DUPLEX AUD lead. If +10 volts is placed on the AUDIO GATE line, audio placed on the DUPLEX AUD pair will be fed to the transmitter. This is used to place telephone line audio on the air. When the DISABLE TIMER lead is grounded, the three-minute time-out timer is bypassed and the repeater will not time out. This is used during emergency telephone calls. The time-out timer is on the input, not the output of the repeater. Between each transmission, the timer resets. It is not necessary to let the repeater carrier drop. However, when the "beep" is active, a fraction of a second after the input signal disappears, the repeater will beep. The FORCE TIMER line, when grounded, makes the control shelf believe that a signal is present even if it is not. This is used so that when the "beeper" is enabled, not waiting for the beep will not reset the time-out timer.

The connections for the 440 repeater use the same definitions as the 150 repeater. There is a separate interface for that repeater which provides an autopatch on a second telephone line. That is not

—Correction—

Yaesu FT-227RA

The product review of the Yaesu FT-227RA in the January issue of 73 incorrectly states that a conversion kit is available through Yaesu. There is no conversion kit available.

of importance when interfacing with the control system, except that the autopatch logic includes a 1#1 output function so that when that code is sent, the LINK line is grounded. This permits linking up the repeaters from the 440 end.

The telephone line interfaces with the control system and is switched properly by it. In this system, the telephone company interface device is at a member's house. There is a dedicated line from his house to the repeater site. The audio and a reversing dc voltage are on the single pair, and its operation will be described later. If the telephone company interface device is to be located at the repeater, all of the necessary signals are present in the control system to handle it and it would be simpler than our arrangement. There is a tape recorder connected to the line during autopatches, and the recorder is located at the member's house rather than at the repeater. This allows changing tape easily.

There are various subassemblies in the control system. Rather than building everything from scratch, we used good quality commercial units where possible. There are three audio amplifiers. Two are used for the telephone line and one for driving the touchtone decoder. The amplifiers are IT&T K227s. They are balanced input/output, 600 Ohm. The gain is variable from -.5 to +36 dB, and they each draw 18 mA from a 16- to 24-volt supply. Similar amplifiers should not be too difficult to find, or a few op amps should do the trick nicely. The touchtone decoder is an IT&T K-247-B. It is normally 600 Ohms and is modified for 10k audio input impedance. The digit lockup is disabled. The decoder has 13 outputs: one for each of the 12 digits and one which detects any valid touchtone (VTT). Each of these lines is normally open and goes low when active. Any decoder may be used which follows these conventions, but beware of 567-type decoders which do not employ high/low audio group filtering. I encourage the use of commercial decoders. Lacking that, be sure to test homemade ones extensively. While the microprocessor is the brain of the system, the decoder is the heart of the system.

A standard touchtone pad is included to facilitate controlling the repeater when at the repeater site.

The tape loop is a Mohawk Message Repeater. This is an antique vacuum tube device which could certainly be replaced with a newer piece of equipment. When one pair of wires is shorted, it activates the tape. While the tape is running, an output pair is shorted. Any cartridge-type machine should be suitable, and a standard 8-track player could be modified for this use. The tape must turn itself off when completed. ■

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Islington, Ontario
Canada M9B 5Z5

The Cosmac Connection: Part 2

—meeting Mr. Morse

Program your way to CW happiness.

Now you can reduce operator fatigue in that next CW contest by storing commonly used messages in your microcomputer, all ready to be sent automatically at the flick of a switch. Imagine relaxing in your armchair . . . you reach over to your computer, flick a switch, and out comes CQ FD CQ FD DE VE3CWY/3 K. No answers? Flick the switch again for a repeat. You've got somebody. You casually call him with your hand key, W1XXX. Then push another button on the computer and presto! Out comes DE VE3CWY/3 QTH HR IS. . . You wait until it's finished. The code is the best you've ever heard. Now how much simpler could things get? Not much, unless you also have an automatic Morse decoder, too! Of course, you don't have to be a contest operator to use this little gem. I use it now for many regular QSOS to put out the initial CQ and to send the first message, which, for most people, is simply a signal report, QTH, and operator's name.

Speed (wpm)	5	7	10	13	16	20	25	30	35	40
Hex code	3F	2D	1F	17	13	0F	0C	0A	09	08

Table 1. Hex byte for code speed desired is entered in M(0004).

One-byte characters

A	22	N	21
B	41	O	37
B	41	O	37
C	45	P	46
D	31	Q	4B
E	10	R	32
F	44	S	30
G	33	T	11
H	40	U	34
I	20	V	48
J	4E	W	36
K	35	X	49
L	42	Y	4D
M	23	Z	43

word space	EE
stop	FF

Two-byte characters

1	50	1E
2	50	1C
3	50	18
4	50	10
5	50	00
6	50	01
7	50	03
8	50	07
9	50	0F
0	50	1F

.	60	2A
,	60	33
?	60	0C
/	50	09
double dash	50	11
end of message	50	0A
end of work	60	28
wait	50	02

Table 2. Hex codes for letters and punctuation.

Equipment Required

The Cosmac microcomputer constructed around the CDP1802CD CPU is used with 256 bytes of RAM of which 105 bytes are used for the main program, the rest being used for storage of the messages. Program timing assumes a clock frequency of 1 MHz, but it is easily adapted for other clock frequencies. Other hardware that you will need is shown in Fig. 1. This includes some ICs to interface the computer and hand key to the transmitter and a sidetone oscillator.

How the Program Works

The byte stored in M(0004) is selected initially by the operator from Table 1. This byte sets the length of a dot and hence sets the speed of the code. The program triples this to get a number that will represent the length of a dash; this is stored in R6.0. Four times the dot byte represents a word space, and this byte is

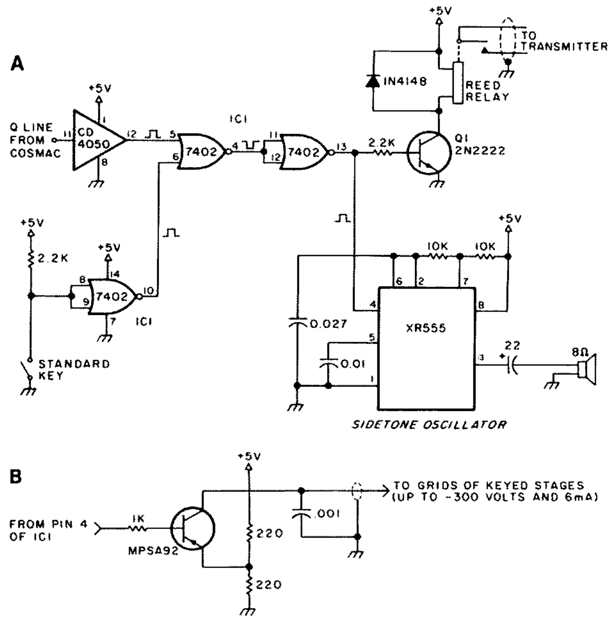


Fig. 1.(a) Interface between Cosmac and transmitter; (b) alternate circuit for rigs with grid-blocked keying eliminates relay and Q1.

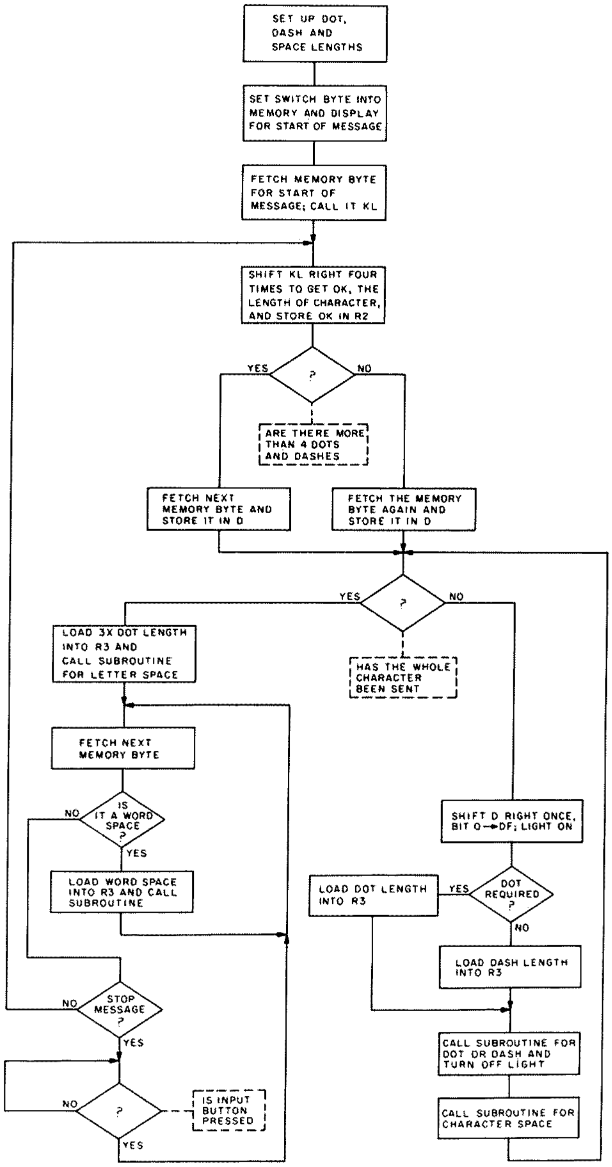
stored in R7.0. Actually, this space gets added to the usual space of three dots that follows every letter so that the actual space between words is equal to seven dots. These bytes are later used to specify the length of a timed loop and thereby set the length of all the dots, dashes, and spaces.

The program fetches the first byte of the programmed message from M(0069). It is 45, which stands for the letter C, as you can see from Table 2. The first digit, 4, is the total number of dots and dashes in the letter. The second digit, 5, specifies the order in which the dots and dashes appear. Taking C as the example, —·—· can be represented in binary form by 0101, where the 0 represents a dot and the 1 represents a dash. This is the binary code for the number 5. So byte 45 tells the computer the order of dots and dashes and the number of dots and dashes in the letter. To actually generate the code —·—·, the number 0101 is stored in the D-register. D is shifted right giving 0010, and the 1 that peels off the right end of the number tells the computer to send a dash first. D is shifted right again, giving 0001; this time, a 0 peels off the right end, producing a dot. A third shift gives 0000, pushing a 1 off the right end, thus making a dash. A fourth shift gives 0000, pushing a 0 off the right end; this makes the final dot. The computer stops shifting D now because the 4 in byte 45 tells it to make only 4 shifts. A letter space is then generated and the next byte is fetched from M(006A).

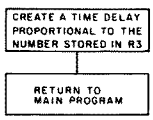
Since there are no letters that have more than 4 dots and dashes in total, the order of dots and dashes in any letter can be represented by four binary digits or one hex digit. The numbers, punctuation, and other special characters listed in Table 2 contain 5 or more dots and dashes. To handle each of these, two bytes are required; the first specifies the total number of dots and dashes, while the second specifies the order in which they occur.

The rest of the program is easy to follow from the

Fig. 2. Main program flowchart.



Subroutine flowchart



R0—forms timed loop in subroutine, setting the speed of the code
R1—main program counter
R2—stores the total number of dots and dashes in the character being sent
R3—stores length of dot, dash, or space for use in subroutine
R4—subroutine counter
R5—memory pointer for length of dot
R6—stores dash length
R7—stores word space length
R8—stores address of the start of the recorded message
R9—stores hex code for character being sent
RA—memory pointer; points to M(0005)

Table 3. Register assignments.

Fig. 3. Program listing. Title: Programmable Morse code generator.

Address	Bytes	Comment
0000	F8	06→D set main
0001	06	program counter
0002	A1	D→R1·0
0003	D1	1→P go to main program
0004	0D	store dot length
0005		address of start of message
0006	F8	5C→D set subroutine counter
0007	5C	
0008	A4	D→R4.0
0009	F8	04→D set memory pointer
000A	04	
000B	A5	D→R5·0 points to dot
000C	E5	5→X
000D	F0	MX→D fetch dot length
000E	F4	MX + D→D
000F	F4	MX + D→D
0010	A6	D→R6·0 store dash length
0011	F4	MX + D→D
0012	A7	D→R7·0 store word space
0013	F8	05→D set memory pointer
0014	05	
0015	AA	D→RA·0
0016	EA	A→X
0017	6C	input switch byte→ MX, D
0018	A8	D→R8·0
0019	64	MX→display, RX + 1
001A	2A	RA-1
001B	E8	8→X
001C	F0	MX→D fetch byte KL
001D	F6	shift D right
001E	F6	
001F	F6	
0020	F6	
0021	A2	D→R2·0 store OK
0022	FD	04-D→D, carry→DF
0023	04	
0024	3B	go to 28 if DF = 0
0025	28	
0026	F0	MX→D fetch byte again
0027	C8	long skip to 2A
0028	18	R8 + 1
0029	F0	MX→D fetch next byte
002A	A9	D→R9·0 store character
002B	82	R2·0→D OK→D
002C	32	go to 44 if D = 00
002D	44	
002E	89	R9·0→D
002F	F6	shift D right, bit 0→DF
0030	A9	D→R9·0
0031	7B	1→Q start timed interval
0032	3B	go to 38 if DF = 0
0033	38	
0034	86	R6·0→D load dash
0035	A3	D→R3·0
0036	30	go to 3B
0037	3B	
0038	45	M5→D, R5 + 1 load dot
0039	25	R5-1
003A	A3	D→R3·0
003B	D4	4→P call subroutine
003C	7A	0→Q end of timed interval
003D	45	M5→D, R5 + 1
003E	25	R5-1
003F	A3	D→R3·0 make space
0040	D4	4→P call subroutine
0041	22	R2-1 decrement length
0042	30	go to 2B
0043	2B	
0044	86	R6·0→D load letter space
0045	A3	D→R3·0
0046	D4	4→P
0047	18	R8 + 1 fetch next byte
0048	F0	MX→D
0049	FF	D-EE→D
004A	EE	test for word space
004B	3A	go to 52 if D ≠ 00
004C	52	
004D	87	R7·0→D
004E	A3	D→R3·0
004F	D4	4→P make word space
0050	30	go to 47
0051	47	
0052	F0	MX→D
0053	FF	D-FF→D
0054	FF	test for end of message
0055	3A	go to 1C if D ≠ 00
0056	1C	
0057	3F	go to 57 if EF4 = 0
0058	57	wait
0059	30	go to 47
005A	47	continue message
005B	D1	1→P return to main program
005C	F8	4E→D start subroutine
005D	4E	set speed
005E	A0	D→R0·0
005F	20	R0-1
0060	80	R0·0→D
0061	3A	go to 5F if D ≠ 00
0062	5F	
0063	23	R3-1
0064	83	R3·0→D
0065	3A	go to 5C if D ≠ 00
0066	5C	
0067	30	go to 5B
0068	5B	end of subroutine
0069	45	C recorded message
006A	4B	Q
006B	EE	word space
006C	45	C
006D	4B	Q
006E	EE	word space
006F	45	C
0070	4B	Q
0071	EE	word space
0072	31	D
0073	10	E
0074	EE	word space
0075	48	V
0076	10	E
0077	50	3
0078	18	
0079	45	C
007A	36	W
007B	4D	Y
007C	EE	word space
007D	48	V
007E	10	E
007F	50	3
0080	18	

0081	45	C
0082	36	W
0083	4D	Y
0084	EE	word space
0085	35	K
0086	FF	stop
0087	33	G
0088	23	M
0089	EE	word space
008A	37	0
008B	23	M
008C	EE	word space
008D	50	double dash
008E	11	
008F	EE	word space
0090	34	U
0091	32	R
0092	EE	word space
0093	32	R
0094	30	S
0095	11	T
0096	FF	stop
0097	40	H
0098	32	R
0099	EE	word space
009A	20	1
009B	21	N
009C		etc.

flowchart in Fig. 2. Two special bytes were set up. One is EE, which calls for a word space; the other is FF, which halts the program until the input button connected to EF4 is depressed.

Using the Program

Select the code speed desired from Table 1 and store this byte at M(0004). Table 1 was constructed assuming a clock frequency of 1 MHz. If your crystal is not 1 MHz, simply experiment a little with different hex bytes to get the different speeds. The code speed varies inversely with the size of byte.

After entering the main program, decide on the messages you want and select from Table 2 the bytes for each letter, number, or punctuation. Note that the numbers and punctuation require two bytes each. Terminate each message with FF so that the program will halt. To initiate one of the messages, enter the memory address of its first byte from the front panel of the computer using the toggle switches. Turn on the run switch. When the message terminates, you can make it carry on with the next stored message by pressing the input button which is connected to EF4. This way, you can have pauses inserted in messages to allow you to enter a signal report or callsign manually.

Interface Circuitry

The circuits shown in Fig. 1 are just suggestive. They work for me, but you may have to adapt them to your own rig. One possible area of difficulty I have noticed is that of rf from the transmitter getting into the IC gates and playing havoc with them. The problem seems accentuated at 14 MHz and higher with my 180-Watt rig. Typically, after a few dots and dashes are sent, the transmitter comes on and stays on. The cure is to shield the IC circuits in a metal enclosure and bypass incoming and outgoing leads with 0.001 uF ceramic capacitors. ■

Learning the Code

—a better way

Let your micro be your guide.

George Waldie
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To get my ham license in 1949, I had to produce one minute of perfect copy at 13 wpm. A full year's striving to reach this goal resulted in a set of conditioned reflexes by which the code sounds entered my ears and came out my fingers as written text, after which the message was interpreted by my eyes. This roundabout process caused habits which have ever since inhibited both my skill and enjoyment where CW is concerned. The inclusion of my handwriting in the process was particularly unfortunate since, under pressure, my writing tends to become rather spastic. The process inhibits the ability to "copy behind" and to "copy in the head."

I needed a method of creating a new set of reactions which would generate mental images from the code sounds. Many ideas came to mind, but none provided a simple method of coordinating audio and visual presentations of characters, together with flexibility, without complicated special-purpose equipment.

Then, a couple of months ago, we added an audio alarm to our office minicomputer. This alarm gives a single 960 Hz beep in response to PRINT HEX(07). It is used to signal the operator when the machine needs attention for any reason foreseen in the program. Once I found that the duration of the tone could be controlled by changing the number of iterations in a loop containing this statement, it was inevitable that I would program a code teaching machine.

I have written this article hoping that others with similar CW problems, or those conducting code classes, will find the system useful and will let me know how they fare. The program contains a few wrinkles which may prove interesting to persons concerned primarily with programming methods.

Practice material can be stored in data statements in the program or, with simple changes, in external files. The program accommodates a full range of numerals, punctuation, and upper and lower case alphabetic character material. As the text is scanned, each character is converted into its audible CW equivalent and, an instant later, appears on the CRT as an addition to the string of previously sent characters.

The code element speed and the element and character spacings are adjustable, as well as the delay of the CRT display of the character. There are a number of apparent advantages to this system. A student working solo with this program need never try to memorize the code from any printed representation, either in dots, dashes, or didahs. All that is stored in the program. The code sound is emitted, and then the letter appears on the screen to reinforce the character recognition. For code classes, practice material can be selected from any source and stored for later use. The instructor can input text to his machine and then recall it as CW at any speed appropriate to class needs. My equipment will store 80,000 characters on a cassette, some 16,000 words, or 64 typed pages of text. Such material can be used over and over at any desired speed.

Characters are handled in a computer as binary numbers which have decimal, octal, and hexadecimal equivalents. In developing this program, it was necessary only to consider the ASCII decimal equivalents of the various CW characters. Fortunately, and possibly not coincidentally, the characters used in CW transmissions

are represented by ASCII decimal numbers lying in the range 40 to 90. A table of these characters is shown in Fig. 1, together with the string symbols used to control the audio output. Lowercase letters are represented by ASCII decimals 97 to 122. A few characters — the star, semicolon, "less than" and "greater than" symbols, and the @ sign — have no international Morse symbols that I could find, so provision is made to skip these characters when encountered.

The equipment required to use this program is a small computer programmable in BASIC with STRING functions, a CRT display, and an audible tone alarm. The version of the program given here, which includes several lines of practice text, runs in about 2350 bytes.

My machine is a Wang WCS1OT, which includes the CRT, cassette drive, and keyboard in a single console with an outboard CPU. The BASIC compiler is hard-wired, so I do not have access to the machine language. Wang BASIC is an augmented subset of general BASIC, and only those features special to STRING manipulation and character identification have been used. If your BASIC lacks any of these features, but you can write machine language functions, you should be able to run a version of this program. Notes relating to conversion of the program to other dialects are located at the end of the article.

The program can be followed readily from the listing of Fig. 2. A word is in order about this listing. The program was originally written and debugged using one statement per line. When operation was satisfactory, the program was "compressed" by removing REMs and combining as

ASCII No.	Character	Code Symbol
40	(	101101
41	)	010010
42	*	2
43	+	01010
44	,	110011
45	-	100001
46	.	00200200
47	/	10010
48	0	11111
49	1	01111
50	2	00111
51	3	00011
52	4	00001
53	5	00000
54	6	10000
55	7	11000
56	8	11100
57	9	11110
58	:	111000
59	;	2
60	[	2
61	=	10001
62	]	2
63	?	001100
64	@	2
65	A	01
66	B	1000
67	C	1010
68	D	100
69	E	0
70	F	0010
71	G	110
72	H	0000
73	I	00
74	J	0111
75	K	101
76	L	0100
77	M	11
78	N	10
79	O	111
80	P	0110
81	Q	1101
82	R	010
83	S	000
84	T	1
85	U	001
86	V	0001
87	W	011
88	X	1001
89	Y	1011
90	Z	1100
97	a	01
98	b	1000
99	c	1010
100	d	100
101	e	0
102	f	0010
103	g	110
104	h	0000
105	i	00
106	j	0111
107	k	101
108	l	0100
109	m	11
110	n	10
111	o	111
112	p	0110
113	q	1101
114	r	010
115	s	000
116	t	1
117	u	001
118	v	0001
119	w	011
120	x	1001
121	y	1011
122	z	1100

Fig. 1. ASCII decimal codes, characters, and CW sound codes.

many statements as possible on each line. This saves a sensible amount of core and results in an almost unreadable LIST. To get the listing given here, the compressed program was processed by a utility which prints one statement per line and indents FOR/NEXT loops. The line numbers went unchanged throughout, except for deletions, accounting for the peculiar sequence shown here.

Now for program operating: At LN 30, the variables are dimensioned as necessary. C$(52)8 provides for a list of 52 code symbols, each 8 characters or less.

M$64 sets up a string variable containing up to 64 characters to receive text lines.

T(4) is a list of the speed control numbers.

T$(4) is a string list to receive speed prompts. In this BASIC string, variables with no specified length take a default of 16 characters. So the prompts can be up to 16 characters in length.

A$1 sets up a single character variable.

At LN 80, a loop READs the speed data prompts from DATA into list T$(). Then another loop READs the code symbol strings into 52-element list C$(). At LN 170, a third loop displays each of the prompts on the screen. An "edit" routine follows, providing for inputing the necessary control numbers. This method of data INPUT is one I use rather routinely, but it is not essential to the program. The Wang INPUT statement allows the inclusion of the prompt message in the statement. If you lack this feature, you should use a PRINT statement "CHANGE ITEM #" preceding INPUT. Each INPUT of a value causes a loop back to LN 170 where PRINT HEX(03) blanks the screen and prints a new data display from the top. When the necessary controls have been entered, "0" used as an answer to "CHANGE ITEM?" will exit the edit routine.

The change of variables at LN320 may seem unnecessary. My computer has a HALT/STEP key which will interrupt program operation at any time and permit the program to

be restarted after changing the value of a variable. Use of the unsubscripted variables makes the value changing a mite simpler during an interrupted RUN.

The next statements blank the screen, set the DATA pointer to the beginning of the practice text, and move the cursor to the center of the screen, respectively. HEX(OA) is a line feed.

At LN 410, the next text line is READ and tested. If the DATA is not "***", the program continues, otherwise the DATA system is reset and the program repeats from LN 410. If your BASIC does not have the ability to RESTORE to a particular DATA item, you will have to program an alternative at this point. This version of the program assumes the practice text is stored in DATA statements. Changes at this READ routine will permit the text to be taken from some other storage medium.

LN 490 counts the characters in text line M$, and the program enters a loop to process the line one character at a time. The next character is stored in A$, and the ASCII decimal value of A$ is put in A.

The following IF statements provide a means for accepting a variable only if it has a value between certain limits. Letting U, L be the upper and lower limits, respectively, the comparison statement is set up as:

ABS(A − (U + L)/2).LE.(U − L)/

and will reject any value outside the limits.

The first comparison rejects A unless it has a value between 40 and 90, which includes characters from "(" to "Z". Any value outside this range is tested again at LN 490. Values from 97 to 122 represent lowercase letters and are shifted to uppercase at LN 640. Any other value of A results in a blank being printed on the screen, and no code sound is generated. If your machine does not have lowercase, you can simplify the program by removing the second test of A.

A anomaly of the program as written is that a lowercase letter is interpreted so as to produce the same code sound as an uppercase, but the lowercase character is added to the screen. Of course, this presents no difficulty.

At LN 660, A is shifted in value to serve as the subscript for array C$(), and the coding for the corresponding CW sounds is stored in C$.

There follows the loop to process the code symbols. There are other ways of analyzing the symbol

Fig. 2. BASIC program listing.

```
10    REM  DIDAH1.2    GW     FEB 04, 1978
20    REM  GEORGE WALDIE      26½ S.MAIN, MT. GILEAD, OHIO 43338
30    DIM C$(52)8,M$64,T(4),T$(4),A$1
80    FOR J = 1TO 4
        READ T$(J)                                   Read speed prompts
        NEXT J
      FOR J = 1TO 52
        READ C$(J)                                   Read code symbols
        NEXT J
170   PRINT HEX(03)
        FOR J = 1TO 4
        PRINT J;T$(J);TAB(15);T(J)                   Display control data
        NEXT J
      PRINT
      Q = 0
      INPUT "CHANGE ITEM #",Q                        Edit control data
      IF Q = OTHEN 320                               Exit edit routine
      INPUT "CHANGE TO",T(Q)
      GOTO 170
320   T1 = T(1)
      T2 = T(2)                                      Change variables
      T3 = T(3)
      T4 = T(4)
      PRINT HEX(03)                                  Clear screen—home cursor
      RESTORE 57                                     Reset data
      PRINT HEX(030A0A0A0A0A0A0A)                    Center display
410   READ M$                                        Read data line
      IF STR(M$, 1, 3)<>"***"THEN 490                Test for end
      RESTORE 57
      GOTO 410                                       Repeat
490   M = LEN(M$)                                    Length of data string
      FOR J = 1TO M
        A$ = STR(M$,J,1)                             Next character
        A = VAL(A$)
        IF ABS(A-65)<25THEN 660                      Test for uppercase
        IF ABS(A-109.5)< = 12.5THEN 640              Test for lowercase
        A$ = " "
        GOTO 940
640     A = A-32                                     Shift from lowercase
660   C$ = C$(A-38)
      FOR I = 1TO LEN(C$)
        CONVERT STR(C$,I,1)TO C
        ON C + 1GOTO 790,840
```

strings, but the method shown suits my equipment and is efficient. The next character in the symbol string is CONVERTed to a numeric which then controls the branching. Any value of C but 0 or 1 generates a blank.

In the DATA statements for the character codes, you will notice the appearance of "2"s in several places. In most cases, these mark characters for which no CW code combinations were found. However, the CW period does include internal spaces which require this "2".

The "normal" branches to LN 790 and 840 go, respectively, to generators for dits and dahs. These are identical loops, except that the dah loop has twelve times as many iterations as the dit loop. If you are puzzled because you understand that a dah should be only three times as long as a dit, remember that the speed of the CPU enters here. In fact, you may have to adjust these loops to make the output sound right. The twelve multiplier was arrived at experimentally.

Both the dit and dah loops exit to 880, the intracharacter space loop. This is simply a "do nothing" loop to use up time. Again, you can change the multiplier to suit your taste (ear?). Notice that both dit and dah loops are controlled by T1, and the intracharacter loop by T2. At 940, B$ is a shift register to maintain, on the screen, the last 16 characters sent. In Wang BASIC, string variables are 16 characters long unless otherwise dimensioned. You must use whatever string length specification is required by your language. LN 940 moves the last 15 characters of B$ to the first 15 positions, leaving a space at the tail of the string for the next character, which is added in the next statement.

Another loop delays the display of the shift register. In this case, a meaningless arithmetic operation is included to provide the delay with fewer loop iterations. In the initial learning stages, this delay can allow "capture" time for CW character recognition. The delay can be reduced as the recognition time decreases.

Remember that, when a FOR/NEXT loop is encountered, it is exercised once even though zero iterations are called for. So, in this case, there will be a delay of the screen display equal to one iteration of the loop even if T4 is zero. This is the reason for the inclusion of the arithmetic operation within the loop. This seems to work well at CW speeds up to about 20 wpm, but this loop is a factor limiting maximum speed, since it does work once for every character. This is a point to look at when you try for maximum possible code speed.

After the shift register B$ is printed, there is a space

```
          IF I<>1THEN 880
          A$ = " "
          GOTO 880
790       FOR T = 1TO T1
          PRINT HEX(07);                                       Generate dit
          NEXT T
        GOTO 880
840     FOR T = 1TO 12*T1
          PRINT HEX(07);                                       Generate dah
          NEXT T
880     FOR T = 1TO 9*T2
          T = T                                                Intraelement space
          NEXT T
        NEXT I
940     STR(B$,1,15) = STR(B$,2,15)
        STR(B$,16,1) = A$                                      Register shift
        FOR T = 1TO 4
          T = SQR(T*T)                                         Print delay
          NEXT T
        PRINT HEX(0C);TAB(20);STR(B$,1)                        Print register
        FOR T = 1TO 4*T3
          T = T                                                Space
          NEXT T
        NEXT J
   GOTO 410
1120    DATA "CHAR. SPEED","LTR.SPACE","WORD SPACE","PRINT DELAY"    Speed prompts
1180    DATA "011110","101101","010010","2","01010","110011"
1190    DATA "100001","00200200","10010","11111","01111","00111"
1200    DATA "00011","00001","00000","10000","11000","11100","11110"   Code symbols
1210    DATA "111000","2","2","10001","2","001100","2","01","1000"
1220    DATA "1010","100","0","0010","110","0000","00","0111","101"
1230    DATA "0100","11","10","111","0110","1101","010","000","1"
1240    DATA "001","0001","011","1001","1011","1100"
1290    DATA " THIS IS A PROGRAM TO TEACH THE INTERNATIONAL MORSE"
1300    DATA " CODE."
1302    DATA " A B C D E F G H I J K L M N O P Q R S T U V W X Y Z"
1304    DATA " 1 2 3 4 5 6 7 8 9 0"                                Practice text
1306    DATA " ()* + - ./0123456789:;[ = ]? @abcdefghijklmnopqrstuvwxyz"
1310    DATA " THE QUICK BROWN FOX JUMPED OVER THE LAZY DOG"
1350    DATA "****"

1360    REM Compressed approx program length—1620 bytes
1370    END
```

between characters generated by the delay loop controlled by T3, after which the program goes back for the next text character and repeats the process just described until the entire text string has been used. It then proceeds to the next string of text data.

There is another possible anomaly you should be aware of. Some BASICs include trailing spaces in text strings; others do not. If your version of the language crops trailing spaces from the strings, as mine does, you will have to add a leading blank to each text line, or the last word of each string will run into the first word of the next string without a separating space. Notice the space I have included after the leading quote in each line of the DATA statements at LN 1290 to 1330.

This program illustrates very nicely how a general-purpose computer can serve a very specialized purpose merely by software implementation.

Conversion Notes

The manual for Ohio Scientific, Inc., 6502 8K BASIC states that this dialect will run, without change, programs written for ALTAIR, IMSAI, and SWTP machines and, with slight changes, programs for PDP-8, PDP-11, and NOVA BASICS. The following notes have been prepared using this information. I regret that I have not been able to test the effects of these suggestions.

LN 30 — In Wang BASIC, the DIM statement is used to set the sizes of lists and arrays and also the number of bytes reserved for string variables. Thus C$ is defined as a list of 52 elements of 8 or less characters. There is a default length of 16 characters. This specification appears to be unique to the Wang system.

LN 170 — When the system is turned on, output is selected to the CRT. Alternate outputs can be selected, but are not pertinent to this program.

LN 170 and LN 320 — PRINT HEX(03) clears the screen and homes the cursor to the upper left corner of the screen — corresponds to TTY keyboard CTRL C.

LN 790 and LN 840 — PRINT HEX(07) keys the audio tone — corresponds to TTY keyboard CTRL G.

LN 940—Each 0A in PRINT HEX(0A) issues a line feed — corresponds to TTY keyboard CTRL J. PRINT HEX (0C) moves the cursor up one line.

LN 320 and LN 410 — RESTORE 57 resets the DATA pointer to the 57th item of data, beginning of sample text. OSI BASIC does not offer this feature. Some other BASICs allow RESTORE to a particular DATA line number.

LN 410, LN 490, LN 660 and LN 940 — STR(M$,1,3) refers to string M$, starting with the 1st character, and including 3 characters, to create a substring of M$. OSI uses MID$(M$,1,3) with same meaning.

LN 490 and LN 660 — LEN(M$) returns the number of characters in M$. OSI uses same function.

LN 490 — VAL(A$) returns ASCII decimal value of 1st character of A$. OSI uses ASC(A$).

LN 660—CONVERT STR(C$,I1) to C sets to the numeric value of numeral(s) in string variable—corresponds to OSI CHR(MID(C$,I,1).

The relation operator .LE. is not accepted by my equipment, but is used here because my output writer does not have the usual left arrowhead on its type ball. The operator stands for "less than or equal to."■

Reader Service—see page 211

Books for Beginners

—you have to start somewhere!

The Joy of Computing comes home.

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Programming a Microcomputer —6502, Caxton C. Foster, Addison-Wesley Publishing Co., Reading MA 01867, 230 pages, 6" x 9" softcover, $9.95.

The Little Book of BASIC Style, John M. Nevison, Addison-Wesley Publishing Co., Reading MA 01867, 150 pages, 6" x 9" softcover, $5.95.

Although the instruction contained in *Programming a Microcomputer —6502* pertains in a general way to any 6502 machine, it is based specifically on the KIM-1. In fact, for best utilization of this book, a KIM-1 should sit at the reader's fingertips. This would also make an excellent classroom text as long as one or more KIMs were available to the students.

An advertising flyer states that this book is also usable with the PET, but since the PET is hard to program in assembly language as yet, this hinges on Commodore providing more information about how to operate the PET.

One unusual aspect of the book is a complete lack of mention of the 6502 except in the title and in the appendix, which lists op codes and addressing modes. All 6502 attributes are indicated as if they were KIM-1's exclusive features. To quote, ". . . the inventors of the KIM-1 provided a form of addressing that circumvents the problem. It is called 'immediate addressing.'" The inventors of the KIM-1 and the MCS6502 are indeed one and the same, but emphasis should be placed on the fact that we are really talking about the KIM-1.

As the result of a coincidence, I became the happy owner of a KIM two days before I received these books. I am an 8080-Z-80 programmer and the 6502 instruction set was a foreign language to me. From that point of view, I'm a beginner, I guess.

Chapter one is a discussion of how the instruction set is used and chapter two takes you step by step through the operation of the KIM-1. Both are well done, but the true neophyte would do well to go very slowly in chapter one. At one point in chapter two, the author failed to tell the student (me!) to restore the program counter after a STOP and before a GO, which means that the following steps didn't work.

Chapters three to thirteen comprise a group of experiments. A problem is presented and instruction on methods is given. The student then writes a program to gain the desired results and attempts to run it. The author's reasoning and solution to each problem are covered in an appendix. Extensive debugging help is also given.

The experiments included involve a Morse-code oscillator, a piano keyboard, a combination lock, a tune player, a digital clock, and many more. In each case, whatever hardware is needed (very little) is fully explained. The chapters that I found most interesting concerned an interpreter and an assembler for a "Dream Machine." The "Dream Machine" is a pseudo-sixteen-bit processor whose instruction set is interpreted by a KIM program. While the instruction set is limited by the amount of KIM memory available, it is an informative and effective means of examining the operation of any instruction on any processor.

The appendices contain sections on binary math, KIM routines, 6502 op codes and addressing modes, and solutions to the programming problems contained in the text. These solutions are written

in assembly language and the student will have to reduce them to machine code in order to run them.

I would hesitate to recommend this book to the complete novice unless he has access to a KIM-1. However, by combining the information contained in the three manuals that come with the KIM-1 with *Programming a Microcomputer—6502*, I feel that I have become an effective 6502 programmer.

The Little Book of BASIC Style wasn't what I thought it would be. Rather than attempting to teach you how to program in BASIC, it is concerned with writing programs so that they can be more easily read by the user.

Nevison contends that programs that are readable are better programs and that they will run the first time with fewer problems. Twenty rules are presented and woven into a discussion which advocates clear structured programs. Many of these rules make good sense, but some are difficult to put into practice.

Variable spacing within a line to make it easier to read won't work if your BASIC interpreter (like mine) eliminates all excess spaces. Using a blank line to separate blocks of code is also a good idea, but it is another no-no for my BASIC.

The author calls for more comments within the body of a program to make for better understanding. One of his programs contains more lines devoted to remarks than it does operational statements. If you are like most computer hobbyists, you don't have the excess memory that all of those remarks take. I like well-commented programs, but I usually strip off the remarks at entry time. But that doesn't mean that you shouldn't use remarks while writing programs. They will clarify to you and anyone else who uses them what is intended.

Each of the rules is presented with one or more examples. Both good and bad methods are shown side by side so that it is easy to see the advantages of style. Many of the rules, such as matching the variable to its meaning—V = Value, I = interest, etc.—and labeling constants, make very good sense. Have you ever attempted to read a poorly-commented program and tried to figure out what purpose each variable and constant served?

After a discussion of the rules of style, some practical examples are given: sorting, craps, plotting, bar graphs, dealing a deck of cards, and more. And then comes the biggest program of all—STYLIST. STYLIST is designed to style your programs for you. While it is a huge program meant to do a task that the programmer should be doing for himself, it does present itself as an example of how to structure a program correctly.

After studying *The Little Book of BASIC Style*, take one of the better programs that you have written and rewrite it according to Nevison's twenty rules. You'll be surprised at how much more readable it is, and six months from now, you'll still be able to figure out how it works without having to rewrite it again.

Addison-Wesley publishes many other computer titles and their 100-page *Business and Computer Science Catalog* should be in every computerist's library. I have just read an advance flyer on the third volume in *The Joy of Computing* series, *BASIC and the Personal Computer*, and I am looking forward to its publication. ■

The 2 Meter ECM Caper

—James Bond, move over!

Snake-Oil gets shut down.

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The "Conditional," or Class C, license began many years ago when regular licenses were Class A and Class B. Honest in original intent, the Class C license was supposed to encourage ham radio for the handicapped and others who lived more than 75 miles from an examination point and couldn't make the expensive and time-consuming trip to an FCC office. Later, the distance limit became 175 miles. General Class privileges were available to the Conditional Class, which replaced the old Class C. All that was needed was for someone to swear that 13 wpm could be copied and, as for the Technician Class, to "supervise" the mail-order technical exam.

Because the change from 75 to 175 miles was made not too many years ago, a fair number of phony Conditionals exist, many of whom "bought" their licenses for cash or favors from some radio amateur without ethics. Phony Technicians exist, too, but we won't go into that since this is the story of what happened to a certain phony Conditional. Two meter FM seems to attract these people, for some reason which escapes me.

The story is fascinating. I wouldn't believe it if it were told to me. I'll change a few names to protect the guilty. Even so, I'll bet a dime it reminds you of somebody on FM you know.

It all started when my old friend John came over one night to chew the rag about the DX he works and the DX I used to work. John is an electronics engineer at the local electronic countermeasures (ECM) factory, but he gets his kicks out of working DX on CW. Like me, he uses 146.94 to keep in touch with his local ham friends. We were discussing VR6AY on Pitcairn Island when the .94 receiver opened up to interrupt us. There was Snake-Oil, sounding off like an expert to his phony Technician friends. John says, "Let's have some fun," taking my code practice oscillator off the shelf and standing it in front of the microphone. As soon as Snake-Oil stands by, John gives him a one-by-one call on the straight key at a brisk 10 wpm. Snake-Oil comes back, not to John, but to one of his friends, saying "Hey, the band is

really open tonight! Just heard the code ID of the repeater upstate!" John looked at me, reached for my *Callbook* and quickly thumbed through it. Finding Snake-Oil's call, he says, "Just as I thought!" and points to the "C". To prove the point, John broke in again with the CPO, sending only Snake-Oil's call, but three times, at about 5 wpm. No answer. Snake-Oil couldn't even recognize his own call!

As time went on, Snake-Oil more and more incurred the wrath of John and other old-timers by setting up a .34/.94 repeater, but his popularity as the local FM "expert" grew as the number of appliance operators grew. Within about six months, .94 became almost useless for a simplex channel. I told John it was impossible to fight this, but he answered, "Don't you ever watch 'Mission Impossible' on TV?" I thought he was kidding.

As I worked around the shack now, .94 never seemed to shut up. It was alive with talk about the coming Division convention. Snake-Oil was on the program and would demonstrate his FM repeater with its vast satellite receiver system which enabled anyone with a hand-held rice box to use the repeater from anywhere in the county. (Snake-Oil was a really busy fellow.) As I said, there wasn't much simplex activity on .94 anymore, and the old-timer didn't like standing in line to use the repeater while all those rice-box mobiles were telling each other what exit they just passed on the expressway. The local intercom feature of .94 seemed to be giving way to "progress."

One Sunday morning, while driving down a street near Snake-Oil's house, I noticed a cable-TV truck parked by a telephone pole about a block away. I caught a quick glimpse of a guy in coveralls and a hard hat. There was something familiar about the guy, but I couldn't put my finger on it. On the way home that afternoon, I saw the cable-TV truck in another part of town. This time I took a real close look at the guy in coveralls. The bell rang—it was John, but with a mustache??? The next Sunday I saw him again in another part of town. What the hell was going on? John is a well-paid engineer. He wouldn't be moonlighting as a pole jockey for a cable-TV outfit, would he? And, how come on Sunday? Was this a gag?

The more I thought about it, the more curious I got. Finally, I couldn't stand it any longer. I called up John, who had been "too busy" lately to come over to chew the rag about DX, and insisted upon going over to see him that night. John was in his basement, at his workbench, apparently breadboarding a bunch of transistors and ICs. This struck me as strange, too. John wouldn't be doing any homework for his job, as his work was highly classified, and John's ham interest was operating—working DX.

I let him have it with both barrels. We were old enough friends, I told him. He could darn well let me know what was going on, as I had a strong feeling that it had something to do with ham radio.

John swore me to secrecy, and then proceeded to unfold the wildest, most complex scheme imaginable, a scheme designed to completely foul up Snake-Oil's coming Division convention demonstration of his repeater system. Pulling out a drawer of his workbench, John showed me a small collection of plastic pill bottles, each with a very short, stiff wire coming out the top and a longer, flexible wire coming out the bottom. Then John took down from a shelf above his workbench a small black box, also with a short stiff wire on its top. The box had several push-button switches, one of which was labeled, "destruct." This switch had a safety cover which had to be flipped up and held up before the switch could be actuated.

As John explained it, each pillbox was a transponder which would generate white noise, upon command, across the entire 2 meter band. John demonstrated it on his .94 receiver. The noise compensated squelch of the FM receiver would simply cut off the audio in the presence of the white noise, which also covered any signal. Of course, the small size of the transponder made its range very short—hence John's crazy scheme of planting one on top of a convenient telephone pole (so it wouldn't be noticed from the ground) close to each one of Snake-Oil's satellite receivers. This he did by borrowing the cable-TV truck from another friend and using it on Sundays to climb the poles himself. The truck was as common a sight in this county as a telephone company truck.

"What's with the 'destruct' switch?" I asked John, having the distinct feeling that this was no gag either. Obviously, John was utilizing considerable know-how from his job at the ECM factory.

"Well," John replied, "with all these transponders out, sooner or later one would be discovered, and it wouldn't take the FBI long to trace it to me."

At this point, John took one of the miniature transponders and set it up on top of a stick stuck into the ground in the middle of his backyard. "Watch!" John manipulated the buttons on his black box and the transponder went "pooff!" A bright flash, a small wisp of white smoke, and the transponder was gone! John said, "Don't worry, I've got plenty more of them!"

"What happened?" I asked.

"Thermite," John answered. "A small amount, in the bottom of each pill bottle."

I went home shaking my head. This whole crazy scheme (were all ECM engineers this crazy?) seemed to be an awful lot of trouble just to foul up Snake-Oil. I could think of lots of ways to foul him up, more simple ways, but they all involved long jail sentences for the violence required.

Two days before the convention, John called me up and told me that all was ready. All the transponders were planted, one near every one of Snake-Oil's satellite receivers, all over the county. The black box was mounted in John's car, ready for the operation and then the "destruct" trips around the county.

The night before the convention, John called me up excitedly. "Guess what?" he asked, immediately answering the question himself. "Snake-Oil got called in by the FCC for reexamination, and he flunked not only the 13 wpm test, but the 5 wpm test as well, so they lifted his license!"

What a let-down! All I could think of was the tremendous wasted effort John had put into this crazy jamming project. That night, on the ten o'clock news, it was reported that police switchboards all over the county had earlier lit up with a rash of phone calls, each reporting a mysterious flash of light in the sky. ■

"I Love My Ten-Tec!"

—a look at the 540/544

It's tough to argue with pulpit praise.

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For the past six and a half years, my hamming had become less and less enthusiastic. My reliable Swan 350 wasn't at fault. The level of activity on my favorite bands had increased, not diminished; that wasn't it either. There is just no way to know why our interests rise and fall. But then, something did happen. One morning, on one of my few remaining skeds, a good friend commented on the fact that tubes were becoming scarce. RCA had gone out of manufacturing tubes and others were soon to follow. What would replace them? Transistors, of course.

That did it. My mind went into a "red alert" condition, and I began reading and rereading all the ads and specs of solid-state rigs. True enough, there were more and more solid-state transceivers for the HF bands. Heathkit's SB-104A and the Atlas 180 had given way to the 350XL, and the little 210X and 215X seven-pound delights were right there in the Atlas lineup. A strange new company had come out of nowhere, and they were producing something called a Triton IV (now termed the 540 or 544) which sounded good. Ten-Tec was its name. A quick overview of the situation reminded me of what I had forgotten. These were the people that came out with the little modules and finally the QRP rig, the Argonaut with 5 Watts input. That did it. Over to the local radio emporium I went. What a display. There they were—the Kenwood TS-520S and the TS-820S, the Yaesu models, the Atlas, the ever-changeless Drake line, and the Ten-Tec 540. One by one, I listened to them all, but one was a standout: the Ten-Tec 540. Words fail me. It was like listening to pocket radios before walking into a high fidelity store for a demo. The receiver on the 540 was fantastic!

But, when I listened around the band, all I heard were TS-520s. What could I do? I took the plunge and bought a Ten-Tec 540, the CW filter, and the ac power supply. My ham life hasn't been the same since. My ham activity has skyrocketed.

It's been about 16 months since I first put the 540 on the air. The first thing I noticed was the absence of warm-up. Press the button and the machine speaks. The single-conversion receiver has a bandwidth of 2.7 kHz, which gives none of the squeezed audio that is often apparent with narrow designs. One overlooked factor comes in the audio distortion spec. Every receiver on the market has a 10% distortion allowance, but not the 540. It has 2%, or 1/5, the amount of unpleasant noise to listen to along with the signal. That makes a big difference when you are on the air for over an hour or so. The 540 has a little 2" speaker located in the center of the bottom of the unit that outperforms two separate outboard speakers that I've tried so far. The receiver and the transmitter are not tied together as they are in most of the transceivers on the market. Peaking up or detuning the receiver doesn't affect the transmitter at all. Using the remote vfo doesn't automatically mean that the further you go from the transmit frequency, the more your receiver is off resonance! That's quite a remarkable feature of broadband design, especially if you are a DXer. Stable? You bet. 10 Hz allowed by the specs per hour hardly makes it worth mentioning. The sensitivity is really closer to .2 μV instead of the .3 that is advertised.

The standard for most units is .5 μV. The receiver is quiet. The absence of the ac supply from the unit and the lack of tubes all make a contribution here.

The transmitter does as well as the Swan 350 with its 400 Watts input. The Ten-Tec 540/544 has 200 Watts input on all bands and all modes including CW and RTTY. Output is about 100 to 110 Watts. I have had many, many QSOs on crowded bands that have lasted 45 minutes to an hour with the Ten-Tec. The reports all indicate good audio and a lot of punch to the SSB signal.

It really does get out smoothly and superbly. I did buy a DenTron Super-Tuner to match the 540 to my old inverted-vee dipole. The swr bridge is built right into the 540/544 so that, in the transmit mode, you can monitor swr without an external meter. I just reach over and touch up the knobs on the tuner while I'm transmitting if I change frequency very much. This past year, I worked Sweepstakes for the first time. What fun! I'd just go from one end of 40 meters to the other, hitting all the strong signals instead of sitting in one place with a kilowatt. The sprightly rig and that broadbanded design made it work. Many folks don't like contests and don't move around the band that much, but I do and it's nice to have the capability.

The features of the Ten-Tec are well chosen, making it the most versatile rig I've ever come across. Take the 25-kHz calibrator. It's pulsed so you can distinguish it from a carrier. WWV is obtainable on both 10 and 15 MHz. It's the only rig I know of that has that capability on two frequencies. For the CW man, there is a $25 filter for 150 Hz—that's right, a two-position filter. I tried another well-known outboard CW filter, and it didn't surpass this little wonder. The full break-in keying for CW is like having your sinus cavities open . . . wide! One fellow 540 owner told me that he thought his transmitter wasn't working until the station came back to him. You can listen to the band in between the dits on the number 5. There's more for the CW addict. The sidetone not only has adjustable volume, but there is also an adjustment for the tone over a full octave to beat off the wearies of listening to the same tone. Both adjustments are made through a hole in the bottom of the unit that doesn't require moving the unit.

If you work round tables, you know how vexing it is to wander around from one station to another, so the Ten-Tec people have incorporated an offset tuning control on the front panel . . . with a little LED to let you know when it's working. It has an effective noise blanker for any kind of impulse noise for an additional $29.

The back of the radio has all kinds of switches and plug-in possibilities. All of the plugs are available for phone patches, linear amplifiers, external receivers, external speakers, foot switches to activate the mike, and a plug to take the remote vfo or 160 meter converter.

The alc is adjustable on the front panel so you can reduce the power input to 75 Watts if you are on emergency power. The 540/544 is essentially a 12-pound dc-powered unit drawing 15 Amps on peaks, so it can function well on a 12-volt battery stuck in a corner of the shack for emergencies. Naturally, that 12 lbs. goes a long way toward making it an ideal mobile station. The dimensions are a bit larger than the Atlas 210X, but not nearly as great as many of the hybrid (tube-transistor) rigs on the market.

What about protection? Well, the radio is designed to shut down if you forget to put the antenna on or if the swr is too high. It doesn't blow a fuse; it just quits playing. That has gone a long way toward keeping the transistors in the final from requiring replacement. The factory said that they have only replaced 6 transistors so far in the thousands of units on the air around the world.

The service of the Ten-Tec people is outstanding. I started off with a used Triton IV, and, soon after I purchased it, the antenna relay stuck and I had to key the mike to get it to go back into receive. It wasn't a big problem, but it was annoying. I called the factory, and they shipped me a little circuit board via UPS that took 3 days to arrive. I sent the old one back. Even though the unit was way out of warranty, they made that swap at no expense to me. There are ten circuit boards in the unit that are all field replaceable. The rig is sure easy to service. There are no high voltages to induce a healthy fear in the amateur. The layout is clean, neat, and simple to get at. The manual is a joy to read. Every circuit board is clearly described and defined.

The Ten-Tec 540/544 is one of the finest, most versatile HF rigs I've ever seen and easily the best radio that has ever graced my ham shack. Over the months that I've been on the air with it, I've listened to many other amateurs operating this particular piece of equipment. They have experienced the same service that I've experienced from the factory, and they are uniformly delighted with their good fortune.■

A $5 Phone Patch

—the darn thing really works

If you think you've seen everything in phone patches, check out this one's price tag.

Lewis Tarnopol WA6RJK
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After reading Mr. Johnson's home brew phone patch article (D.H. Johnson, "Phone Patch Tips," *73 Magazine*, July, 1977, p. 138), I thought I might throw my hat in the ring, too. I built this phone patch into an old desk model extension phone several months back and it has worked great from day one. In building it, I discovered some very useful hints I'd like to pass along.

Before building or buying a phone patch, I had a few basic criteria to meet. First it had to be cheap! Also, I didn't want VOX—it costs more and its features appealed to me less. With VOX, the beginnings of sentences sometimes tend to be clipped off. Being picky, I preferred the more natural sounding voice. Since I had to monitor the QSO and add 10-minute IDs anyway, I opted for manual control of transmission and receive. Installation of a small SPST switch to control my Drake T-4XC push-to-talk (transmit relay) circuit would allow the person on the phone to talk without receiver noise being present. Any transceiver or transmitter/receiver combo should be able to accept this simple switch, allowing hassle-free communication.

Once the decision had been made, I went to work drawing on paper what I needed and then scrounging in my junk box for the parts. Being a recording engineer, I found one small low-to-high impedance transformer, some audio cable, and all the plugs and jacks (audio-type) I needed. A quick trip to the neighborhood electronics shop took care of the rest.

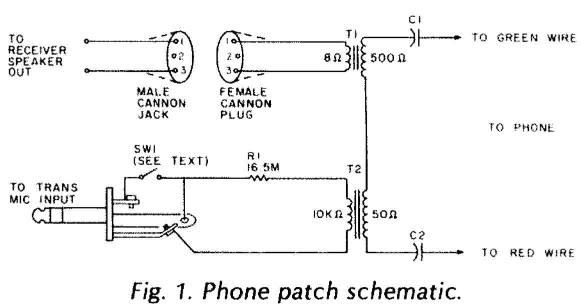

Fig. 1. Phone patch schematic.

Construction

The phone patch schematic is shown in Fig. 1. The phone line impedance is about 600 Ohms. It makes sense to match that impedance as closely as you can because doing so will yield excellent fidelity from the phone mouthpiece. Since I had one transformer with a low impedance side of 50 Ohms, I connected, in series with it, another transformer with a 500-Ohm side. Figuring 550 Ohms to be close enough, I let it go at that. Then I connected up one capacitor in series with each "hot leg" of the phone. This gave me isolation from any dc. I found that 3 uF was a good choice for fidelity reasons. This side of the circuit was then permanently connected to the phone inside the phone cover. I'd like to add that there have been no problems with this permanent arrangement and one could easily put in a switch to disconnect it if desired.

The other side of each transformer was hooked up to its respective device. The high-impedance (10k) leads went to the mic input of the transmitter and the low-impedance (8-Ohm) side went to the speaker output of the receiver. For the speaker, I ran speaker cable connected in parallel to the speaker output of the receiver, soldered on a male Cannon connector, mounted it in a small metal box I had handy, and attached it to the front of my ham desk. It's very accessible. I then soldered a female Cannon plug with about 3 feet of wire to the 8-Ohm side of the transformer. Thus, whenever I want the receiver audio in my phone, I simply plug the Cannons together. I made a plug which, when inserted in the mic jack of my Drake, connects together both the audio wires from the transformer and the two wires leading from my trans/receive (PTT) switch mounted in the phone cover. (For Drake, PTT amounts to shorting out ground and ring on the plug for transmit. I presume most ham PTT functions can be switched in and out similarly.) Cable for the mic section of the phone was good shielded cable. Its use prevented any possible hum from entering during transmission. I recommend always using shielded cable for high-impedance applications in audio.

Originally, the 16.5-megohm resistor (made from a 10-megohm and a 6.5-megohm in series) wasn't part of my plan. Without it, however, I cleverly discovered the phone mouthpiece would *clip* the input of the transmitter. Turning down the transmit gain didn't stop the distortion. Instead, I made the phone yield the same output voltage characteristics as my Shure 444. By inserting the resistor, I had *no* distortion and excellent voice quality. Hooray for carbon mics!

Results

The very first day I assembled my phone patch I had the opportunity to use it. There was a ham in Iowa who wanted to patch into Glendale, California. I answered his CQ Glendale, and he explained he wanted to talk to a sick friend who had almost died from illness a week earlier. I made the patch without hesitation. When the call was done, I received many compliments from both sides, thanking me for helping out. I felt extremely good to have participated in what was a very happy occasion for all.

I later made some on-the-air tests for voice quality. Nothing but compliments came from all those who heard me testing. Many times people couldn't tell the difference between my phone and my Shure! Having the ability to hook up my receiver to my phone (without the transmitter) is nice, too. When I hear something interesting, I call up a friend, plug my phone into my receiver, and we both listen. I might add that I find the transmit switch arrangement very convenient. All communications are done with the phone handset. Since my transmit switch is mounted on the phone, my left hand holds the handset, and my right hand switches the trans/receive switch. Those of you inclined to mount the switch in the handset could pull off one-handed operation. Or, how about a footswitch?

The only change I've made was to add an on/off switch for my receiver. Now I can adjust the receiver gain in the phone to any level without the distraction of an outside speaker blaring away. Since then, I've been quite happy with my home brew phone patch. All in all, I spent less than five dollars. That's what I call cheap! ■

Underside view of phone with patch inside. The wire coming out of the uppermost part plugs into the Drake's mic input. The lower wire plugs into the Cannon box below the electrical outlet (bottom of picture). The PTT switch is centered in the bottom of the front of the phone.

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Warner Robins GA 31093

The Filcher Foiler Revisited

—vehicular protection

The best news for hot rods since the green light.

After reading Mr. Helvey's article ("Filcher Foiler Car Alarm," *73 Magazine*, Dec., 1977), I decided that it was just what I needed to protect my old Ford hot rod with its chrome-plated engine, dual quads, custom gauges, etc. Being a middle-aged hot-rodder in a neighborhood full of fifteen-year-olds will almost always ensure a good-sized audience for my car projects. This day was no exception.

The first thing I did was purchase all the required parts, including the door switches. Upon completion of one door jamb, I overheard a supportive ten-year-old telling his older brother in no uncertain terms that, no, Mr. Davis wasn't crazy, and, yes, it was undoubtedly going to be faster with dual light switches! After pretending (?) to go berserk and chasing all the youngsters away, I went inside to reread the article and see just why I was installing another set of door switches.

The very first thing I discovered, which was incidental to my quest, was that the relay as shown is not in a true latching-type configuration. The next thing I discovered is that most vans don't have door switches for the courtesy lights already installed. Hence Mr. Helvey's installation. Well, the Bondo job on the doorpost wasn't too difficult and neither is the new alarm system outlined here.

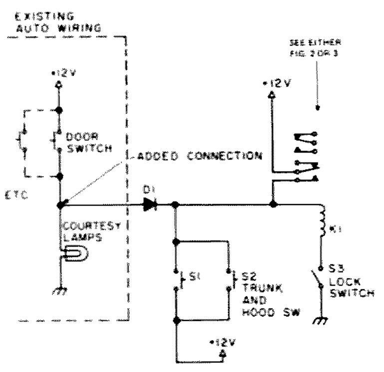

Fig. 1.

My hot rod and my Mustang were both wired the same, insofar as the courtesy lamps use switched 12 volts from the door switch while the other side of the lamp is grounded. Car manufacturers, however, being what they are, have probably made cars where the lamp is at 12 volts on one side and uses a switched ground on the other side. If your car falls in the latter category, simply reverse the grounds and 12-volt sources on the large schematic (not the two smaller alarm schematics), and reverse the polarity of diode D1. I have made provision in my system for hood and trunk switches; however, any number of extra switches may be used.

Isolation diode D1 has been included to prevent the courtesy lights from coming on when the trunk or hood switch is closed. The size of this diode is not very critical, but it should be at least 25 V piv and have a current rating capable of handling the relay coil. Notice the configuration of the latching circuit for relay K1. This corrected design ensures that the relay will latch by positively holding the relay closed for as long as a switch is closed, which will be more than long enough for the armature to contact its latching contact. Mr. Helvey's problem with the relay buzzing rather than latching is not due to a defective relay, but rather to trying to have the relay do something it wasn't designed to do.

Two different methods of activating an alarm device are shown in my schematic: 1) using the existing car horns, where the

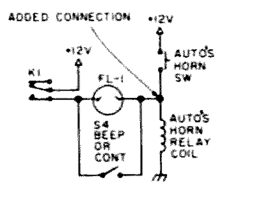

Fig. 2. For use with existing car horns with horn relay.

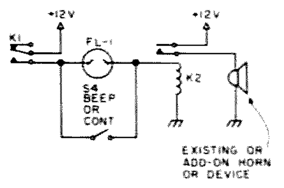

Fig. 3. For use with existing horns without horn relay or to use sirens, bells, or add-on horn.

horns are operated from a horn relay in the car, and 2) using the existing car horns where there is no horn relay (as in the case of most mid-60s Ford products) or for using a siren, bell, add-on horn, etc. Both above circuits are shown with a heavy-duty automotive flasher installed to provide a beeping alarm, rather than a continuous tone. A switch (S4) is included to change from beeping to continuous tone. If not desired, this feature may of course be deleted entirely, thereby eliminating S4, the flasher, and relay K2 from the circuit. K2 is required only because the large current drain of the horns will not permit the flasher to operate properly and will burn out the flasher very quickly.

One last note: Use only a 12-volt source capable of supplying high current (cigarette lighter, battery terminal, etc.), and use a heavy-gauge wire for all wiring. This will prevent an electrical fire, which in a car is very dangerous■

Parts List

D1	50 V 3 A silicon rectifier (Radio Shack 276-1141)	$ .69
FL1	Tung Sol 552 heavy-duty flasher (Auto Parts Store)	2.50
K1, K2	DPDT 12 V relay 10 A contacts minimum (275-208)	4.99; 9.98
S1, S2	Contact switch (for trunk and hood) (275-513)	1.49; 2.98
S3	SPST locking switch and key (275-511)	7.95
S4	SPST toggle switch (mode selection) (275-701)	.99

Lee Reed W4RBL
1406 Railton Street
Memphis TN 38111

Build An Economy Zener Checker

—versatile test rig

Why not do it right?

The device shown in Fig. 1 was developed to check zener diodes but it has also been found useful for other purposes.

With no load across the alligator clips, the panel meter will read about 50 volts. With a *silicon* rectifier across the clips, the meter will still read 50 volts for one position of the switch but only .6 volt for the other position. Note that the switch is cross-connected to provide voltage reversal across the diode.

When the alligator clips are connected to a *zener* diode, the meter will read .6 volt for one position of the switch, but for the other position it will read the rated zener voltage up to a maximum of 50 volts.

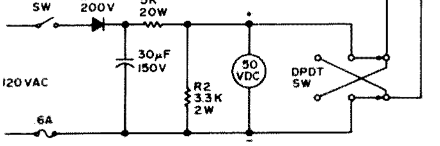

Fig. 1. Zener checker schematic diagram.

A third use is to check the total forward voltage across a string of series-connected rectifiers without applying power. This would be about .6 volt per rectifier. This check could not be made with most VOMs because their ohmmeter source voltage is not high enough.

This device *should not* be used to check *germanium* diodes unless the supply voltage is reduced. This can be done by forward biasing a silicon rectifier to obtain a .6-volt source. Then the germanium can be connected across the .6-volt source in both forward and reverse directions to see if the meter reading will drop to .2 volt in the conducting direction.

A 50-volt panel meter is probably optimum for this checker. However, other voltages could be used if the values of R1 and R2 are changed■

Loren Carlberg WB5WDG
2423 Canterbury
Muskogee OK 74401

Alaskan Adventure
—stalking the elusive KL7

If you crank up your perseverance, you can WAS.

Yep, I got Alaska! After a solid year of frustration, anxiety, and keen disappointment, I finally corralled a KL7 station.

I believe *Reader's Digest* said that Alaska has something like thirty-seven million acres of land, and the *Callbook* shows something like fifteen hundred amateur radio stations having KL7 calls . . . so it looks like getting Alaska would be about as hard as hitting Texas with a seven and a half gallon hat.

Well, believe me, it ain't! The first thing I did was set up a sked with a station at the North Pole. I had already worked Hawaii and Australia, plus a few other DX points of interest, so, with a sked, things would be easy and I could spend more time on Delaware and the Dakotas. But the sked just didn't come off as expected . . . three times each week KL7IUM and I would toss CQs back and forth at each other, but none of them made connections in a faithful six months of effort. One by one, the other states came dropping in until I was down to Delaware and Alaska . . . and try as I would, I just couldn't find the range.

A funny thing happened on the way to WAS, however . . . I was glued to the CW bands, and one day I heard a CQ that ended: "CQ, CQ, CQ de LA WARE!" I went back to him, not being sure where LA was, nor what country had calls without numbers. The *Callbook* said that LA was Norway, but they had a number after the "LA" . . . so I assumed I had read 3 into a W . . . missing a few dits in the translation. Could happen! So I called and called . . . no reply. Then I told my friend WB5WDD about it, and he said he had heard the same station but couldn't get it to come back. We agreed it was Norway . . . and let it go at that. Finally I landed a Delaware station, and it was then and only then that I realized the CQ I heard was FOR Delaware and not FROM Norway. It could happen to anyone!

But, after concentration on Alaska, I began to hear a few KL7 stations . . . one of them coming in quite clearly on a Sunday afternoon. He called CQ South America, so I waited through several of his calls until finally I assumed he would not get his desired station. Then I called him and anxiously awaited his return call. It came like this: "Can't you hear? I am calling South America!" So there was lesson number XX on CQ courtesy . . . but I kept listening and dialing. One evening I heard a truck driver, mobile in California, rag chewing with a strong KL7 station . . . so I waited . . . and waited . . . and waited . . . not daring to holler "break" after the previous experience. They gabbed a good half hour, and the truck driver, who evidently had not read the book on ham courtesy, either, closed by saying, "I have a buddy tuned in on us now that would like to have a word with you . . . so I'll be . . . etc., etc." And the buddy took over until the band closed! Well, it was important . . . the buddy was trying out a new rig, and he wanted the opinion of this stranger in Fairbanks on whether he should buy the rig or not!

Finally, in desperation, I decided that the next KL7 I heard would either pitch me out on my ear . . . or QSL! And then it came . . . again, a strong station in KL7-land hooked up with a California ham . . . and I sat through the usual routine of statistics before timidly shouting "break" plus other pertinent data that I thought would get

me through. There was a short silence and KL7 said, "I believe we had a breaker . . . come on in, breaker!"

Here was the chance I had been so long waiting for . . . and behold, my voice almost failed me! Finally I got it out: "KL7ABC, this is WB5WDG, Muskogee, Oklahoma. Do you copy?"

There was an exciting few seconds of dead silence, and then California said, "I believe he is calling you, KL7."

Then KL7 said, "No, I think he was calling you." and with that, they went back to their aforementioned QSO and never paid me another bit of attention. I snapped off the rig, snapped at my XYL, and told her where they could put Alaska if Russia ever wanted her back . . . and went to bed, only to roll and toss and count caribou, grizzlies, fjords, and permafrost.

But the final blow came a couple weeks ago when KL7 came in quite clearly, slowly, and with a hesitating dahdididahdit followed by SA . . . so, naturally, I assumed that this was a Novice newly upgraded who was trying out his new wings. I went back to him in fear and trembling, hoping that this was it. And it was . . . he heard me and came back loud and clear. A real live KL7 . . . and he was answering my call . . . at last, the big hunt was over. I was so excited that I almost missed his QTH when he gave it as Ft. Bragg, North Carolina. He had been transferred from a military base in Alaska and was still using his KL7 call . . . the SA I had heard after the dahdididahdit was not an SA at all, but a four. Your ears hear what you want them to hear.

But enough of that stuff . . . quitting never gets it . . . and I just didn't quit. Quite by accident, I heard a QSO that ended identifying itself as having a treasured Alaska station as one of the participants. Again I waited patiently until it ended, and I swung in behind the finale with my call. Believe it or not, the KL7 answered.

At last, my luck had changed and I was ready to apply for my WAS award. His signal was strong . . . his fist was great . . . and everything was deathly quiet. He acknowledged my call, gave me his name, and then started with his QTH—just as a 4-land station with a million-Watt linear started his big CQ, almost knocking my cans from my ears. I ditted a few thousand times and he stopped just as the lad in Anchorage was telling me that he had to get to work, but would answer my QSL as soon as he got it. And that ended that . . . thanks to the million-Watter in orange country.

Only this time I was ready. This had happened to me before . . . many times . . . so I was prepared. While I was listening to the KL7 QSO, I was copying his data as he sent it to the former recipient . . . and even though Florida knocked the orange juice out of my coax, I was ready with the proper address and now have my QSL merrily on its way to Anchorage with an SASE enclosed!

Why didn't I refer to the *Callbook*? Well, this lad had already said that he was too new to be in the latest edition of the *Callbook* and he had to get his QSLs in care of his dad, who was in the book! Practice may not make perfect . . . but it helps. ■

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The Last DXpedition

—"QTH hr is Purgatory"

What the devil is going on here?

This old-timer was one-in-a-million, with a personal history dedicated to amateur radio. He was the envy of operators the world over. He held more certificates than the average ham ever knew existed, was winner of numerous contests and citations from all over the world for amateur radio services above and far beyond the call of duty, and was designer and builder of practically every type of radio equipment from the spark-gap days on up. This old-timer had just expressed his last "73" along with his final "dah-dit-dah." In simple words, he died.

He awakened, feeling no pain, and discovered he was lying on a very comfortable, elaborate bed, in a gorgeous room which was permeated by the faint odor of burning sulphur. "Oh, brother," sighed the old-timer, "I knew this would happen to me. I should have been more careful to always stay within the legal bands. I knew I was wrong in using that 'California Kilowatt' so often, and I should not have worked those guys with the HS, XU, XV, 3W8, and 8F calls. Yes, I'm confined to eternal damnation!"

"Just a minute there, my friend. Don't be upset about what happened to you." Jumping from his bed, the old-timer found himself face-to-face with a man who was reddish of face and the epitome of sartorial splendor in his superbly tailored suit, bright red socks, and foot-long cigar. The old-timer could plainly see the horn-like protrusions, all polished and gleaming, near the top of the man's head, and even the shadow of a tail extended from his rear. "Allow me to introduce myself. I am lovingly called Satan by my many admirers and I welcome you to Purgatory. Now, don't get yourself all uptight about things you heard concerning me and my home from those narrow-minded people up there where you used to live. I've been given a bad press all my life, and I honestly don't feel I deserve such humiliating treatment. They don't like me up there for some reason, and they sure paint a black picture of Hell. Now, don't misunderstand me—it's Hell down here alright, but we still have plenty going for us, as you'll soon discover. Here, have a glass of 20-year-old bourbon, a fine cigar, and pull up a chair. Tell me all about yourself, you lucky man!"

Before the old-timer had time to collect his thoughts, Satan started in again. "Look, pal, I'm going to try to make you like it down here. Sure it's Hell, but just for openers, tell me what you like the best. Do you want a dozen or so beautiful, sexy gals—or maybe you'd like to become a millionaire? Is it just hunting, fishing, and yachting you like? Tell me what 'turns you on' and it's yours, absolutely free of charge, with no strings attached."

"Well, Mr. Satan," replied the old-timer, "up there I was one hell, oh, pardon me, of a ham radio operator, and I thought just maybe you'd have . . . "

"A ham radio operator!" screamed Satan. "Why the hell didn't you say so in the first place! Quickly, come with me." Satan then rushed the old-timer outside to a warehouse, unlocked the door, and said, "We'll start with your tower. Here's a nice medium height one of about 500 feet, OK?"

"Wow!" yelled the old-timer. "These are built better than the commercial towers up there. You sure there's no catch to this?"

"Aw, come on, pal," replied Satan. "Would I fool you when you're going to be my guest for quite some time? Why shouldn't I try to please you with the best of everything just to make you happy? Sure, it's Hell down here, as I said before, but we still have much more to offer a nice guy like you. Now, let's get some antennas up. How's this—a simple Christmas tree of rotary beams, simple 10-element beams for every band? I'll have them erected immediately."

"Yes, but what am I going to do for a transmitter and receiver?" queried the skeptical old-timer.

"Never fear, friend, Satan is here. Take a look and pick up any of these." Here was a room filled with every late model transmitter and receiver, all in sealed cartons. The old-timer was dumbfounded, as he had never owned any equipment that wasn't "home brewed."

"Wait a minute, friend," said Satan. "Pick up a good linear while you are at it. And by the way," he whispered, edging over to the old-timer, "how about one of my special 'Satanic Kilowatts' that makes those 'California Kilowatts' up there sound like peanut whistles? Here's a great new 10 kW job.

"Sure, this is Hell, but answer me truthfully, did anyone up there ever offer a nice guy like you so much for free with absolutely no strings attached?"

The old-timer was absolutely at a loss for words. Having scrounged all his life for every dime to buy used parts to build anything he ever operated, he never dreamed he would be so fortunate as to have such magnificent appliances to operate for all eternity. "Let's get this set up!" yelled the old-timer. "I just can't wait to get on the air!"

"Certainly," said Satan. With a wave of his smoking hand, there was a loud clap of thunder and a puff of sulphur-ridden smoke, and the old-timer found himself in a shack fit for a king, with everything properly set up.

"Great, great, absolutely beyond belief!" cried the old-timer. I just don't know how to thank you enough. I'm going on the air to tell everybody up there the true story of you and your kindness, Mr. Satan. I'll tell them the absolute truth about the goodies you have to offer everyone. By the way, where do I plug in this magnificent equipment?"

"Well, my friend," replied Satan as he hastily headed for the door, "that's the hell of it—we have no electricity!"■

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An Audio Morse Memory

—got a tape recorder?

Listen to your own fist—and learn.

The tape recorder decoder (Fig. 1) can be very useful and is easy to duplicate. It converts an audio signal to dc to key a relay. Code can be recorded on a tape recorder, then played back through the decoder, thus keying a transmitter, monitor, or both. Works just dandy for a "CQ" tape or a "CQ field day" tape. CW can also be recorded from a receiver and then played back to key your transmitter, letting a fellow amateur hear his own fist! A delayed test-transmission with a timer can also be arranged, allowing you to check signal quality from a friend's shack.

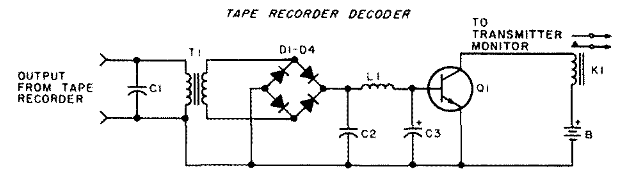

Fig. 1. Tape recorder decoder schematic diagram.

Parts List for Tape Recorder Decoder

Q1—For maximum sensitivity, a high-gain transistor such as a 2N447A (gain of 200) should be used. But any transistor of reasonable gain is OK (2N338, 2N3641, 2N3843, etc.). A PNP transistor can be used as easily by reversing the polarity at the battery and C3 (2N1307, 2N404, 2N408, 2N1025 with a gain of 100).

C1—.001 to .005 uF rf bypass.

C2—.1 to .25 uF disc ceramic, mylar, or electrolytic (6 V).

L1 — .5 H choke. A toroid is best because of its small size and low losses. The value is not critical and can be replaced with a 68- to 100-Ohm resistor, though performance is degraded slightly when demodulating low frequencies.

C3—1 uF to 2 uF, 3 V electrolytic.

T1—miniature transistor audio output transformer with primary of 8 Ohms (to match tape recorder output) and a secondary of 500 to 1000 Ohms.

D1-D4—1N34 or equivalent. Just about any small-signal, germanium diode will work.

K1—reed relay with 3- to 6-volt coil. A 10-Watt reed relay with coil can be bought at Lafayette Radio, or a range of relays, with and without coils, can be obtained at suppliers.

B—battery, 3 to 6 V.

None of the part values are critical. The volume control setting on playback and record will have to be adjusted to obtain the best results. Playback volume should be as low as possible to prevent background noise from causing odd clicks, or overloading from causing mushy characters.■

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The Amazing Active Attenuator

—can you find a use for it?

The op amp is the answer.

I'm sure, by now, you have heard of many uses for op amps. But did you know that they can be used as attenuators? For some uses, they are better than attenuators consisting of only resistors. While the principle is very simple, I have not seen much mention of it in the various electronic magazines.

In an inverting op amp amplifier, as shown in Fig. 1, the gain can be varied from the open loop gain down to a gain of one. This gain is determined by the equation R_f/R_{in}, where R_f is the resistor from the output to the input and R_{in} is the resistor from the driving source to the input of the op amp (Fig. 1). Now, what happens if R_{in} becomes greater than R_f? To save you the trouble of running this experiment, the answer is that there is a loss from input to output and the circuit becomes what I call an active attenuator.

There are, unfortunately, some disadvantages to this attenuator. The first problem is that an active component, along with its associated power supply, is required. Also, frequency response is restricted to the bandwidth of this active component. Next, you must remember that this circuit inverts, so if you are using it for dc, you will get a negative voltage out if you feed in a positive voltage and vice versa.

Now, for the advantages. The output of this active attenuator, as in any op amp amplifier, is a low impedance (independent of resistor values). This means that any loading (within reason) of the output will not change the output voltage. Also, it is great for driving long, unshielded wires without the worry of hum. Also, although I am not yet sure what it is useful for, you can use this circuit as a summing attenuator. This is done by using different input resistors for each input desired. Fig. 2 gives the details.

Here are a few things to watch out for: First, the amplifier configuration must be inverting because a non-inverting op amp amplifier has a minimum gain of one no matter what. Second, the input impedance is equal to R_{in}. So, when calculating the resistor values, choose R_{in} first, so that it is equal to the desired input impedance. Then choose R_f for the desired attenuation. Using this procedure, the resistor equation can be rearranged as $R_f = R_{in} \div$ desired attenuation. Also, make sure that the op amp is still useful at the desired frequency of operation. One thing that I am interested in knowing is what happens to the open-loop frequency response when the circuit is used as an attenuator. I know that as the gain of an op amp increases, the frequency response drops, so with an active attenuator, does the frequency response increase?

Well, I hope that you can put this information to use. I have not given too many details because most of the information required can be found in many magazine articles and books dealing with using op amps. I have found the *IC Op-Amp Cookbook* by Walter G. Jung (Howard W. Sams & Co.) especially useful. If you come up with some new data or uses for the active attenuator, please let me know about it. If nothing else, you can use this circuit as an answer to those people who go around talking about "passive amplifiers and active attenuators." ■

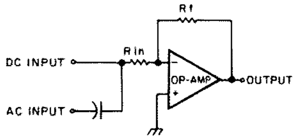

Fig. 1. Circuit for the active attenuator. $V_{out} = (R_f/R_{in})V_{in}$ and $R_{in} = R_f \times$ desired attenuation.

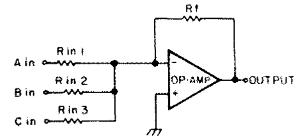

Fig. 2. Circuit for summing attenuator. Attenuation of $A_{in} = R_f/R_{in}1$, $B_{in} = R_f/R_{in}2$, and $C_{in} = R_f/R_{in}3$.

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La Mesa CA 92041

A Single IC Time Machine

—amazing clock

You name it—this does it.

Both clocks set up and operating. The small clock is on GMT, the other on local time. The radio is connected to the alarm output of the larger clock.

How would you like an electronic clock with options from the following assortment of features?

Single-chip operation
Fluorescent direct drive
Simple forward or reverse time setting
4-digit nonmultiplexed display
Am/pm and 1 Hz activity indicator
50 or 60 Hz timebase operation
Three-function wake select (radio tone, radio, followed by tone in 8 minutes)
Count inhibit
Power-up clear
Leading zero suppression for tens of hours
Month-date or date-month format
A second alarm time
LED direct drive (10 mA/segment)
Low-voltage standby allows 9-volt battery backup
Intensity control
Slow-up circuitry eliminates RFI
12- or 24-hour display format
24-hour alarm
Variable sleep (1 to 59 minutes)
Seconds display

INSTRUCTIONS

1. To adjust, remove a screw on each side and remove the cover. As viewed from the rear, left to right, there are 6 switches as follows:

#1 (Red toggle)	Set hours/month
#2 (Green toggle)	Set minutes/day
#3 Slide switch	Inhibit/run
#4 Slide switch	Spare
#5 Slide switch	Alarm select—UP alarm #2, DOWN alarm #1
#6 Slide switch	Display format—UP 24 hours, DOWN 12 hours

Note: In 12-hour mode, pm is indicated when 3 bars appear In the first digit position.

2. On initial light-off, all time functions will read 0:00, colon on or off, date will indicate 12 31, and seconds 00. To start the clock, momentarily place switch #2 (green toggle) in the advance position; seconds will start counting and the colon will flash. (Minutes may be set at this time if desired.)

3. To synchronize (to WWV or a time-tick), place switch #3 in its up position, stopping the clock as indicated by the absence of a colon and 00 seconds. At the instant of the "00 seconds" pulse from WWV or other time source, depress switch #3, restarting the clock.

Note: Step #2 must be performed first, after initial light-off.

4. Place function switch on LOCAL and set time:
   (a) To set hours, use switch #1 (red toggle)—UP advances; DOWN decrements; and MID-POSITION is the normal run position.
   (b) To set minutes, use switch #2 (green toggle) as in (a) above.

5. Place function switch on zone, alarm 1, or alarm 2, and set the desired time as in step 4(a) and (b). Repeat for each desired function.

6. Place function switch on DATE and set the desired date, using the #1 toggle for month and #2 toggle for the day.

Note: After the seconds have been initially synchronized, any and all times (and/or dates) may be changed at will. No further synchronization is required unless the timebase is gaining or losing time—or the clock is accidentally stopped when changing power sources.

7. To use the alarm(s), select the desired alarm with switch #5, and then place the front panel alarm switch to ON. When the alarm energizes, it may be stopped for 10 minutes by pressing SNOOZE, or by momentarily turning off the alarm switch. (A momentary turn-off rearms the alarm to energize at the designated time 24 hours later.)

Notes: SNOOZE inhibits the alarm for 10 minutes from the time it is pressed (not from the time entered), e.g., if the alarm is set for 06:00 and is "snoozed" at 06:03, it re-energizes at 06:13. This may be repeated indefinitely and makes the feature amenable for use as a 10-minute timer during long-winded QSOs. Also, if the display is blanked, the alarm feature will activate but will not sound off until the display is unblanked, if done within 1 hour of the time set. (Unless the snooze button is pressed, the alarm operates for an hour and then resets itself should the alarm circuit be on but the clock unattended.)

8. On the right side of the front panel are two slide switches which control the illumination level of the LEDs. The first blanks or unblanks the display; in the blank position, the alarm output is also made inoperative (see step 7, above). The second (outboard) switch controls the display illumination level: HI for daytime viewing and LO for nighttime viewing.

OPERATION

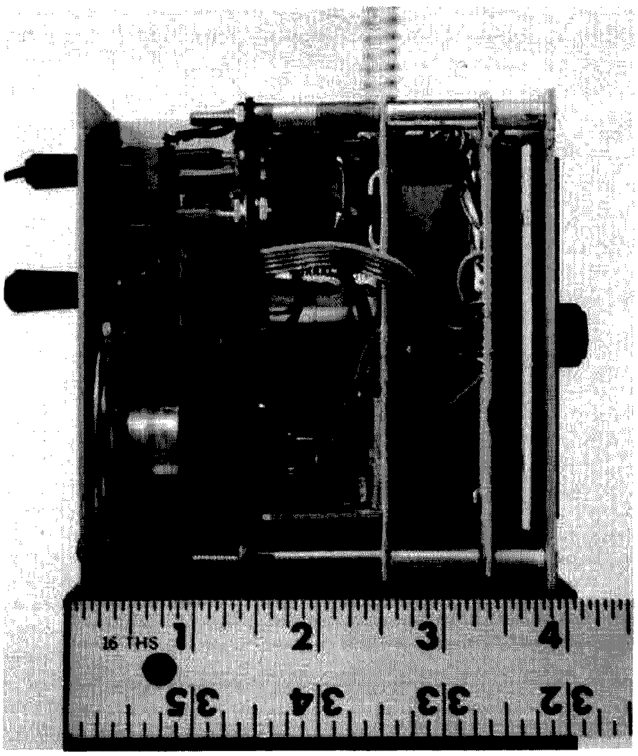
1. This clock is designed to operate from a number of power sources, 9 to 13 V dc or 6 to 9 V ac at the power input jack, without regard for polarity, or on a 9-volt transistor battery internally mounted. A small earphone-type jack is in parallel with the internal battery and may be used to (a) parallel the internal battery with an external battery while exchanging the internal battery, (b) provide a convenient test point for measuring the internal battery voltage condition, or (c) if necessary, be used as a recharge point for the internal battery.

2. The input to the power supply is a bridge rectifier which will accept ac or dc voltages of either polarity. A -5-volt regulator (7905) provides the LED voltage and a regulated 5-volt source for the internal crystal timebase. All circuits have been isolated from the case; therefore, it is safe to use this instrument in a car, using its battery connected to the power jack without regard to polarity. Caution: The shaft of the function switch is at circuit ground (+) and *must* have a plastic knob. Use of a metallic knob will invalidate the preceding statement.

3. The crystal timebase adjustment capacitor has been paralleled with a small piston-type capacitor to provide a "fine" adjustment, and is accessible via a small hole in the back skirt below the alarm speaker.

4. In operation, this unit draws current from the power source as follows:

7 mA — Illumination blanked
26 mA — Illumination LO
160 mA — Illumination HI



Battery version, top view.

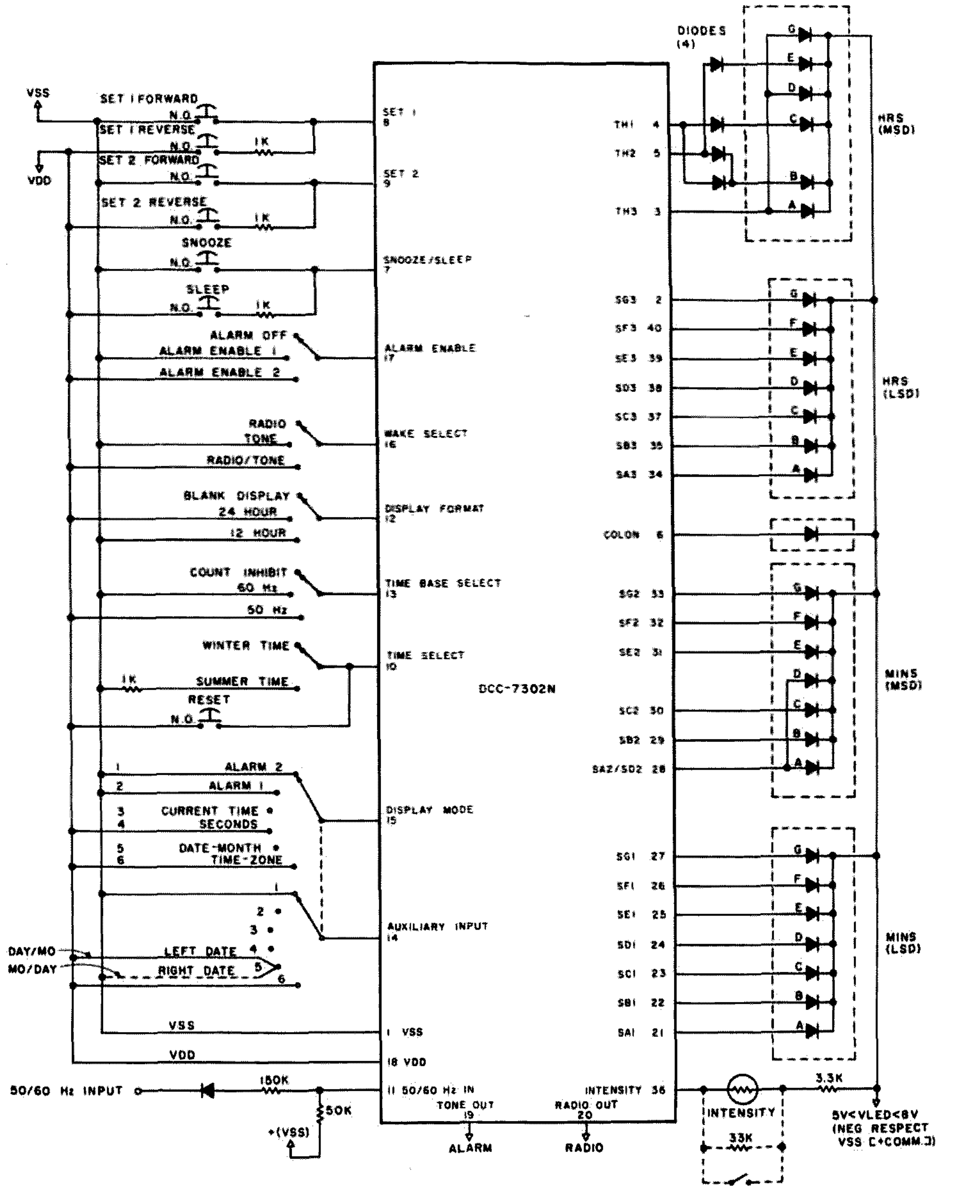


Fig. 1. Generalized circuit (24-hour or date left display format) — a modified drawing to show the 12- or 24-hour option, the 50/60 Hz option, and the manual intensity control option.

Summer/winter time switch for Daylight Savings Time
Brownout indication
Four-year calendar
One time zone register

Would you like to use it independently of power lines, as well — possibly in your car or in foreign countries when you travel on 230/115 V, 50 or 60 Hz?

If you desire a clock with the above listed features, the DCC-7302N clock chip comes in a kit, available with fluorescent display, for about $30. In order to add options, read on. The chips are available for about $6.00 and an LED 4-digit display for about $10, or you can fabricate your own display from individual LED readouts.

I have produced 2 clocks around the 7302N chip. One is designed to operate from 115/230 V, 50/60 Hz power lines and includes many of the published chip options. The second is designed to be operated from either a battery source or a filament transformer — in this, a bonus was obtained when it was discovered that the clock will function nicely on 9 V or less, and the battery drain may be minimized by using low illumination or a blanked display as much as possible. Blanked, the total current is 7 mA; at minimum illumination, it is 26 mA, and, at maximum illumination, 160 mA (using a 9 V source).

The 115/230-volt version uses the power lines as a timebase and has most of my desired options, as indicated in the drawings.

The battery-operated version uses a crystal timebase sold by S. D. Sales, and several options were deleted to conserve on space and the number of switches required. A 7905 negative regulator IC chip is used in this unit to provide 5 V regulated for the timebase and the supply voltage for the LEDs.

Caution: Although these chips use a positive ground

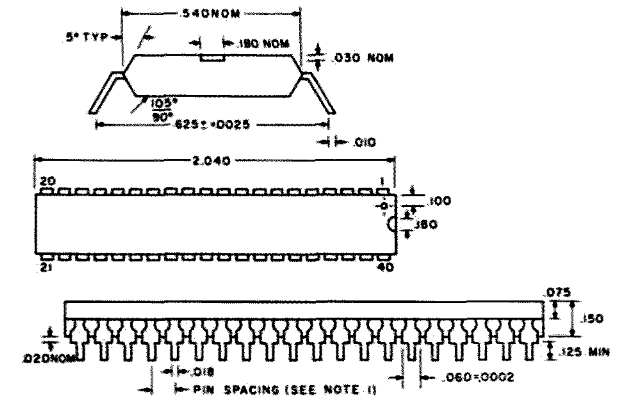


Fig. 2. The pin spacing is 0.100 between centerlines. Each pin centerline is located within ±.0010 of its true longitudinal position relative to pins 1 and 40.

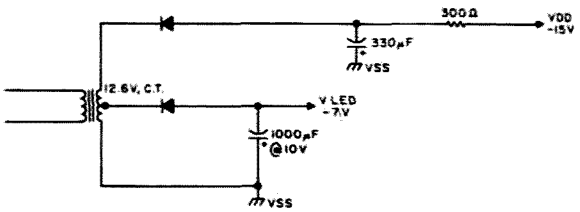


Fig. 3. Recommended power supply for LED operation.

(common), the LED display must be of the common cathode configuration.

PC Board Preparation

Lay out the circuits on graph paper, full scale, 10 lines to the inch, making a template. The template is then taped to the copper side of the PC board stock and each hole point lightly punched through the template. Remove the template and clean the copper with scouring powder and/or a steel wool soap pad, rinsing

Input function	V_{SS}	Open	V_{DD}	Aux input
Display mode	alarm 1	current time	seconds	open
Display mode	alarm 2	month-date		V_{SS}
Display mode		date-month	time zone	V_{DD}
Set 1	forward		reverse	N.A.
Set 2	forward		reverse	N.A.
Timebase select	60 Hz	count inhibit	50 Hz	N.A.
Display format	12 hour	blank	24 hour	N.A.
Wake select	tone	radio	Radio and tone	N.A.
Alarm enable	enable 1	off	enable 2	N.A.
Snooze/sleep	snooze		sleep	N.A.
Time select	summer	winter	reset	N.A.

Table 1. Input selection table.

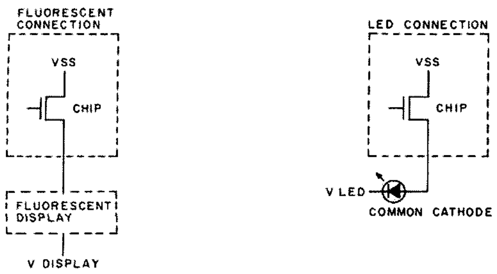
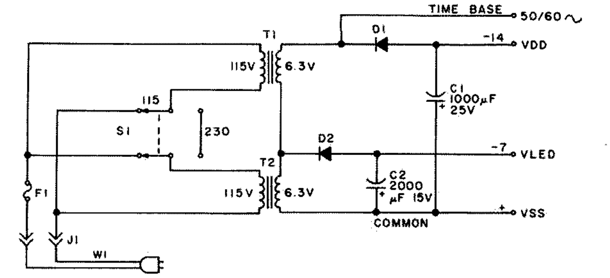


Fig. 4. Display connections.



C1	1000 uF, 25 V dc
C2	2000 uF, 15 V dc
D1, 2	1 Amp, 50 V piv diodes
S1	DPDT miniature slide switch
F1	¼ Amp Slo-blo
J1	115 V TV-type receptacle
W1	115 V TV-type cheater cord with 220 V adaptors, as required

Fig. 8. 115/230-volt power supply. Note: there are at least 3 types of 230-volt receptacles in use in Europe.

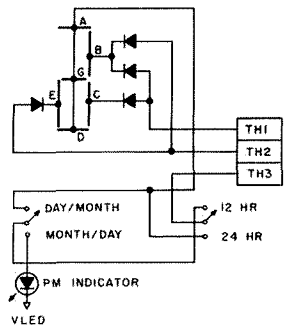


Fig. 5. Selectable 12-hour or 24-hour display.

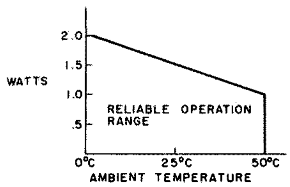
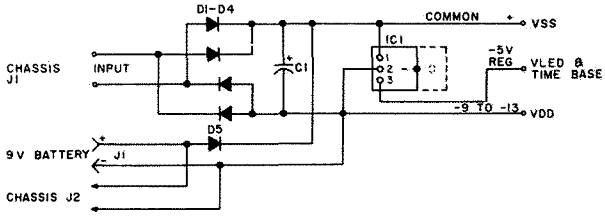


Fig. 6. Total chip power dissipation.



C1	1000 uF, 15 V dc
D1-5	1 Amp, 50 V piv diodes
IC1	7905 -5 V regulator
J1	9 V transistor battery connector
Chassis J1	input jack, insulated from chassis
Chassis J2	input for auxiliary battery and small earphone jack, center positive and insulated from chassis

Fig 9. Less than 2 inches must separate the capacitor and the chip, or a second capacitor will be required across the chip input.

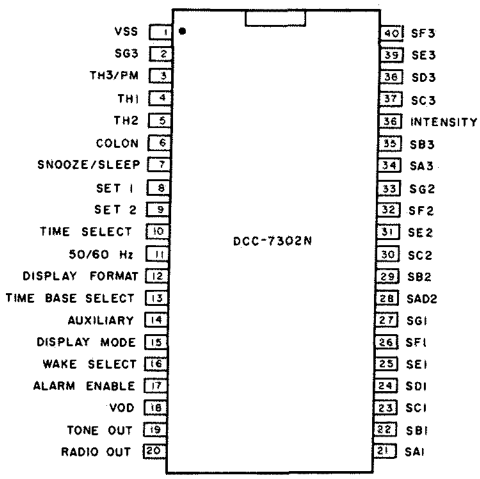


Fig. 7. Pin connections.

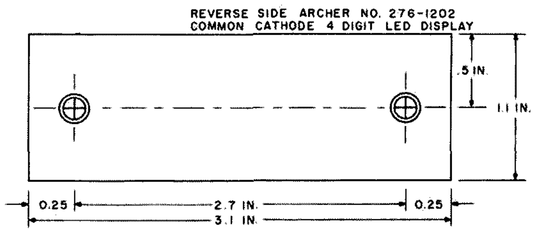


Fig. 10. Glue two spacers, 3/16" diameter x 1/4", i.d. tapped for #4-40 screws, to the two places shown. These spacers must align with the 2 holes in the main board.

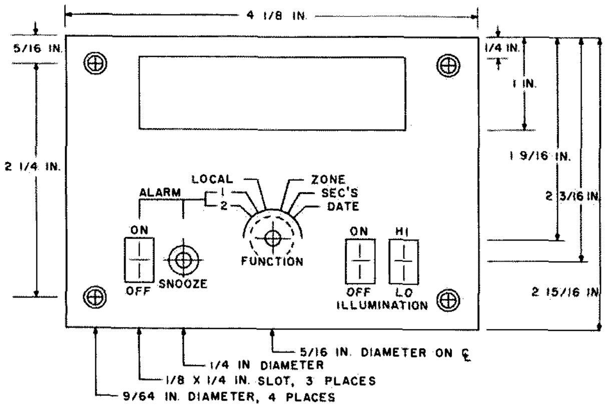


Fig. 11. Front panel dimensions and markings — battery version.

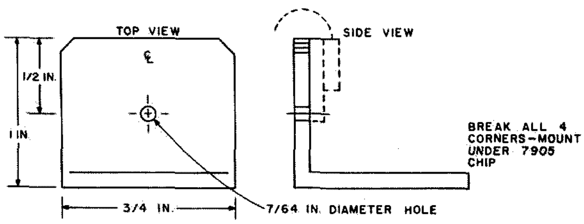


Fig. 12. Heat sink detail. Use 1" x 1" x 1/16" aluminum angle cut ¾" wide or fabricate it from aluminum or copper stock.

and drying each PC board thoroughly.

After the PC board is dry, use a wide-tip permanent marking pen and draw a wide line (about ¼") through all close-spaced contact points (20 on each side of the chip and others). Then, using a straightedge and a scribe, remove about 1/64" of the ink from between each of the contact points. Using a narrow etch-resist pen, draw a circle around the individual contact points (those separated by more than 0.1"), and connect the various contact points as indicated on the template. Use care not to soil the copper during this process. After all contact points have been correctly and properly connected, use the wide marker pen and fill in as much of the unused copper as possible to reduce the amount of copper that has to be etched off. This will speed up the etching and prolong the life of the etchant. In the battery version, remove the copper around the corner holes and the function switch mounting hole.

Etch the PC boards with your favorite etchant.

Note: There are several permanent marking pens on the market that will satisfactorily perform as etch-resist pens: El Marko™ and Marks-a-lot™ are examples that have been used here. If in doubt, try your favorite on a scrap of PC board. These pens are much less expensive than the etch-resist pens available from your friendly Radio Shack or other dealer.

Construction

All PC boards should be the same size for mounting ease, unless you wish to mount the programming board separately, as in the case of the 115/230 V version.

Check over the features

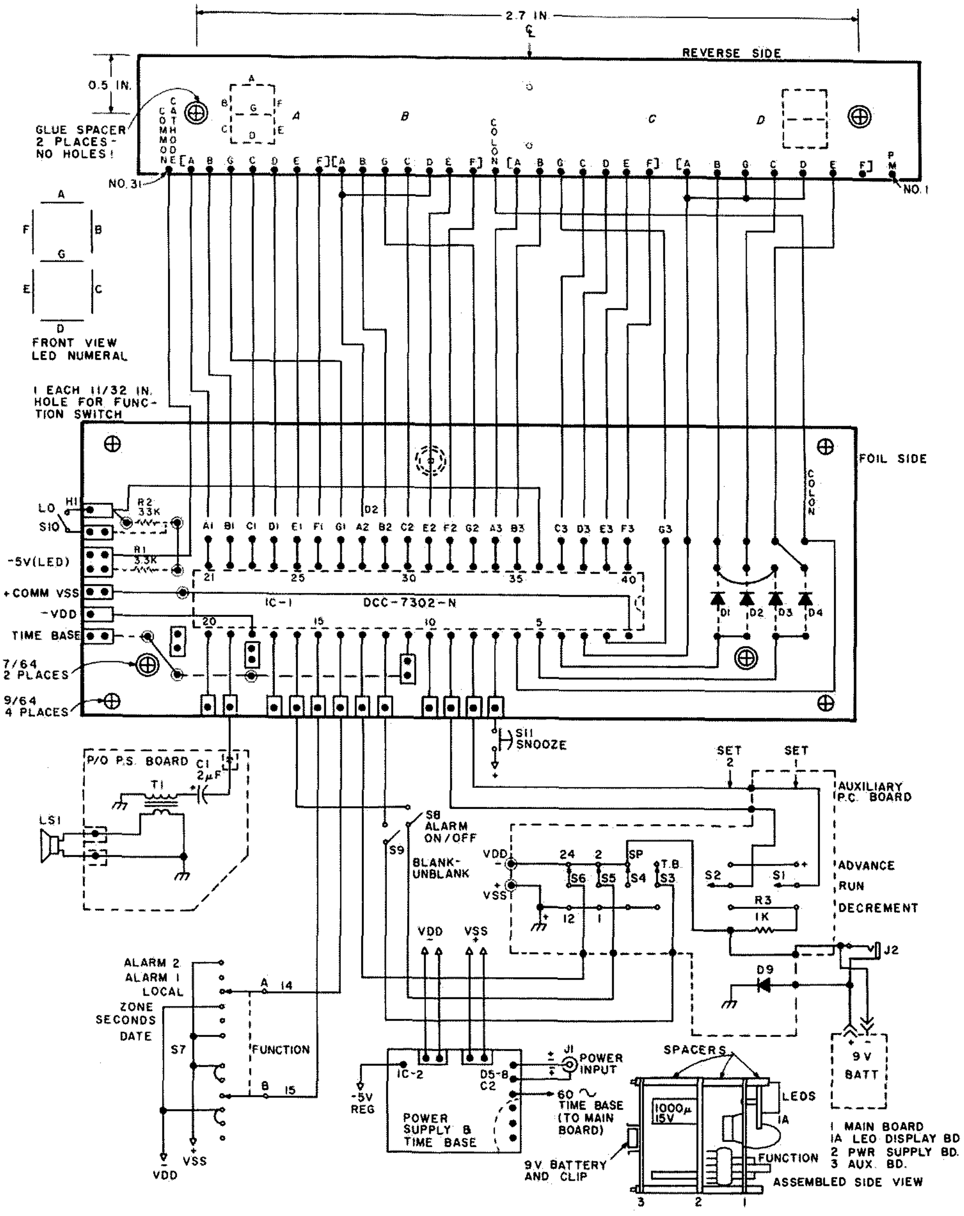


Fig. 13. Wiring arrangement used for the battery version. J1 and J2 must be isolated from the cabinet chassis.

and decide which ones you need and which ones you can live without. Then determine how many switches you need. Time can be set with push-buttons, but, to conserve space, use SPDT miniature toggle switches with center-off. For economy, use single-pole slide switches where possible. Minimize the number of front panel switches. In the 115/230 V version, I used 6 push-button switches, 5 SPDT center-off toggle switches, 2 SPST slide switches, and 1 DPDT slide switch. In the battery version, it came out 2 SPDT center-off toggles, 1 push-button, and 7 SPDT slide switches, of which one is a spare and 4 are used in SPST functions.

Two problems were encountered in the timebase inputs. In the 115/230 V version, the chip would not initially clock. A copy of the kit schematic was obtained, and it indicated that pin 11 was biased back to common via a 150k Ohm resistor. This cured the clock problem but created another – the chip was clocking at 2 pulses per second rather than one pulse per second. A diode cured that. In the battery version, I found that pin 11 would drive directly off the output of the timebase without a diode, an isolation capacitor, or isolation resistor. However, I found that if the filter capacitor and the 7905 chip were not adjacent on the PC board, it would be necessary to place about 0.1 uF across the input to that chip to stabilize the output of the timebase.

A socket for the 7302N chip is recommended but not necessary. When drilling the PC board, use care, and, if possible, use special drills* for glass epoxy boards. Use nothing larger than a #65 drill, except at the edge points where wire connections are made, where a #60 drill is more correct. Of course, the hardware holes must be of the correct sizes to accommodate the screw sizes used. If a drill press is not available, be very careful with a hand drill or it will drift or make slanted holes, and aligning 40 pins of a chip or socket is no fun under those conditions (experience speaketh).

*Special drills are available from: Ford Cutting Tools, M.A. Ford Mfg. Co., Inc., Davenport IA, or Tools & Metals, 301 N. Johnson, El Cajon CA 92020.

The 2-pole 6-position non-shorting function switch may be mounted on the same PC board as the chip. The LED display and the chip PC are mounted back to back with a ¼" spacer between them (see drawings for details). Locate the positions on the back of the display that correspond to the positions on the template for the main board (with the chip). Thread the spacers for #4-40 screws, and use Super Glue™ (or its equivalent) to bond them in position.

I also used Super Glue to secure all slide switches in position, and, in the battery version, the battery clip was secured similarly. If done right, a good bonding is affected; if done wrong, try, try again (it took 3 passes for the battery clip to hang in there).

6-32 x 3" screws were used to mount the PC boards into the cabinets, using spacers and the front panel for support. If necessary, ¼" Plexiglas™ tubing may be used to fabricate the desired spacers. The i.d. is slightly smaller than a 6-32 thread and can be either tapped or drilled out – for ease of assembly and disassembly, unthreaded spacers are recommended.

Use care in locating the 4 mounting holes for the 6-32 x 3" screws, the openings for the display, and the shaft of the function switch on the front panel. In the battery version, provide an insulated mounting for the switch or insulate the shaft with shrink tubing, and be sure there is no contact between the shaft and the case (this has been

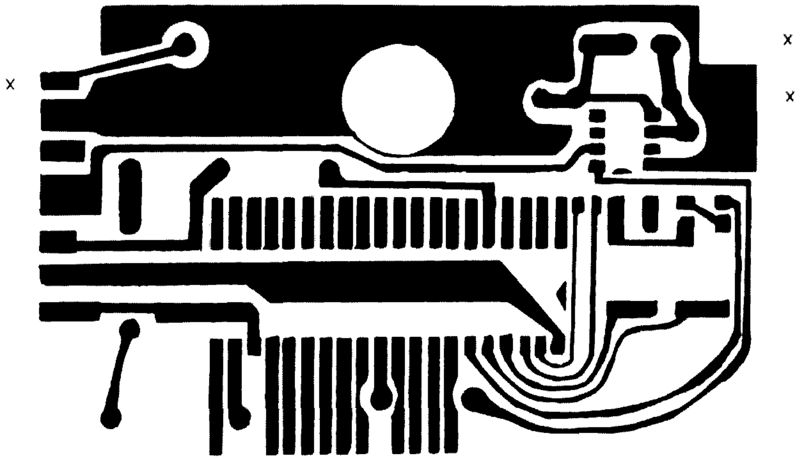


Fig 14(a). Main circuit board – PC board.

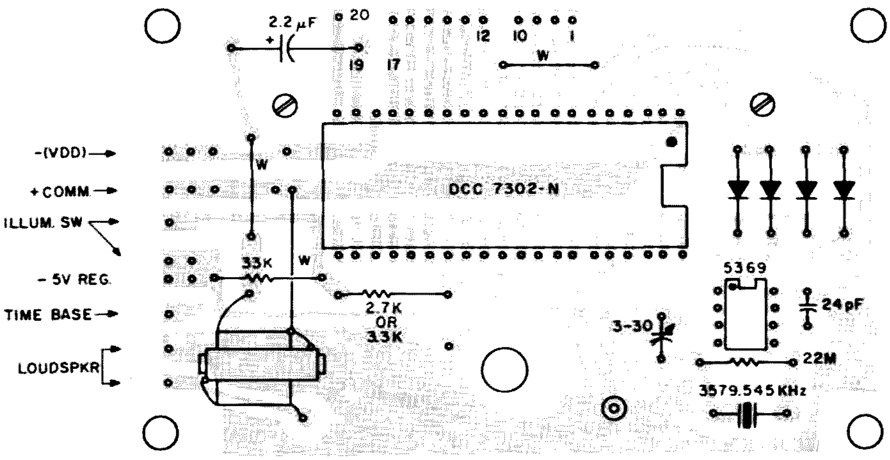


Fig. 14(b). Main circuit board – component layout.

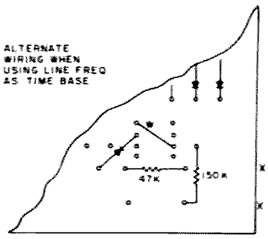
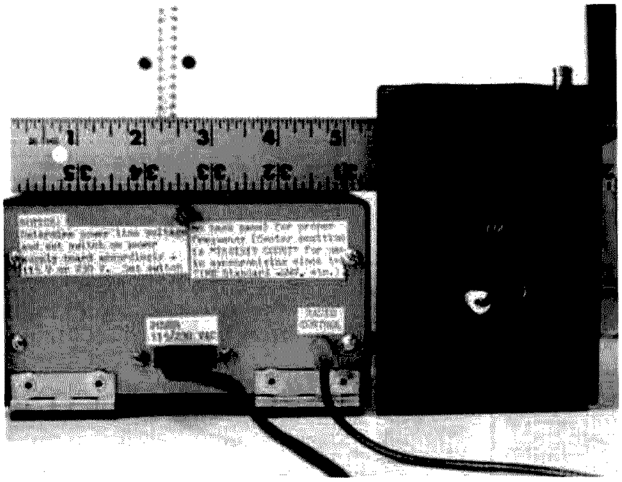


Fig. 14(c). Alternate wiring when using line frequency as timebase.



Ac operated version, rear view.

corrected in the included template drawing).

The illumination control is a 33k Ohm resistor with an SPST switch in parallel to add or subtract the 33k to or from the circuit. If desired, the switch and resistor may be replaced with either a 30k Ohm variable resistor or a photocell control of about 30k Ohms maximum resistance.

At this writing, it has been determined that the battery-operated unit is hard on 9 V transistor batteries, in spite of its low drain in the "low" or "blanked" conditions. A Duracell™ only lasted about 20 hours under a 26 mA load; a regular carbon-zinc battery lasted about 18 hours (both new batteries). Although the clock works satisfactorily on a 9 V battery charger, I learned that the circuit "loads" the charger to about 7.8 volts, and a new battery inside the unit will supply power to the clock, in parallel, until it is at or below the input voltage from the charger.

When the clock is on the internal battery, it will continue to function (blanked or low) at terminal voltages below 7.0 volts, but disturbing the input power (paralleling the battery or applying an external supply) can and does cause glitches, if not done carefully. When glitches are introduced, the displays become random – like showing 65 seconds, or a 3 in the tens-of-hours column, or beeping the alarm tone when the alarm is turned off. Under these conditions, the best cure is to remove power completely and restore the correct voltage level; the clock needed resetting anyway.

If it is desired to use the pm indicator in the 12-hour mode (rather than display 3 bars), the 12/24-hour selector will have to be a DPDT (center-off) switch, and the date format will have to be the American style (month/day). Similarly, if only the 12-hour option is desired, the month/day format must be used in order to access the pm indicator, as the 3-bar output required for a 2 or a 3 is also the pm indicator in the 12-hour mode, and no digit greater than a "1" can be

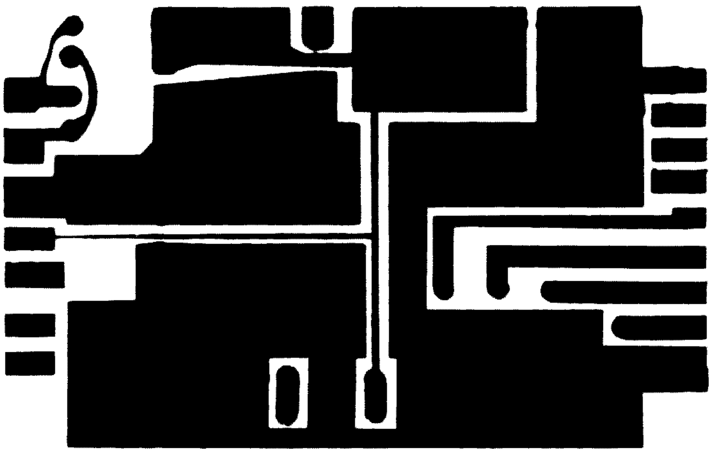


Fig. 15(a). Auxiliary board – battery version – PC board.

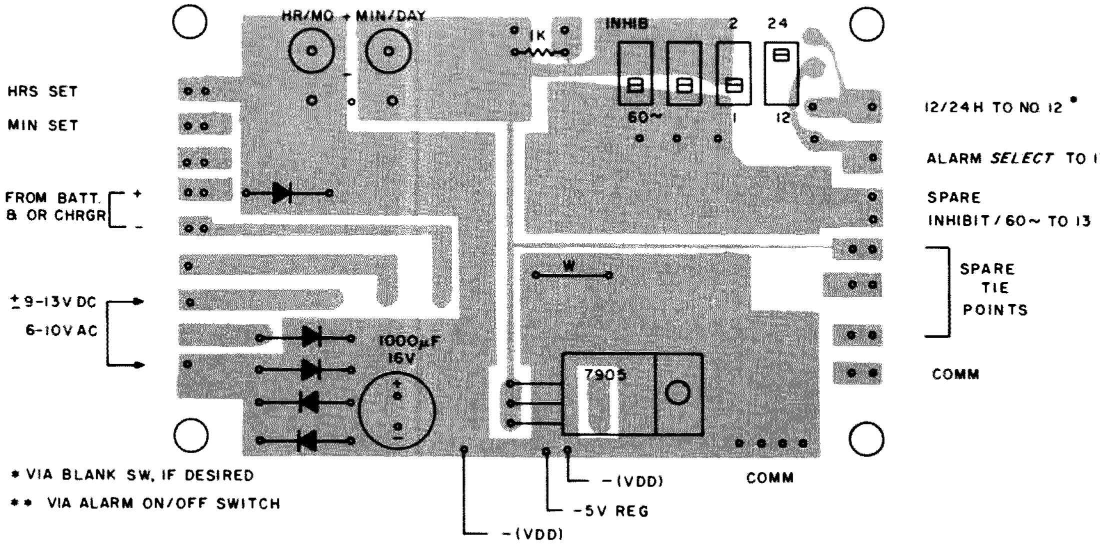


Fig. 15(b). Auxiliary board – battery version – component layout.

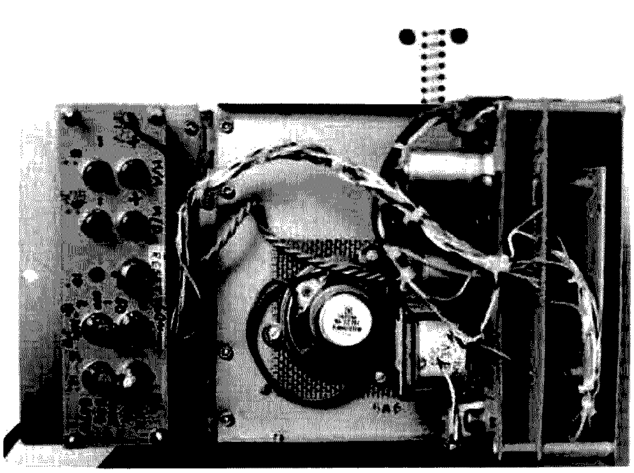
Parts List

Quantity	Description	115/220 V version	Battery version	Both	Price
1	7302N clock chip, Integrated Circuits Unlimited			x	6.00+
1	40-pin IC socket, ICU or IC Elex.			x	.50
1	LED display, four ½" digits + colon + pm indicator, Archer #276-1202			x	
5	Diodes, 1N277 or equivalent	x			
4	Diodes, 1N277 or equivalent		x		
2	Diodes, rectifier, 1N4001 or equivalent	x			
5	Diodes, rectifier, 1N4001 or equivalent		x		
1	7905 -5 V regulator chip, ICU or IC Elex.		x		
2	Transformer, 115 V pri., 6.3 V 300 mA sec., Radio Shack	x			1.69 ea.
1	Transformer, output, 1200Ω pri., 8Ω sec., Calectro D1-724			x	
1	Capacitor, 1000 uF, 15 V			x	
1	Capacitor, 2000 uF, 15 V	x			
1	Capacitor, 2.2 uF, 15 V			x	
1	Resistor, 33k, ¼ W		x		
1	Resistor, 3.3k, ¼ W		x		
1	Resistor, 1k, ¼ W			x	
1	Resistor, 330Ω ¼ W	x			
1	Resistor, 4.7k	x			
1	Resistor, 5.6k	x			
1	Resistor, 27k	x			
1	Resistor, 47k	x			
1	Resistor, 150k	x			
1	Speaker, 8Ω 0.12 W, 2", Calectro S2-202 or equivalent			x	
1	Relay, 6 V 5kΩ (SPST n.o. only used)	x			
2	Switch, SPDT center-off toggle MS167		x		
4	Switch, SPDT center-off toggle MS167	x			
1	Switch, push-button, n.o. Electrocraft 35.414		x		
6	Switch, push-button, n.o.	x			
1	Switch, slide, DPDT	x			
2	Switch, slide, SPST Electrocraft 35-202	x			
1	Switch, rotary, 2 pole 6 posit. miniature, Archer 275-1384 (nonshorting type)			x	1.70
2	Switch, slide, SPDT		x		
4	Switch, slide, SPST		x		
1	Timebase kit, S.D. Sales		x		5.95
3	PC board 4" x 2½"		x		
2	PC board 5" x 2½"	x			
1	PC board 5" x 1½"	x			
1	Mini phone jack			x	
1	Jack, power input and matching plug set		x		
1	115 V power conn. TV type	x			
1	115 V TV cheater cord	x			
1	Cabinet 4¼"W x 3"H x 4-3/16"D, Ten-Tec TG 34		x		
1	Cabinet 5¼"W x 3"H x 5-7/8"D	x			
1	Transistor, 2N2219 or equivalent	x			
2	Hinge, brass 1½" x ½"	x			
4	6-32 x 3" screws, cut to size as required			x	
1	Mounting clip for NEDA1604 transistor 9 V battery		x		
1	Battery connection for NEDA1604 transistor 9 V battery		x		
	Assorted hardware and spacers				

tolerated in the tens-of-hours digit when the pm indicator is desired.

The clocks were mounted in small utility boxes. The 115/230-volt version was installed in a box 3" H x 5¼" W x 6" D. The chassis was U-shaped, but the back panel (skirt) was sawed off at the bend, dressed up to allow for hinging, and hinges were installed. The programming board is mounted on this, and, when it is desired to set the clock or change the program, one thumb screw is removed and the back drops down, disclosing the programming switches. The battery version is mounted in a Ten-Tec TG34 box which is 3" H x 4¼" W x 4¼" D. It is of a double "U" construction, and the top/sides piece is removed by removing one screw on each side, exposing the interior and making the set and program switches available.

An attempt to operate the battery clock off the cigar lighter outlet in the car met with failure, causing a glitch when the car was started. A filter is proposed, consisting of a small resistor and two 12 V zener diodes back to back to act as shorts for any transients. ■



Ac operated version, top view with the rear skirt opened to disclose "program" switches.

Car Battery Charger

—junk-box special

This is the safe way.

David E. Roscoe W1DWZ
49 Cedar Street, RFD #2
East Bridgewater MA 02333

One of the most useful pieces of "junk" that can be found in any self-respecting ham's junk box is an old, but serviceable, 12-volt automotive battery. They can be very useful for bench testing, field day operation, running that mobile rig at the home QTH, jump-starting the wife's car, etc. To be maintained at the peak of their usefulness, they do require occasional recharging. After getting along for a number of years with a haphazard (and dangerous) collection of hay wire and diodes, we decided to remedy the situation. Most of the commercially available chargers did not seem to meet the requirements we wanted, so we set out to fabricate our own. We wanted one that had the capacity to put out 15 Amperes or so if needed, yet have the capability of being adjustable to 1 or 2 Amperes for a trickle charge, or to some value in between.

After experimenting briefly with series resistors and series-regulating pass transistors, these ideas were discarded as we found it difficult to dissipate such large quantities of power (and heat). While thumbing through some manufacturers' applications literature, we came upon one describing the triac and decided that this would be a really neat way to do it (Fig. 1).

A triac is basically two SCRs connected in parallel in opposite directions so that conduction is permitted during both halves of the ac sine wave. By controlling the phase and amplitude of the signal to the gate, the firing point of the triac can be controlled and, thus, the conduction angle can be varied to regulate the input power to a transformer primary. A bilateral thyristor (D1, a diac) is used in the gate circuit to provide a threshold level for firing the triac. C3 and R4 provide a transient suppression network to protect the triac from damage when the power is switched off to the transformer primary.

R1, R2, R3, C1, and C2 provide a phase-shift network for the signal being applied to the gate. R1 is selected to limit the maximum charging current at full rotation of the control pot to stay within the ratings of the rectifiers, transformer, etc., of the specific components chosen by the builder. As is true of most ham projects, we tried to use what parts we had available. Readers wishing to build this unit could substitute whatever they might have in their junk boxes for the bridge and the transformer and their unit would only be limited by the voltage and current ratings of these components. ■

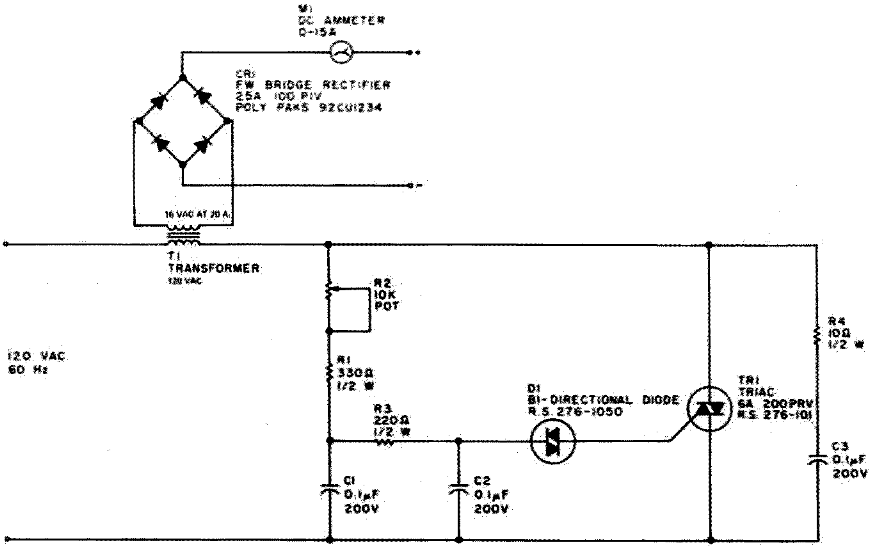


Fig. 1. Battery charger schematic diagram.

Immortality for Vacuum Tubes?

—build a solid state tube saver

This circuit doesn't replace tubes—it prolongs their life!

Lewis J. Newmire K5KXM
217 South 103rd E. Ave.
Tulsa OK 74128

The deleterious effects of simultaneous application of heater and plate voltages to vacuum tubes are well known. High power transmitters have interlocks and time delays to prevent such occurrences. For reasons of economy, however, such interlocks or delays are seldom designed into consumer electronics.

The solid state circuit shown in Fig. 1 is a simple but effective 60-second B+ delay. Q1 is any SCR able to block unloaded B+ voltage and pass the required load current. Using an RCA S-2061M, this circuit will perform in power supplies up to 600 volts and 4 Amperes.

This circuit is not a perfect switch. It has a voltage drop when on of about 1 volt and a "leakage" current when off equal to (Volts$_B$ unloaded /30 in mA. This "leakage" current of a few milliamperes limits plate voltages in most applications to only a few volts. The 10-Watt resistor is operated at full rating with a B+ of 600 volts, but only for 60 seconds at each turn-on.

Wire the B-delay into the power supply as shown in Fig. 2. The + end of the switch is connected to the input filter capacitor. All other wires except the one from the rectifier(s) must be removed from this capacitor and connected to the − end of the switch.

The B-delay may be installed in all types of vacuum tube equipment including receivers, transmitters, instruments, and TV receivers. Note: In a color TV receiver, the automatic degaussing may be visible on the screen for a few seconds after B+ is switched. The original B-delay used an RCA 40812 SCR. It has been operating in my black and white TV for 6 years, during which not a single tube has been replaced.■

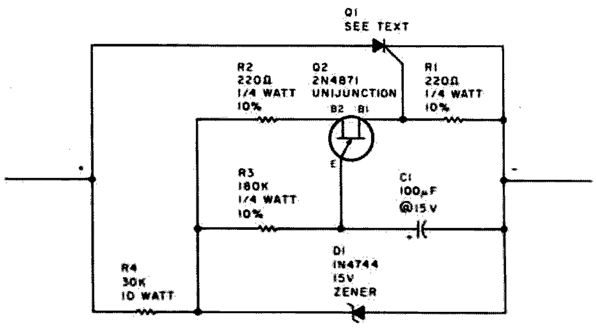
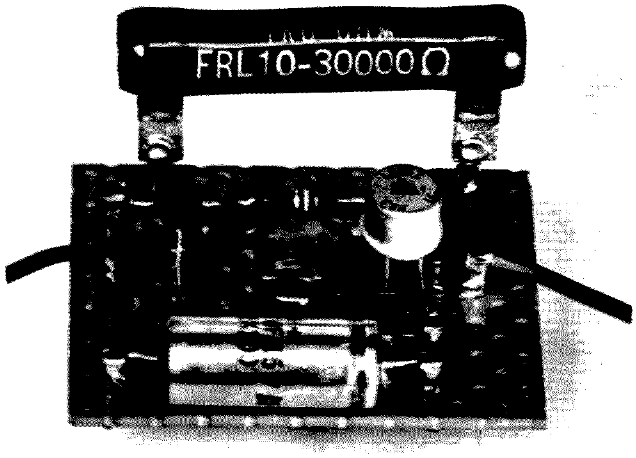


Fig. 1. Schematic.



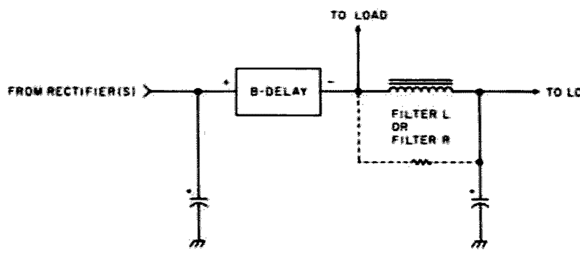


Fig. 2. Connection of B-delay in a power supply.

John A. Burton WB9QZE
2282 McKinley Ave.
Columbus IN 47201

The Hot Mugger X1

— coffee drinkers, rejoice!

There is no such thing as a cold drink.

Ever since Wayne Green's editorial in the July, 1977, issue of *73*, I have been thinking about a coffee warmer. He gave some ideas on how to make one and also said that it should be a real money-maker. I, too, hate cold coffee with a passion and usually end up with such every time I bring a cup out to the shack. So, with his idea and my junk box of parts, I put together the Hot Mugger, destined to become the most popular piece of gear in the ham shack.

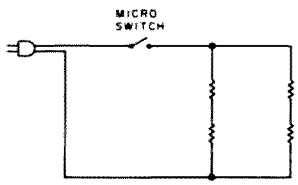


Fig. 1. Schematic.

I have used the Hot Mugger for several months now, and it works very well. But I have left a lot of room for improvement and would be interested to see other ideas for a coffee warmer. I am surprised that no one has written one up yet, as it is a very practical item for the ham shack. I hope this will set the wheels in motion and we will see many improvements and innovations.

The Hot Mugger does not require much in the way of parts. My junk box yielded all that were needed. There are four 550-Ohm, 15-Watt power resistors in series parallel, which gives 26 Watts of power dissipation. The 26 Watts does a good job of keeping a cup of coffee warm. I don't know how much lower you can go in power dissipation and still keep your cup warm, but you might try whatever you have on hand. I don't recommend exceeding 26 Watts, as this wattage will cause ¼ cup of coffee to become quite hot.

The cup should be a flat-bottomed one without any recess. I chose my cup before making the top for the coffee warmer so that I could cut the hole to the right size. The microswitch has a long actuator so that the cup will sit down on it and turn on the heating element (resistors). The base and housing were made out of printed circuit board, soldered and screwed together with an opening cut out of the top for the cup.

That's just about it except for painting. I used Rust-oleum® primer, which I don't recommend because it gave off a fishy smell for a long time afterward. Probably a good auto engine paint would be a better choice. A nameplate could be added so that your friends will know what it is.

As I type this, the Hot Mugger X1 is on the job keeping my coffee warm to the last drop. What is there left to say except, "Try it; you will like it." ■

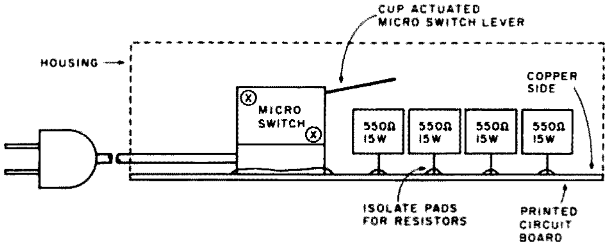
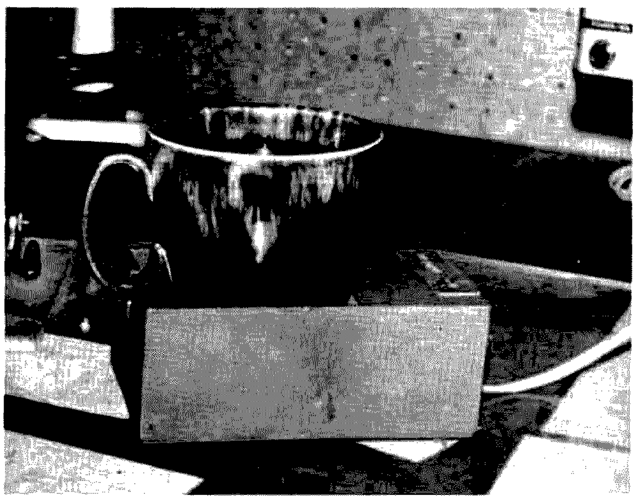


Fig. 2. Construction.



Side view of the finished Hot Mugger.

Winford Rister WB4MBL
402 Allicia Street
Albertville AL 35950

Build the Mini-Probe

—it's only logical

Decoding digital with a Polaroid™ pistol.

Here is an inexpensive logic probe that will determine all possible states of digital logic. It is built by point-to-point wiring on a piece of perforated board just wide enough to fit into a discarded Polaroid™ film-coating container and about 2½ inches long.

The Circuit

Referring to Fig. 1, the plus 5 V and ground connections are made to the circuit under test, and the probe is touched to the pin under test. If the pin is open, Q2 will conduct slightly because of the bias introduced by R1. This will cause the yellow LED to light at about half brightness. If the pin under test is ground, both Q1 and Q2 are off so neither LED will light. If the pin is high, the red LED will blink once because Q1 puts a high signal into the one-shot, and the yellow LED will light at full brightness because Q2 is turned on. If only the yellow LED were used, it would be difficult to differentiate between an open and an oscillating condition. This is where the one-shot goes to work. It gives a relatively long (.5 seconds or so) pulse anytime the probe goes high—even if for a very short duration. So if the probe contacts an oscillating pin, it will blink continuously.

Unless pulses of very high frequency are to be detected, there is nothing critical about the layout except for space economy so that the board can be slipped into the case.

So there, in a nutshell (plastic one), is a way to know what's happening inside that digital monster's mind.■

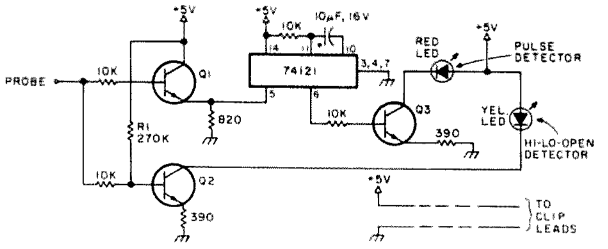
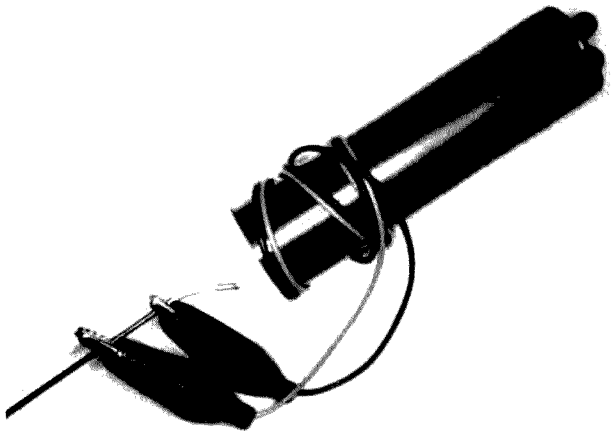
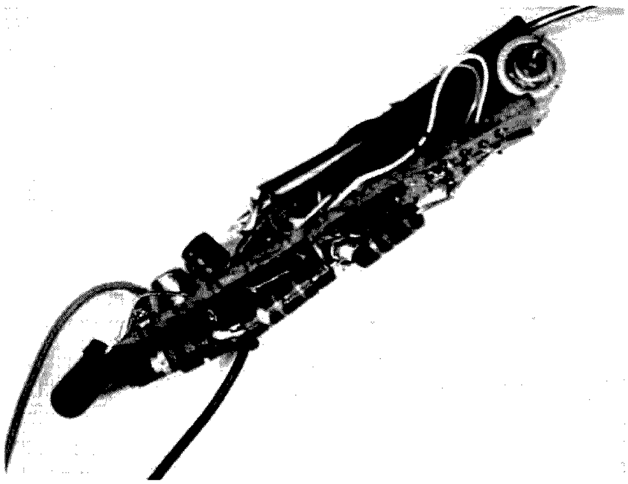


Fig. 1. Logic probe schematic diagram. Resistors ¼ Watt, 10%. Transistors ECG 123A or equivalent. LEDs as desired.



Completed probe.



Circuit board assembly.

W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

from page 4

interested in the same end . . . a better world, helped along a whole lot by amateur radio. Hamming can only provide these benefits to the world if it is fun, so let's all try to do what we can to make amateur radio fun . . . for everyone. I don't ask *you* to speak out against those who are lousing things up, whether by intention or stupidity—I just ask that you look into these things with an open mind and vote with your conscience.

ALSO AT ATLANTA

In addition to laying it on the line about amateur radio . . . and I expect the usual goon squad . . . I'll be talking about microcomputers. I'll be talking about them primarily in terms which may be of particular interest to you . . . how to make money in microcomputing. I'd talk about how to make money in amateur radio, but I don't know anyone who has figured it out yet. Perhaps those who are pushing for the Communicator Class license on 220 have the answer.

The opportunities in microcomputing are still as good as ever for making a bundle. The industry has grown some since I got involved. Sales in 1975 were about $5M. This went up to about $25M in 1976 . . . $100M in 1977 . . . and passed $300M in 1978. With Atari and Texas Instruments now hitting the market with microcomputers, 1979 is still an unknown quantity. Radio Shack has a very big lead and may just be able to hold it, what with about 10,000 of their stores selling the TRS-80.

I'll be talking about hardware which is needed and which can be marketed easily to make money. I'll be putting software into perspective. Mostly, I'll try to answer as many questions as I can. I may even talk a bit about the whole philosophy of making money . . . what the secrets of success are and how to achieve success if you want it. Most people have blundered into the trap of the good old American system . . . guaranteed to keep you poor for life and with no real hope of spectacular success. Is there anything to do about this? I think so . . . and the first step is to become aware of the system and how it can be beaten.

Will I be seeing you at Atlanta June 16-17th? I hope so. What about Dayton? I don't know . . . I skipped it last year, but haven't decided about this year yet. With two or three new magazines in various stages of getting started, Instant Software really getting going, and some other projects, I don't really have time to go most of the places where they want me, much less where they don't.

MEET ME IN ST. LOUIS

Yes, Wayne Green is coming to St. Louis . . . for the big hamfest on March 31st. I'll be talking about amateur radio . . . the good things and the bad. I'll be answering questions on just about anything. In addition to that, as at Atlanta, I'll be talking to microcomputer hobbyists about the many ways of making money in this new field. I'll try to give some perspective on what has happened and what I see as coming in both fields.

This will be my first trip to St. Louis, so I'm looking forward to it. I'll be getting in a day early, so I'll have a chance to get on the local radio and television stations and promote the hamfest.

If you're a Wayne Green fan, be sure to come to the show . . . at the new convention center. If you're anti-Green, it's even more important for you to come and make sure you are right in your assessment. Is it possible that you are more a part of the problem than a part of the solution? Find out at the St. Louis hamfest.

There will be a raft of exhibits and other talks . . . with manufacturers showing their latest ham gear and dealers doing their best to cut their own throats. They're lining up some fantastic speakers and forums (in addition to my talks), so you'll have a great time.

I'm looking forward to seeing you . . . please come.

THAT LONNNG ARRL PIECE

One of the problems is that I'm spread a lot thinner than I should be. Instant Software is demanding . . . as is *Kilobaud MICROCOMPUTING* . . . and with two or three more magazines in the planning stages, when do I sleep? This came to a head last month with my endless editorial about the League.

Normally, when I write an editorial, I sit down and write with smoke coming out of my typewriter. Then I find the heat abated a bit and write a second draft which is a bit less fiery. If I don't like the first two drafts, I try a third time. In December, *all* of the drafts of my editorial managed to reach print, end to end. I'm supposed to get a chance to review my editorial before it goes to the printer . . . but they skipped me last month. Rats.

Oh, I get annoyed at a lot of the crap I get from the League, but I'm not as upset about it as most people think. You'll perhaps get better perspective on this at St. Louis or Atlanta if you come and say hello and get into one of my talks.

ARTICLES NEEDED

Our increased use of color in *73* permits us to run some color photographs of interesting DXpeditions. The time was when we had to run all those pictures of gorgeous places in black and white. We're looking for colorful DXpedition pictures accompanied by interesting articles. An article will not only help pay some of the freight for the trip, but could also encourage others to help out a bit when they send for your QSL card. DXing is one of the most exciting aspects of amateur radio, so let's see more of the DXing fun in articles for *73*.

If I can get my new tower up, I'll be back in there scrapping with you for the rare ones. I'm a tough one to beat, so watch out! I racked up over 300 confirmed countries (all on 20m phone) in one year a while ago . . . and even managed 100 countries on 20m phone one weekend, just to prove to myself that I could do it. I didn't get much sleep.

It appears that we are up to here in antenna, keyer, and counter articles, but really in need of articles on transmitters, receivers, and transceivers. Surely someone out there has built a rig which will get thousands of hams hot to follow suit. Let's see more construction projects on ham gear.

It is my conviction that the tens of thousands of hams who have bought microcomputers should be using them in place of Teletype™ equipment. Let's have more articles on RTTY using microcomputers.

SLEP WRITES

A letter from Bill Slep (Slep Electronics) mentions that his ads have been selling stuff right and left. That's always nice to hear. Bill says that there has been a recent run on microwave equipment which hams are using to receive the TV satellites direct. I've been reading a lot about this recently and would like to encourage those who have been successful in getting something inexpensive together to do the job to write for us about it.

Why bother to get TV direct from a satellite? Well, right off the top there is the challenge. It isn't easy. Once you get set up, you'll be getting network program feeds. This means that you'll be able to get, for example, Johnny Carson before the salty language is bleeped out. You'll get a lot of programs which are not being broadcast in your area. You'll get the Home Box Office stuff . . . late movies.

I've been corresponding with Bob Cooper K6EDX/5, who publishes a magazine for the CATV field and is deeply into this direct satellite TV reception. I may be able to get him to either write an article for us or at least get him to get someone else to prepare such an article. Using commercial gear for the effort would run you into the thousands of dollars. Heck, just a receiver for 4 GHz costs thousands. Then they want you to buy a ten-foot dish and a special preamplifier. Some experimenters have been getting the stuff with a lot less expense and trouble. If you're one, write to me about it.

NEW COVER PRICE

The new cover price shouldn't come as much of a surprise to anyone. A big part of it is inflation, which has been running about 10% of late. It's been two years since there has been an increase in cover price. If inflation keeps up like it has (if you continue to let your congressman spend money on more and more government), the price increases will have to come more often. How'd you like to find a different price every month? Keep it up, Congress!

We see the inflation in many ways. Postage has gone up beyond belief . . . made even worse by the great big, thick, heavy issues of *73*. Paper costs have doubled in the last couple of years, and no end is in sight. Wages all around have been going up in step with inflation. Our advertising rates, once under $100 per page, are now over $1,500 for a page!

Obviously, the way to beat the cover price is to subscribe. I've been hinting gently at that for a long time. At $2.50 per issue, this comes to $30 per year. The subscription rate is $18 for one year and $36 for three years. That means you can get three years of *73* for just a little bit more than buying one year on the newsstand. Convinced? Remember when a life subscription was going for $37?

Of course, those early issues of *73* were much smaller (about one half the size of this page) and thinner. You're getting eight times as much material for about six times the price . . .

so it is a good deal. Fifty-seven feature articles in the November issue! That's more than all the other magazines combined, isn't it?

THE 10 GHZ SAGA

Chuck Martin WA1KPS started off going great guns (Gunns, that is) on 10 GHz with contacts with New Hampshire from Massachusetts, Vermont, Maine, and even the Granite State itself (106 miles between Pack Monadnock in southern New Hampshire and Mt. Washington, up north). From there on, the situation got more difficult.

A couple of tries from hills in Rhode Island didn't make it. The paths were even difficult on 220 MHz, so the failure on 10 GHz wasn't very surprising, even if it was disappointing.

Chuck got the two transceivers together and found little things to do which supposedly improved their action. He also borrowed a two-foot dish to perk up his end of the signal, just in case this would help. It might push a signal through some trees, but it wouldn't boost it over any mountains.

On November 19th, I braved icy winds gusting to over 80 mph up in the superstructure of a tower on the Pack, while Chuck relaxed up in the branches of a tree on a hill in Rhode Island. Well, he was perhaps only partly relaxed, considering that he was trying to hold on to the tree while he aimed the dish and tuned the transceiver . . . and gradually froze.

Perhaps it was worth it all. We did manage some short contacts as the two transceivers drifted in frequency about 16 MHz as they cooled down to the subarctic temperatures. The AFC system is pretty good, but definitely not equipped to handle that kind of drift. And tuning the little buggers is about like trying to tie an appendix with boxing gloves on. You have to turn the tuning knob about a thousandth of an inch to tune in a signal. This is interesting to do when you are being blown almost out of a tree or a tower by gusts of very cold wind . . . shivering . . . and your hands are turning blue as frostbite creeps up towards your armpits.

That makes five states on 10 GHz, with all contacts being over 50 miles. Anyone done better than that, or should we send it to the book of world records? Our laurels will not be crushed. Chuck has some ideas on pepping up the transceivers, and if we put the darned things outside so they can come to a steady temperature, we should avoid the drift miseries. The next stop obviously is Connecticut for state number six . . . if we can get organized before the snow hits.

Those little Microwave Associates Gunnplexers sure are good fun. They put out enough of a signal so that you should not have to have any additional antenna for a contact over any line-of-sight path. Our contact of over a hundred miles was plenty strong.

Sherry has been itching to get a hot air balloon ever since we went down to Florida and made the balloon cover for *73* a couple of years ago. If we get one, I understand that contacts from the balloon count for New Hampshire as long as the balloon is tethered. I wonder if a 5,000-foot kite string counts as a tether?

OCTOBER WINNER

Our readers have selected "Antenna Design: Something New!" as the best article in our October issue, so Harry A. Mills W4FD and Gene Brizendine W4ATE will be sharing our $100 Most Popular Article prize. Remember, your ballot is your Reader Service card.

DX

from page 14

from Greenland to South America out of our home base, Wright-Patterson AFB, on a two-week "worldwide" communications test of an experimental airborne satellite terminal. Among the crew of 25 men, we had four hams: Sandy Cole K1SC, Tom Walilko K8NOQ, Bob Beach W8LCZ, and Wayne Beeson K8WB.

After landing (on Ascension Island) on Saturday night, we immediately searched for the acting base commander, Captain Lord, and finally found him in a barracks card game. Captain Lord informed us that the required forms and the British Islands Administrator's signature needed to obtain our own ZD8 calls would not be available until Monday morning. Meanwhile, he authorized the use of your call, ZD8KG, for us as guest operators. He presumed your kind permission since you were not then on the island.

The authorization seemed adequate, as we had the word of the *Lord*, so we rushed over to barracks 14 and set up our FT-101E and 18-foot vertical antenna. Our first QSO took place just after midnight on September 17th with W7PFZ on 20 meter SSB.

We then proceeded to have the time of our lives working our first pileup from the fun (rare) end of the QSO. An awesome and enjoyable experience almost every DXer has dreamed of was coming true. All four of us took turns as noted in the enclosed log copy.

We worked 10, 15, and 20 meter CW and SSB. Conditions on 10 were great, so we used that band a lot in racking up 230 contacts from ZD8KG in about 36 hours.

On Monday, we filled out the required forms, got the necessary signatures, and finally received our own calls. Sandy got ZD8SC, Robert got ZD8RB, Wayne got ZD8WB, and I got ZD8TW. We still had some operating time left, so we returned to the rig and ran off 105 more contacts in the four hours before our plane took off for Brazil.

We totaled five continents, fifty countries, and 325 contacts, of which 101 were with stateside stations. We earned no awards but we had a terrific time.

During some hurried and confused packing, we yanked our antenna off the barracks roof in the middle of our last QSO with WB0TXV on ten meter SSB. A sudden end to our DXpedition. We all had a ball and can't wait to do it again. Our plane will return to Ascension Island in March, 1979, and again in the summer of 1980. We plan to bring multiple rigs next time and to use our newfound experience to cut through the pileups faster. Meanwhile, we left our aircraft number and 73 written with six-foot high rocks on the side of West Bay Hill near the barracks.

We requested everyone we worked to QSL direct to our home calls, but if you or your QSL manager, K4KBL, receive any cards for contacts we made, you can forward them to me. Again, thanks for the use of your call and we hope to see you on a future trip to the island.

Tom Walilko K8NOQ/ZD8TW
712 Sykes Circle
Wright-Patterson AFB OH 45433

BITS AND PIECES

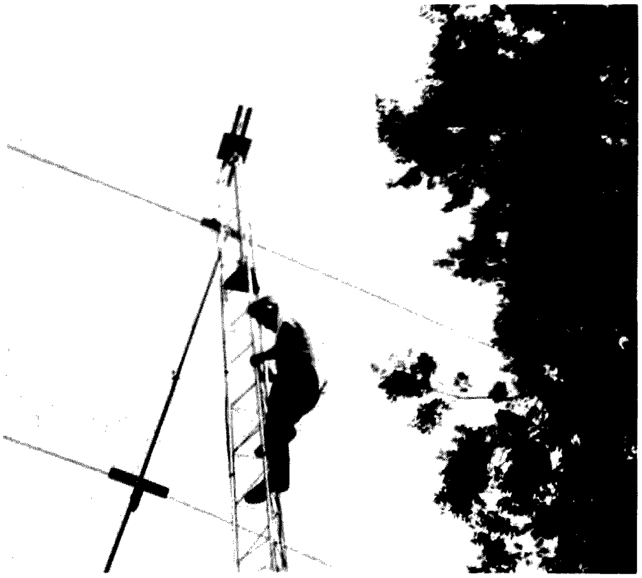
As of this writing, no documentation has reached the ARRL for the HZ1BS/8Z4 neutral zone operation. No documentation, no recognition.

If you still haven't worked KV4, there is really no excuse. KV4AA recently made his 38,000th QSO. Most are CW.

That W0DX who operated from Desecheo recently is Bob Denniston, former president of the ARRL. He runs the Smuggler's Cove Hotel on the north side of the island group.

4U1ITU in Geneva reports that they are receiving QSL requests for 4U1UN in NYC. The correct QSL route for 4U1UN is UN Staff Radio Club, United Nations, Box 20, NYC NY 10017. SASE, of course.

For those who are still confused by the FCC callsign allocations in areas outside the continental U.S., the following should be of some help. The



George Lindley WA5HKW erecting his home-brew three-element beam. George built it from plans in Bill Orr's Beam Antenna Handbook *for about one-third the cost of a commercial beam. He says it works great.*

digit is the key. Alaska stations sign AL7, KL7, NL7, and WL7. The rest are as follows.

Atlantic: 1—Navassa Island; 2—Virgin Islands; 3—Serrana Bank; 4—Puerto Rico. Prefixes are KP, NP, and WP.

Pacific: 1—Baker, Canton, Howland Islands; 2—Guam; 3—Johnston Island; 4—Midway Island; 5—Kingman Reef (K suffix); 5—Palmyra, Jarvis; 6—Hawaii; 7—Kure Island; 8—American Samoa; 9—Wake Island; Ø—Northern Mariana Islands. Prefixes are AH, KH, NH, and WH.

All the foreign nationals have been assigned YS9 prefixes in El Salvador. YS1WPE is now YS9YSS.

The operator at HFØPOL, the Polish base in the South Shetlands, left and the new crew contains no amateurs. QSLs have been printed, but there is a holdup in getting them filled out and mailed.

The ARRL is planning to take the FCC ten meter linear ban to court. As noted before, the innocent hams were the only ones to suffer from this ban. The manufacturers of illegal CB linears either went underground or switched to manufacturing high-powered "amateur transmitters." CBers just plug in their transceiver as a vfo. Passing laws to make it illegal for lawbreakers to break the law has never made much sense to us.

Those working toward WAZ should bear in mind that UAØYAE, heard often on 15 meter CW, is located in Tana Tuva, which is in Zone 23. In fact, any UAØY is in Zone 23.

Gary Yarus WBØMSZ puts out a directory of stateside QSL managers that contains over 1300 managers. This is almost a necessity for the serious DXer and at only $1.00, it's a great bargain. The address is: Gary Yarus, 921 N. Clay Avenue, St. Louis MO 63122, and the list is updated weekly.

UVØBB claims to be the first and only YL operator in Siberia.

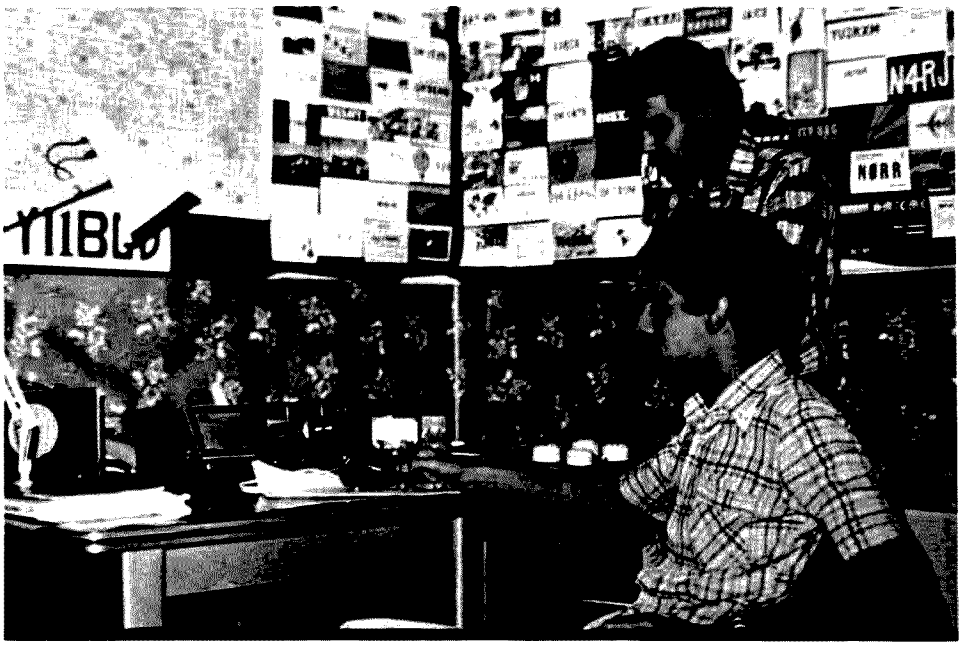
SV1IT is considering a possible Mt. Athos effort this summer. Nothing definite as yet, but if you run across him, you might ask for the latest word.

Amateur radio continues to experience rapid growth. Amateur licenses in the U.S. are expected to top 366,000 by early this year. There were some 28,000 new licenses issued during 1978. The total number of licensed amateurs in the U.S. has increased better than 100,000 since 1975. CB licenses, on the other hand, dropped below 100,000 per month last summer for the first time in several years. Look for several of the larger CB equipment manufacturers to jump into the amateur market.

QSL manager ON5TO notes that the true-blue 9U5CA has not been active since 1971. The one showing in '76-'77 was a pirate. Only 9U5CB, 9U5DS, and 9U5CR are legit at present.

The U.S. and Surinam, PZ, completed a reciprocal operating agreement on October 12. Amateurs of either country wishing to operate in the other country can do so upon application to the proper authorities. Information on this or any other reciprocal operating agreement can be obtained by sending an SASE to the ARRL. Reports indicate a reciprocal agreement with Spain is now in the works.

Ever wonder what the shack of a rare DX station looks like? Here's the operating position of the much-sought-after YI1BGD, the only station currently active in Iraq. Pictured are ops Majid (seated) and Saad, along with their Atlas transceiver. Can you spot your QSL on the wall? Thanks to Jack Winterbourne VE3ITO and the CARF News Service for the photo.



A note from K5OVC straightens out the Argentine-Antarctic callsign designations. LU-ZA, ZG, and ZM are South Orkneys. LU-ZY is South Sandwich. LU-ZC, ZI, ZO, SZ, and ZT are South Shetlands. Others are Antarctica.

Jim Henderson, who spent several months signing ZM7AH from the Tokelaus a few years back, wants to clean up any remaining need for ZM7AH cards and seal the logs permanently. Anyone still needing a card can reach Jim at 13490 Mt. Hood, Reno NV 89506.

The Mellish Reef operation, VK9ZR, managed some 16,000 contacts despite being plagued by generator problems that limited their output.

K4OD notes that he still has all logs from his previous overseas assignments and will be glad to confirm any contacts. Anyone needing a card from OA4DX ('68-'71), HP1XOD ('70-'71), PY1ZAL ('71-'73), EP2OD ('75-'77), or 9D5B ('76-'77) can reach Carl at PO Box 135, Front Royal VA 22630. SASE, of course.

EI8H is a legitimate station, but any EI8H/xx you hear is a definite phony. Pat has been getting loads of QSLs for these operations, but all are going into the trash and he requests that no more be sent.

ZD9GG can often be found on a list operation run by WA7ZTL on 14245 kHz around 1445Z. An Asahi newspaper recently took some aerial photos of Okino Torishima. The outlines of the barrier reef are quite distinct and the foundation of the never-built weather station can be seen in the center. Only two rocks are visible at high tide. One is five feet tall. It is difficult to imagine another operation taking place from here for quite some time.

The DX gathering on 14225 kHz after 1500Z is a great hunting ground. Check it out.

The first DXCC for 160 meter operation was issued on November 15, 1976. Since that time, twelve have been issued. #1 went to W1BB, of course, #2 to W1HT, #3 to W8LRL and KV4FZ (two were issued), #5 to K1PBW, #6 to W4BRB, #7 to W2QD, #8 to W2DEO, #9 to W4QCW, #10 to W4YWX, #11 to K4CIA, and #12 to W9NFC. The east coast pretty well has a lock on this award.

8J1JCI was a special station on from the Japanese Chamber of Commerce and Industry Centennial Exhibition.

QSL INFORMATION

In the November column, a typo snuck in directing QSLs for GU5CIA, GU4EON, and GU3YIZ to K5YY. This was an error and San says no more, please. The correct route is to N6MA, whose address is listed below.

3D6BA to WA4HNL
3YØBZ to VE7ZQ
3Y5DQ/3Y1VC to LA5NM
4079WARC to YU2DX
4NØD to YU2CQ
4N2EC to YU1JAS
7P8BH to WB9ZZK
8J3ITU to JH3DPB
9J2JN to WB2IZN
9K2FX to W4KA
GU5CIA to N6MA, 3800 J Street, Oxnard CA 93030
A7XAH to DJ9ZB
EX9A to Box 88, Moscow
H5RAC to WA4HNL
HH2DX to George Werner, 1045 Le Brun, Jacksonville FL 32205
HZ1AB to K8PYD
J28AZ to I8JN
JY3ZH to DJ9ZB
KA1MI to WB1GXU
KA1NC to K4JEX
KG4KG to YASME
LU3ZY to SARA, Malabia 3029, 1425 CF, Buenos Aires
NØTG/KP1 to Randy Rowe, 3237 Connecticut Drive, St. Charles MO 63301
S8GEH to WA4HNL
TFØDF to K4SAK
ZL3HI/C to N2CW, 207 West Fifth Street, Ship Bottom NJ 08008

Thanks to *The West Coast DX Bulletin*, the Long Island DX Association *Newsletter*, and *Worldradio Magazine* for much of the preceding information.

AMATEUR RADIO IN IRAQ

During a business trip to

Baghdad in September, 1978, I contacted Majid Abdulhamid, Chief Operator of the Radio Club of Baghdad, amateur radio station YI1BGD.

Majid gave me telephone directions to find the club premises, now located in the building of the General Directorate of Scientific Welfare in the Azamia district of Baghdad. This building also houses other scientific clubs.

I was met by Majid and another club operator, Saad Al Tai, both of whom accorded me a very courteous welcome.

On being informed of the general interest of North American amateurs in the situation of ham radio in Iraq, they explained their present status.

YI1BGD is the only legal ham station in Iraq at present. Majid is holder of the license, which is limited to the 20 meter band and 100-Watt input.

The club hopes to be permitted soon to operate on other bands and with higher power.

The present membership, besides Majid, consists of seven operators, including two YLs. Majid expects the club to grow as their activities become more widely known.

The whole operation was made possible through a radio course given by YU1NFV, who has since left Iraq.

The club station commenced operation on April 14, 1978, and has logged a respectable number of countries and QSOs since that time.

The present station is equipped with an Atlas 210 and a two-element quad which is operated manually. Recently, they received a donation from Japan of a Yaesu FT-101, which is awaiting clearance at customs pending the revised station license.

YI1BGD's operating schedule is Monday and Wednesday on 14210 MHz, and on Friday from 2000 UTC until 0100 UTC, their beam is directed at North America. At that time they have regular skeds with VO1CU (Gordon) and I2CBM (Bert) who act as control stations on their behalf. The Friday frequency is 14310 MHz.

When I enquired if they had any QSLs for VE3-land which I could carry back, they showed me the station log which indicated almost 100 percent QSL response from them. Those hams who have sent QSLs are quite certain to receive confirmation, but it will take time. It does not appear that the club takes long to respond, but the distance and conditions really slow things down.

The club has received some publicity in the Long Island DX Association bulletin, one of the British magazines, and locally in an Arabic publication.

My friends were kind enough to let me take a few pictures of them and their station (I hope the film survives the security checks on the return trip), and also gave me a small black and white print of four of the operators in the shack—Kamal, Majid, Mohammed, and Dhia.

Judging by the enthusiasm of these two men, the DX hounds will continue making regular contact with YI1BGD, but it is doubtful that there will be any other YI stations for some time. This information came to us courtesy of Jack Winterbourne VE3ITO, and was first published in the Burlington, Ontario ARC bulletin.—Ed.

FCC

Reprinted from the Federal Register.

ADMINISTRATION OF TELEGRAPHY EXAMINATIONS TO HANDICAPPED APPLICANTS FOR OPERATOR LICENSES IN THE AMATEUR RADIO SERVICE

Order extending time for filing comments and reply comments

AGENCY: Federal Communications Commission.

ACTION: Order Extending Time to File Comments.

SUMMARY: The FCC is inquiring into the administration of its telegraphy examinations to handicapped persons who apply for amateur radio licenses. The comment period ends November 30, 1978. Mr. Norman Kaplan has petitioned to extend the comment period. The comment period is being extended to encourage as wide a participation in the proceeding as possible.

DATES: The comment period is extended to March 30, 1979. The reply comment period is extended to April 30, 1979.

ADDRESSES: Send comments to: The Secretary, FCC, 1919 "M" Street NW., Washington, D.C. 20554.

FOR FURTHER INFORMATION CONTACT:

Mr. Robert Cassler, Personal Radio Division, Safety and Special Radio Services Bureau, 202-634-6620.

SUPPLEMENTARY INFORMATION: See attached document.

Adopted: November 21, 1978.

Released: November 24, 1978.

In the matter of the administration of telegraphy examinations to handicapped applicants for operator licenses in the Amateur Radio Service, Gen Docket No. 78-250.[1]

1. On August 24, 1978, the Commission released a Notice of Inquiry into the administration of telegraphy examinations to handicapped applicants for operator licenses in the Amateur Radio Service. Comments were due no later than November 30, 1978. Reply comments were due no later than December 29, 1978.

2. A petition to extend the comment period to March 30, 1979 was submitted by Mr. Norman Kaplan of the Disabled American Veterans, North Miami Beach, Florida. Mr. Kaplan cites the need for as many handicapped persons to participate in the proceeding as possible. Because of the special nature of this proceeding, we agree with petitioner.

3. Accordingly, the Commission, by the Chief, Safety and Special Radio Services Bureau, pursuant to delegated authority granted to him by § 0.331 orders that the comment period and the reply comment period in General Docket No. 78-250 are extended to March 30, 1979, and April 30, 1979, respectively.

Carlos V. Roberts,
Chief, Safety and Special Radio Services Bureau.

OSCAR Orbits

Courtesy of AMSAT

FINDING OSCAR

The listed data tells you the time and place that OSCAR 7 and OSCAR 8 cross the equator in an ascending orbit for the first time each day. To calculate successive OSCAR 7 orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the day's first ascending (northbound) equatorial crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world from you, it will descend over you. To find the equatorial descending longitude, subtract 166° from the ascending longitude. To find the time OSCAR 7 passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR 7 when it is within 45 degrees of you. The easiest way to determine if OSCAR is above the horizon (and thus within range) at your location is to take a globe and draw a circle with a radius of 2450 miles (4000 kilometers) from your QTH. If OSCAR passes above that circle, you should be able to hear it. If it passes right overhead, you should hear it for about 24 minutes total. OSCAR 7 will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15° east or west of you, add another minute; at 30°, three minutes; at 45°, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

OSCAR 8 calculations are similar to those for OSCAR 7, with some important exceptions. Instead of making 13 orbits each day, OSCAR 8 makes 14 orbits during each 24-hour period. The orbital period of OSCAR 8 is therefore somewhat shorter: 103 minutes.

To calculate successive OSCAR 8 orbits, make a list of the first orbit number (from the OSCAR 8 chart) and the next thirteen orbits for that day. List the time of the first orbit. Each successive orbit is then 103 minutes later. The chart gives the longitude of the day's first ascending equatorial crossing. Add 26° for each succeeding orbit. To find the time OSCAR 8 passes the North Pole, add 26 minutes to the time it crosses the equator. OSCAR 8 will cross the imaginary San Francisco-to-Norfolk line about 11 minutes after crossing the equator. Mode A: 145.85-.95 MHz uplink, 29.4-29.50 MHz downlink, beacon at 29.40 MHz. Mode J: 145.90-146.00 MHz uplink, 435.20-435.10 MHz downlink, beacon on 435.090 MHz.

Oscar 7 Orbital Information

Orbit	Date (Feb)	Time (GMT)	Longitude of Eq. Crossing °W
19272	1	0040:17	71.4
19285	2	0134:34	85.0
19297	3	0033:54	69.8
19310	4	0128:11	83.4
19322qrp	5	0027:31	68.3
19335	6	0121:48	81.8
19347X	7	0021:09	66.7
19360	8	0115:26	80.3
19372	9	0014:46	65.1
19385	10	0109:03	78.7
19397	11	0008:23	63.6
19410qrp	12	0102:40	77.2
19422	13	0002:01	62.0
19435X	14	0056:18	75.6
19448	15	0150:35	89.2
19460	16	0049:55	74.0
19473	17	0144:12	87.6
19485	18	0043:32	72.5
19498qrp	19	0137:49	86.1
19510	20	0037:10	70.9
19523X	21	0131:27	84.5
19535	22	0030:47	69.4
19548	23	0125:04	82.9
19560	24	0024:24	67.8
19573	25	0118:41	81.4
19585qrp	26	0018:01	66.2
19598	27	0112:18	79.8
19610X	28	0011:39	64.7

Oscar 8 Orbital Information

Orbit	Date (Feb)	Time (GMT)	Longitude of Eq. Crossing °W
4636Abn	1	0133:06	65.9
4650Abn	2	0138:19	67.2
4663Jbn	3	0000:17	42.7
4677Abn	4	0005:29	44.0
4691Abn	5	0010:42	45.4
4705Abn	6	0015:54	46.7
4719X	7	0021:06	48.0
4733Abn	8	0026:18	49.3
4747Abn	9	0031:30	50.6
4761Jbn	10	0036:43	51.9
4775Jbn	11	0041:55	53.3
4789Abn	12	0047:07	54.6
4803Abn	13	0052:19	55.9
4817X	14	0057:31	57.2
4831Abn	15	0102:43	58.5
4845Abn	16	0107:55	59.8
4859Jbn	17	0113:07	61.1
4873Jbn	18	0118:20	62.5
4887Abn	19	0123:32	63.8
4901Abn	20	0128:44	65.1
4915X	21	0133:56	66.4
4929Abn	22	0139:08	67.7
4942Abn	23	0001:06	43.2
4956Jbn	24	0006:18	44.5
4970Jbn	25	0011:30	45.9
4984Abn	26	0016:42	47.2
4998Abn	27	0021:54	48.5
5012X	28	0027:06	49.8

New Products

from page 26

ing. The peak reading feature is a must for SSB transmitters. The MP1 also will display swr. Swr is measured directly, without having to use extra charts or graphs.

For ease of installation, the MP1 has a removable coupling unit which may be placed up to 4 feet from the meter.

The MP1 is portable. It contains the latest in low-power ICs and is powered by a 9-volt battery. For long-term non-portable operation, an optional ac adapter is available.

A low-battery-voltage indicator has been built into the wattmeter to indicate when the battery needs changing.

The MP1 will provide all the functions and features needed to maintain an efficient, well-operating HF amateur station.

For more information, please contact your local dealer or *Mirage Communication, PO Box 1393, Gilroy CA 95020; (408)-847-1857.* Reader Service number M75.

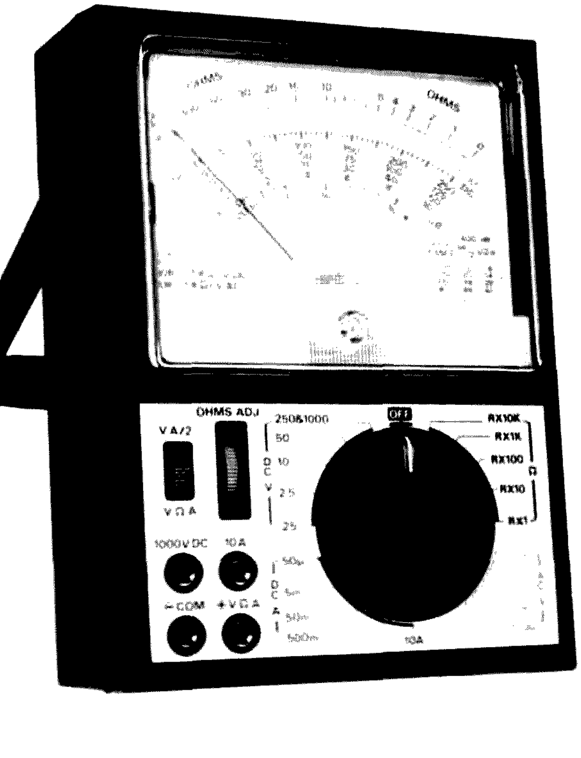
NEW MURA VOM MULTITESTER OFFERS DUAL-RANGE SENSITIVITY

Mura Corporation, manufacturer of home entertainment products, CB accessories, and electronic parts and components, has introduced a new precision VOM multitester with extremely high dual-range sensitivity.

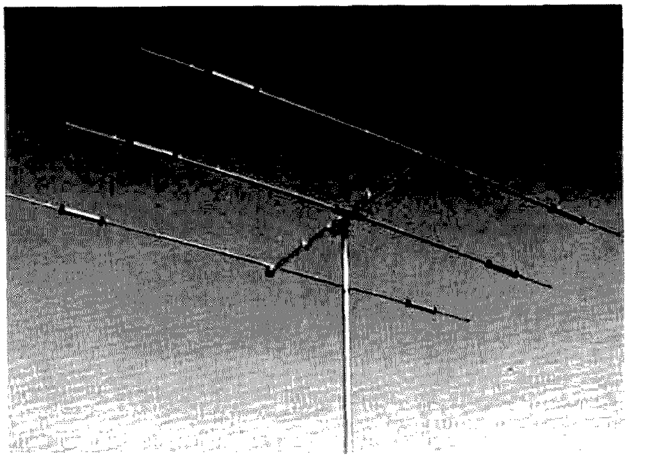
Designated Model 85-M, the new VOM multitester is ideal for use where measurements must not appreciably disturb a particular circuit being tested. It features high 50,000-Ohms/volt dc and 10,000-Ohms/volt ac sensitivities on one set of voltage ranges, and 25,000-Ohms/volt dc and 5,000-Ohms/volt ac on a second group of voltage ranges.

In conjunction with a power supply, the 85-M can be used to measure capacitance and inductance. Special circuitry has been included to protect the meter movement against accidental overload, and a mirror arc has been provided to help eliminate parallel error from readings. In addition, a convenient carrying handle, attached to the unit's high-impact casing, can be positioned for easy meter reading.

The new 85-M measures 6¾" x 5" x 2" and weighs 1 lb., 5 oz., with batteries. *Mura Corporation, 177 Cantiague Rock Road, Westbury NY 11590; (516)-935-3640.* Reader Service number M79.



The Mura Model 85-M VOM multitester.



Wilson's "System Three."

"SYSTEM THREE" BY WILSON

Wilson Electronics is proud to announce the latest in triband antennas for 10-15-20 meters. The "System Three" features lightweight design, heavy-duty materials, low swr across all three bands, a boom length of 14' x 4", wind survival of 100 mph, direct feed with 52-Ohm coax or with a balun, and a capability of 2000 Watts.

For more information on the "System Three," see your favorite dealer or contact *Wilson Electronics, Consumer Products Division, PO Box 19000, Las Vegas NV 89119.* Reader Service number W2.

YAESU'S FT-202R

"The Handie," a new miniaturized two meter handheld transceiver (Model FT-202R), has now been added to the Yaesu line of amateur radio equipment.

Measuring only 67 x 49 x 171 mm, the one-Watt-output, six-channel hand-held should please the most critical user with its excellent receiver performance and high-quality F3 transmitted signal.

The receiver is double-conversion, with a sensitivity measurement of 0.32 mV for 20-dB quieting. "The Handie" covers the entire two meter band and includes a flexible rubber ducky antenna and attractive carrying case. Crystals are supplied for three channels.

Other features include a combination "S"-meter and tuning meter, tone burst or subaudible squelch (optional), built-in speaker, and condenser microphone. Batteries required (not supplied) may be AA-size or nicads to provide 9.6 V dc (not to exceed 12 V dc).

For complete details on this new hand-held transceiver, see your Yaesu dealer or write to *Yaesu Electronics Corporation, PO Box 498, Paramount CA 90723.* Reader Service number Y1.

NEW CUSHCRAFT HF VERTICALS

Many hams are convinced that to work meaningful DX they need a couple of thousand Watts and a monster antenna array. While that undoubtedly helps, where is it written that the ham suffering a money or space cramp can't compete for his day in the DXCC sun?

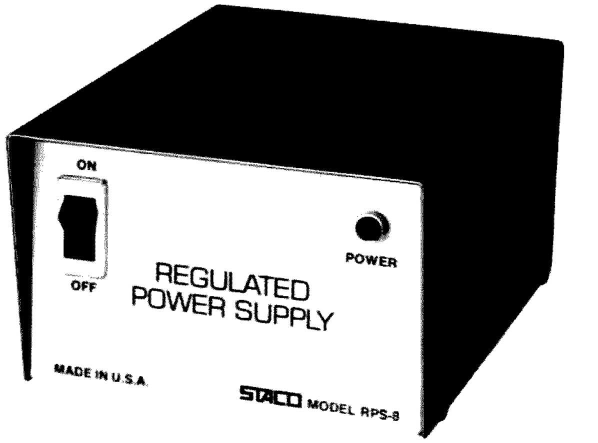
Three new Cushcraft verticals, the ATV-3, ATV-4, and ATV-5, provide a commonsense solution to a commonplace problem. Specifically designed for the DXer, these antennas provide the low angle of radiation necessary for long-haul DX communicalton, along with the performance and quality long associated with the Cushcraft name. The ATV-3, ATV-4, and ATV-5 operate over the 10, 15, and 20 meter amateur bands, with the ATV-4 having built-in 40 meter coverage and the ATV-5 all set for complete 5-band operation.

All antennas feature a built-in PL-259 coax connector and stainless steel hardware for all electrical connections, and are matched to 50 Ohms and rated for a full 2000 Watts PEP. Factory-marked tubing and plain English instructions make assembly a snap.

Built to withstand the severest weather, the ATVs feature specially-designed high-Q traps employing large-diameter enameled copper wire and solid aluminum air-dielectric capacitors. The trap forms are manufactured from filament-wound fiberglass for minumurn dielectric loss and high structure strength. Durable 6063-T832 aluminum tubing with 0.058" (1.5 mm) wails used for the vertical radiator and the heavy-duty phenolic base insulator ensure long life and durability. All this adds up to an antenna line that comes through winter after winter a winner!

For more information and a

The new Mizuho SX-59 preselector from Gilfer.



Staco's new RPS-8 power supply.

full-color catalog highlighting the entire Cushcraft HF, VHF, and UHF antenna line, write to *Cushcraft, PO Box 4680, Manchester NH 03108.* Reader Service number C67.

GILFER INTRODUCES VERSATILE NEW RF PRESELECTOR/ PREAMPLIFIER WITH AUTOMATIC ANTENNA SWITCHING

If you are missing out on those weak DX signals because your receiver needs more sensitivity, here's a low-cost way to hype it up: Add the new Mizuho SX-59 preselector/preamp from Gilfer.

The SX-59 adds 20 dB of gain (3 or 4 S-units) with low noise. Tunable in 3 switched bands from 3 to 30 MHz, the unit is completely automatic in antenna switching—turn it on and it connects itself to the antenna, turn it off and the antenna is reconnected to the receiver. No manual bypass is needed.

Beautifully styled in a solidly-made beige-colored cabinet, the SX-59 has a built-in, switchable, 20-dB rf attenuator to cope with excessively strong signals, plus a range switch, rf gain control, tuning dial, LED "on" indicator, input and output coax (SO-239 and phono plug) antenna connectors, "remote" terminals, and a built-in power supply for 117 V ac.

It's easy to use. Just select the band and tweak the tuning dial for the maximum signal. You'll be surprised at what you're missing. And if you've an old single-conversion receiver, the SX-59 will also reduce those images by 4 or 5 S-units.

For complete information, write *Gilfer, Box 239, Park Ridge NJ 07656.* Reader Service number G6.

NEW STACO REGULATED 8-AMP POWER SUPPLY

A new regulated 8-Amp power supply from Staco, Incorporated, is built to operate amateur, commercial, and industrial transceivers, as well as other 12-volt dc equipment, from 120 volts ac.

The solid-state Staco RPS-8 is ideally suited for fixed output power. A unique current fold-back circuit and internal circuit breaker provide automatic dual overload and short-circuit protection. In the event of component failure, an automatic crowbar circuit protects equipment from high voltage. The RPS-8 features a surge current of 8.0 Amps, a continuous current of 6.0 Amps, and a full 13.8-volt dc output. Ventilated steel housing is clad with black and white vinyl to prevent scratches or mars. Each unit is complete with input power cord, switch, pilot light, and operating instructions. Output connections are easily made to the terminal board on the rear of the unit. The RPS-8 measures 3-5/8 inches x 5 inches x 8 inches, and is backed by a 90-day limited warranty.

For more information, contact *Staco, Incorporated, 301 Gaddis Boulevard, Dayton OH 45403.* Reader Service number S78.

Corrections

I would like to offer a reed relay update to my October, 1978, article ("Happiness Is A Smart Scanner"). This information is from Allied's catalogue #790 (page 180). The following relays may be used: stock no. 929-377 (mfr. type MRR1ADS), stock no. 850-1552 (mfr. type W107DIP-3), or stock no. 703-2012 (mfr. type AMP2012). Also, please note my new address.

John P. Skubick K8JS
791 106th Ave. N.
Naples FL 33940

I just had a letter from Harold Drennon WØFSC who was nice enough to point out an error that he found in my OSCAR turnstile antenna article in the November, 1977, issue, page 63, Fig. 3. In the 2m driving harness, the wording below coaxial line 2 read λ/RG-62A/U, but should be λ/4 RG-62A/U. This is the first notice of a problem I have had, and I am sorry it was not caught by me in the proofs. The original was okay, but the proofs are still my responsibility. I thoroughly checked the entire article again, while I was at it, and, sure enough, I found one of my own errors. Fig. 1 caption should be: "Vertical mast is 10' ± 5' . . ." Surely the builders caught that one or they got strange looks when they went shopping!

Dave Brown W9CGI
Noblesville IN

Eric Corbett WD8PYE and others have pointed out a few errors in the wiring diagram and description of the Novice keyer on page 44 of the March, 1978, *73 Magazine*. The following should be noted:

Fig. 1: IC1 pin 7 should be pin 4. C2 should be reversed (negative side grounded).
Fig. 2: D2 should be connected to R6 at the crossover point.
Table 1: With power applied but key not contacting, IC2 pin 5 should be low (not high as indicated).

Several hams have written with these difficulties, along with shorted diodes, etc. None of them has written to me a second time, so hopefully I have been able to explain enough to them to get their keyers working. If you are having any difficulties, and will describe any voltages differing from those in the article (with above corrections), I'll help you out.

Michael Windolph WØOGX
Chaska MN

Ham Help

I need information on how to update or increase the usability of a Hammarlund Super-Pro or BC-779 shortwave receiver. Any info would be appreciated.

Bill Koczon W2HWQ
85 Lakeland Dr.
Bricktown NJ 08723

I would like to convert a Johnson Canadian model Messenger 352 mobile SSB/AM solid-state 23-channel CB transceiver into a 10 meter mobile transceiver. I would greatly appreciate receiving information regarding this conversion.

Raymond Bolvin VE2BOL
282 Boul Monaco
Duberger, Quebec
Canada G1P 3H4

Contests

from page 24

other ZS1 stations. All modes or combination of modes permitted. All bands or combination of bands permitted. Closing date for the award is July, 1979. No QSL cards are required. Send a copy of your log verified by 2 local amateurs. Fee: US $1 or 10 IRCs; ZS R1.00. Send applications to: The Award Manager, ZS1MO, PO Box 5100, Cape Town 8000, Republic of South Africa. A special indication is given for VHF contacts.

SECOND ANNUAL INTERNATIONAL SSTV CONTEST

The contest is sponsored by R. Brooks Kendall W1JKF and David Ingram K4TWJ.

CONTEST RULES:

Contest is held annually on the second full weekend of March from 1500 to 2200 GMT, Saturday and Sunday, 3/10/79 and 3/11/79. All amateur bands between 3.5 and 29.7 MHz may be used.

EXCHANGE:

Exchange of pictures should include callsigns, RST report, and contest number. FCC rules require verbal exchange of callsigns for U.S. stations. Do not include contact number.

CREDITS:

1 point for each station worked. A station may be worked once on each band for credit. 1 point for each state or province worked. 5 points for each country worked. 5 points for each continent worked. Total score is the sum of all the credits. Excessive discrepancies in the contest entry may cause disqualification. Entries become the property of the contest committee. The decisions of the contest committee are final.

ENTRIES:

Activity sheets should show station worked, state or province, country, and band (80, 40, 20, 15, 10). Summary sheets should show number of stations worked, number of states or provinces worked, number of countries worked, number of continents worked, and total score. Contest entries should be postmarked no later than 4/10/79. Top scorer will be awarded a certificate and a year's subscription to the magazine of his or her choice. Certificates will also be awarded to the top scorer for the most countries and most continents worked.

Send entries to either: R. Brooks Kendall W1JKF, 10 Stocker Street, Saugus MA 01906, or David Ingram K4TWJ, Eastwood Village, No. 1201 South, Rt. 11, Box 499, Birmingham AL 35210.

THE WORKED ALL WEST AUSTRALIAN SHIRES AWARD AND THE WORKED ALL WEST AUSTRALIAN POST CODES AWARD

To become eligible for these awards, it is necessary for overseas amateurs to work 40 shires and 50 post codes, respectively, with proof of the QSOs to be forwarded to the Contest Committee, c/o PO Box 6250, Hay Street, Perth 6000, Western Australia, along with 10 IRCs or equivalent for the initial award. Subsequent stickers will be issued free, although return postage will be appreciated.

A map of West Australia showing all shires is available from the above address for $2 Australian.

Ham Help

I am with the Canadians in Lahr, West Germany. My problem is this: The D.A.R.C. over here has a large number of QSL cards that belong to DA call holders. I am in the position of trying to locate amateurs and pass on the cards. I am *not* a QSL bureau, just a locating service.

At the time of writing, I find myself with over 5000 cards, DA1, DA2, DA4, and DJ (foreign civilians), all of which the D.A.R.C. is unable to locate. So, for some time now, I have been trying to locate same, with little or no luck. Most of the U.S. Army DA call holders are moving around all the time, including going back home, so a lot of amateurs are without their QSL cards. If you are missing some QSLs, let me know.

Michael R. Jackson
VE3KQI/DA1UO
Postfach 1771
7630 Lahr
West Germany

In the October, 1978, issue of *73 Magazine*, in Ham Help, I asked for a simple modification for the popular Kenwood TR-7400A in order to receive the Civil Air Patrol frequency of 148.15 MHz. A reader (Gerald Gray WAØIKA of Topeka) came up with the mod, and I would like to pass it along for use by other 7400 owners. The only components needed are a small switch and a diode. Connect as follows: With the top cover of the radio removed, install an SPST switch with one lug grounded to the cover. Locate the switch directly behind the CT1 terminal. Connect the cathode of a 1N914 diode to the other switch lug. Add a 2" piece of wire to the anode, and slip shrink tubing over switch lug, diode, and wire. Strip the other end of the wire approximately ½" and wrap it around terminal CT1 on PD board X50 1380 10 (refer to Kenwood manual); no solder is required. Install the cover. Label the switch "Receive, + 600." With this switch in the closed position, I can receive the CAP frequency of 148.15 by setting the display dial of my transceiver on 147.550, and, with the TX offset of +600, I can simplex on the frequency. No change is required to transmit on this frequency, and just turn the switch off to receive the frequency displayed. My thanks to Gerald and *73 Magazine*.

George E. Taylor WA4GUW
Muscle Shoals AL

I need to get in touch with other amateurs, faculty members on the college or university level, who teach biomedical electronics and instrumentation. I'm on the faculty of the University of Texas School of Allied Health Science in Houston.

MDs interested in the subject are also very welcome. However, I am seeking resources on at least the post-graduate level in Health Related Science. In addition, those interested should be "teaching oriented."

Jim McClure WB5MHA
801 S. Braeswood, Apt. 1313
Houston TX 77031

We recently obtained a multimeter, ME-26 D/U, serial no. 7747 (similar to HP-410B), manufactured by Sentinel Electronics, Inc. The company is not listed in the *Electronics Buyer's Guide*, and may be out of business. We need the operator's manual and schematic. Thanks for any assistance.

Heritage Christian School
Warren Pettit
Box 50002
6401 East 75th St.
Indianapolis IN 46250

I need the manual for a Heathkit Model V-6 vacuum tube voltmeter. I will gladly reimburse reasonable duplicating and mailing expenses, or I will duplicate on receipt and send back by return mail. Thanks.

V.F. Smith VE1BEA
46 Beaconsfield St.
Fredericton, New Brunswick
Canada E3B 5H2

I would like to hear from people who are using the FCC experimental band and learn where I can get plans for transceivers, transmitters, and receivers.

Rick Todd KA8AKL/N
14470 Basslake Road
Newbury OH 44065

I need a photocopy of *Surplus Schematic Handbook* (red and black, with white schematic on cover, part of *CQ* series, 8½ x 11 inches). Also need photocopy of Wolf's *Motorola Schematic Digest* and photocopy of manual or diagram for National NC-200 receiver.

Finally, I need Knight Signal Tracer and any data, and rigs for two meters in any condition.

John C. White WB6BLV
560 North Indiana
Porterville CA 93257

I would like to obtain a copy of the manual, or at least the schematic, for the Heathkit Model VF-1 vfo. I'll be happy to pay postage and copy costs. Thanks!

Mark F. Allen WD6GZJ
11401 Snowdrop Ave.
Fountain Valley CA 92708

I have an old Hallicrafters S-85 receiver and would like to modify and utilize it for DX work as the receiver is extremely sensitive. I am in need of a schematic and operator's manual. Thanks.

Charles Bott DL-579/WW
PSC Box 56
APO NY 09123

I am in need of an operations manual and schematic for a Dumont Labs type 350-R oscilloscope. I will pay for copies, or whatever arrangement we can come up with.

James G. Brown
15 New Ocean St.
Lynn MA 01902

I need a manual or complete schematic for a Motorola 41 V dispatcher (high band, 110/12 volts). It is needed for a club project.

Chuck Bennett WB8GQW
17060 Paver-Barnes Rd.
Marysville OH 43040

Social Events

MADISON WI
FEB 8-11

The 1979 Spirit of Ballooning Fiesta will be held on February 8-11, 1979, in Madison, Wisconsin. This is a national convention of hot-air balloonists. On the 8th and 9th, 10 balloons will take off each afternoon. On the 10th and 11th, eighty balloons are scheduled to lift off. Amateurs interested in providing communications should contact Clyde Downing W9HSY, PO Box 3403, Madison WI 53704, (608)-244-4744, or contact him on the Madison 16/76 two meter machine. Please provide days and type of equipment available (base, mobile, HT, etc.). K9BIL or K9VAL may also be contacted.

TRAVERSE CITY MI
FEB 10

The Cherryland Amateur Radio Club will hold its annual Swap & Shop on February 10, 1979, from 9:00 am to 4:00 pm, at Northwestern Michigan College Technical Center, Front St., Traverse City, Michigan. For information, please contact Greg North, Box 115, Lake Leelanau MI 49653.

MANCHESTER NH
FEB 10

The Interstate Repeater Society will hold its 3rd annual auction and hamfest on February 10, 1979, beginning at 9:00 am, at the Manchester Armory, across the Amoskeag Bridge from I-93, in Manchester, New Hampshire. There will be commercial exhibits, and the auction will be held rain or shine. Admission and parking are free. Talk-in on 146.52, 146.25/.85, and 224.86/223.46. For information, contact Gary A. Delong WB7NOH/KA1BCA, Interstate Repeater Society, PO Box 94, Nashua NH 03061.

MANSFIELD OH
FEB 11

The Mansfield midwinter hamfest/auction will be held on February 11, 1979, in a heated building at the Richland County Fairgrounds in Mansfield, Ohio. There will be prizes and a flea market. Doors will open to the public at 8:00 am. Talk-in on 146.34/.94. Advance tickets are $1.50; $2.00 at the door. For information, contact Harry Frietchen K8HF, 120 Homewood,

Mansfield OH 44906, or phone (419)-529-2801 or (419)-524-1441.

LANCASTER PA
FEB 18

The 7th annual Lancaster hamfest will be held on Sunday, February 18, 1979, at the Guernsey Sales Pavilion, US Rt. 30 & PA Rt. 896, Lancaster, Pennsylvania. Doors will open at 8:00 am and there will be a prize drawing at 2:00 pm. Admission is $3.00, and table reservations are $2.00 in advance. There is a new, larger indoor flea market area. Food and soft drinks will be available. Talk-in on 146.01/.61. For further information, contact SERCOM, PO Box 6082, Rohrerstown PA 17603.

MARLBORO MA
FEB 24

The Algonquin Amateur Radio Club will hold its annual electronic flea market on Saturday, February 24, 1979, from 10:00 am to 4:00 pm, at St. Mary's School Hall on Broad Street in Marlboro, Massachusetts. There is easy access to the Hall from I-495 via Rt. 20 east. Seller setup is from 9:00 am to 10:00 am. Talk-in on .52. Sellers should contact Charlie W1BK at (617)-562-5622.

VIENNA VA
FEB 25

The Vienna Wireless Society will hold its annual Winterfest on Sunday, February 25, 1979, at the Vienna Community Center, Vienna, Virginia. There will be tables, sales, prizes, food, and frostbite tailgating. Doors open at 6:30 am for vendors and 8:00 am for the general public. Admission is $3.00, including one prize ticket; $2.00 for an extra prize ticket, and $1.00 for frostbite tailgaiting. Preteens with parents are free. Tables range from $2.00 to $5.00, depending on the quantity. Reservations close on February 15, 1979. For reservations, contact Carroll N. Guin, 7533 Oak Glen Court, Falls Church VA 22042. For information, contact the Vienna Wireless Society, PO Box 418, Vienna VA 22180.

LIVONIA MI
FEB 25

The Livonia Amateur Radio Club would like to announce that the 9th annual LARC Swap 'n Shop will be held on Sunday, February 25, 1979, from 8:00 am to 4:00 pm, at the new location of Churchill High School in Livonia MI. Tables, door prizes, refreshments, and free parking will be available. Talk-in on 146.52 simplex. Reserved table space of 12-foot minimum is available. For further information, send an SASE to Neil Coffin WA8GWL, c/o Livonia Amateur Radio Club, PO Box 2111, Livonia MI 48151.

LAPORTE IN
FEB 25

The LaPorte Amateur Radio Club will hold its winter hamfest on Sunday, February 25, 1979, at the LaPorte Civic Auditorium, LaPorte, Indiana. There is a $1.00 table charge. Donation is $2.00 at the gate. Talk-in on .01/.61 and .52. For more information, contact LARC, Box 30, LaPorte IN 46350.

AKRON OH
FEB 25

The Cuyahoga Falls Amateur Radio Club will hold its annual electronic equipment auction and flea market on Sunday, February 25, 1979, at North High School, Akron, Ohio, from 9:00 am to 4:00 pm. Tickets are $2.00. You may bring your own tables, and there will be some available for $2.00 each. There will be refreshments, prizes, and a grand prize of a Triton IV. There is easy access to the high school on the Tallmadge Avenue off-ramp and the North Expressway (Rt. 8). Talk-in on 146.52 and 146.04/.64. For details, write CFARC, PO Box 6, Cuyahoga Falls OH 44222, or phone Bill Sovinsky K8JSL at (216)-923-3830.

DAVENPORT IA
FEB 25

The Davenport Radio Amateur Club will hold its hamfest on February 25, 1979, at the Masonic Temple in Davenport, Iowa. Admission is $2.00 in advance, $2.50 at the door. Refreshments and tables will be available. Talk-in on .28/.88 and .52. For further information, send an SASE to John S. Birmingham WB0QCC, 2022 Brown St., Davenport IA 52804.

CIRCLEVILLE OH
MAR 4

The King of the Pumpkin Ham Fiesta, sponsored by the Teays Amateur Radio Club, will be held from 9:00 am to 5:00 pm

on Sunday, March 4, 1979, at the fairgrounds coliseum, Circleville, Ohio. There will be an indoor flea market, new and used equipment, door prizes, refreshments, and free parking. Table spaces are available at $3.00 each. Advance admission is $1.00; $2.00 at the door. For advanced reservations and information, contact Dan Grant W8UCF, 22150 Smith Hulse Road, Circleville OH 43113; (614)-474-6305.

STERLING IL MAR 4

Sterling Rock Falls Amateur Radio Society will hold its annual hamfest on March 4, 1979, at the Sterling High School Fieldhouse, 1608 4th Avenue, Sterling, Illinois. Tickets are $1.50 in advance; $2.00 at the door. A large indoor flea market is restricted to radio and electronic items only. There is plenty of free parking available, including an area to accommodate campers and mobile trailers. There will be no advance sale of tables. We will take reservations for commercial enterprises only. There will be bargains, miscellaneous prizes, and food. Talk-in on 146.94. For tickets, write Don VanSant WA9PBS, 1104 5th Avenue, Rock Falls IL 61071. Make checks payable to Sterling Rock Falls Amateur Radio Society. Please include an SASE.

FLEMINGTON NJ MAR 17

The Cherryville Repeater Association will hold its annual hamfest on March 17, 1979, from 10:00 am to 5:00 pm, at the Field House of Hunterdon Central High School, just north of Flemington, New Jersey, on

Route 31. Admission is $2.50 per person. There is plenty of space, with over 200 sellers' tables, and displays from major manufacturers. There will be seminars and door prizes.

VERO BEACH FL
MAR 17-18

The Treasure Coast Hamfest will be held on March 17-18, 1979, at the Vero Beach Community Center, Vero Beach, Florida. Activities will include prizes, drawings, and a QCWA luncheon. Admission is $3.00 per family. Talk-in on 146.13/.73, 146.52/.52, and 222.34/223.94. For information, write PO Box 3088, Vero Beach FL 32960.

JEFFERSON WI
MAR 18

The Tri County ARC Hamfest will be held on March 18, 1979, at the Jefferson County Fair Grounds, Jefferson, Wisconsin. Advance tickets are $1.50. Reserved 6-foot tables are $2.00 in advance, while 6-foot space is $1.00. For information, send an SASE to Glenn Eisenbrandt WA9VYL, 711 East Street, Fort Atkinson WI 53538.

LAWTON OK
MAR 23-25

The Lawton Fort Sill Amateur Radio Club, Inc., will hold its 33rd annual hamfest at the Montego Bay Motel Complex at Lawton, Oklahoma, the weekend of March 23-25, 1979. There will be the usual large flea market, ARRL officials, technical programs, QCWA breakfast, and activities for the ladies.

EAST RUTHERFORD NJ
MAR 24

The Knight Raiders VHF Club, Inc., will hold its world-famous flea market at St. Joseph's Church, East Rutherford, New Jersey, on Saturday, March 24, 1979. Doors open at 10:00 am. There will be free admission and free parking. Refreshments will be available. Flea market tables are available for: $5.00/full table or $3.00/half table, in advance; $6.00/full table or $3.50/half table, at the door. Talk-in on 146.52 and 144.65/145.25. For further information, call Bob Kovaleski at (201)-473-7113 or Jack Mandelberger at (201)-857-0016 (evenings only). Send reservations to: R. Wetzel, 419 Union Ave., Rutherford NJ 07070, and make checks payable to: Knight Raiders VHF Club, Inc.

WAUKEGAN IL
MAR 25

The Libertyville and Munde-

lein Amateur Radio Society will hold its second annual Lamarsfest on Sunday, March 25, 1979, at the J. M. Club, 708 Greenwood Ave., Waukegan, Illinois. Doors will open at 7:00 am. There will be plenty of free parking, door prizes, and a large indoor flea market for radio and electronic items. Tables will be available at $4.00 each. Advance tickets are $1.50; $2.00 at the gate, with children under 10 free. Hot lunch will be available and there will be plenty of commercial exhibits and demonstrations. Talk-in on 146.94. For further information, write LAMARS (include SASE, please) at 1226 Deer Trail Lane, Libertyville IL 60048, or call (312)-367-1599.

MUSKEGON MI
MAR 30-31

The Muskegon Area Amateur Radio Council is sponsoring the ARRL Great Lakes Division Convention and Hamfest at the Muskegon Community College in Muskegon, Michigan, on March 30-31, 1979. This event will feature manufacturers' exhibits, technical forums, and a large swap shop. Ample parking and dining facilities are available. Friday evening at the Muskegon Ramada Inn, there will be a "Ham Hospitality" with libation courtesy of the MAARC and a Wouf Hong initiation. For additional information, contact MAARC, PO Box 691, Muskegon MI 49443, or H. Riekels WA8GVK, (616)-722-1378/9.

COLUMBUS GA
MAR 31-APR1

The Columbus Amateur Radio Club will hold first annual hamfest from March 31-April 1, 1979, at the Columbus Municipal Auditorium, US 27 & 280, Columbus, Georgia. Donation is $1.00 at the door. There will be plenty of free parking and overnight free RV space. Exhibitors and flea market will be inside, with a free flea market outside. Talk-in on 28/88. For advance registration and details, write Bob Glasgow N4BGN, 1503 Layard Drive, Columbus GA 31907; (404)-561-7746.

WILLIAMSPORT PA
APR 29

The West Branch Amateur Radio Association will hold its 15th annual Penn Central Hamfest on Sunday, April 29, 1979, from 11:00 am to 5:00 pm at the Woodward Township Fire Hall, Rt. 220 south from Williamsport. For more information, write Richard Sheasley K3QDA, RD 1, Box 454, Linden PA 17744, or call Tony at (717)-322-6017.

NEENAH WI
MAY 5

The 3-F Amateur Radio Club will hold its annual swapfest on Saturday, May 5, 1979, from 8:00 am to 3:00 pm, at the Neenah Labor Temple, 157 S. Green Bay Road, Neenah, Wisconsin, just off Highway 41 at the Highway 114 or 150 exit. Facilities include a large parking area and a large indoor swap area with a free auction at the end of the day. Food and beverage will be available. Advance admission for tickets and tables is $1.50; $2.00 at the door. Talk-in on 52/52. For reservations, write to Mark Michel W9OP, 339 Naymut Street, Menasha WI 54952.

SALINE MI
MAY 13

The ARROW Repeater Association will hold its annual Swap and Shop on Sunday, May 13, 1979, at the Saline, Michigan, fairgrounds. Admission, including parking on the fairgrounds, is $1.50 in advance and $2.00 at the door. There will be food, prizes, and a covered area for trunk sales, as well as indoor tables. Because of Mother's Day, wives will be given free admission. Talk-in on 146.37/97, 223.18/224.78, and 448.5/443.5 MHz. For additional details, write ARROW, PO Box 1572, Ann Arbor MI 48106, or call George Raub AD8X at (313)-485-3562.

Ham Help

My divorce broke me. (Among other things, I lost my TR-4.) Does anyone have any ham gear to spare? A homebrew 40m CW transceiver would do. Thank you.

Lin Hamilton WB6PAV
14100 Chadron Avenue
#130
Hawthorne CA 90250

Hopefully, your Ham Help column can help me find the information I want. I would like to get in touch with anyone who is still using an old Galaxy V transceiver on the air today and find out what their opinions are of it.

Rick Todd KA8AKL/N
14470 Basslake Road
Newbury OH 44065

I would very much appreciate help from anyone in finding a circuit diagram of the McMurdo Silver Masterpiece VI.

Reg Trickey G3DRB
31 Pensby Ave.
Chester, England

I would like to obtain a copy of the original owner's manual for a Viking "Courier" linear amplifier.

John I. Nelson AA7W
19025 73rd Avenue N.E.
Bothell WA 98011

I need a schematic for a Johnson Model 122 vfo. Any help in obtaining this will be greatly appreciated.

Bill Richmond WD4CPQ
122 E. Adair St.
Louisville KY 40214

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	7	7	7	7	7	7	14	14A	21	21A
ARGENTINA	14A	14	14	7	7	7	14	21A	21A	21A	21A	21A
AUSTRALIA	21A	14	14	7B	7B	7B	7B	14	14	14	21	21A
CANAL ZONE	21	14	7A	7	7	7	14	21	21A	21A	21A	21
ENGLAND	7	7	7	7	7	7B	14	21A	21A	21	14	14B
HAWAII	21A	14	7	7	7	7	7	7B	14	21	21A	21A
INDIA	7	7	7B	7B	7B	7B	14	14A	14	7B	7B	7B
JAPAN	14A	14	7A	7B	7B	7	7	7	7B	7B	7B	14
MEXICO	21	14	14	7	7	7	7	14A	21	21A	21A	21A
PHILIPPINES	14A	14	7A	7B	7B	7B	7B	14	14	14B	14B	14
PUERTO RICO	14	7A	7	7	7	7	14	21A	21A	21	21	14
SOUTH AFRICA	14	7	7	7	7B	14	21	21A	21A	21A	21	21
U. S. S. R.	7	7	7	7	7	7B	14	21A	14	14	7B	7
WEST COAST	21	14	7A	7	7	7	7	14	21	21A	21A	21A

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	14	7	7	7	7	7	14	21	21	21A
ARGENTINA	21	14	14	7	7	7	7A	21	21A	21A	21A	21A
AUSTRALIA	21A	21	14	7B	7B	7B	7B	7B	14	14	21	21A
CANAL ZONE	21	14	14	7	7	7	7	14A	21A	21A	21A	21
ENGLAND	7	7	7	7	7	7	7B	14	21A	21	14	14B
HAWAII	21A	21	14	7	7	7	7	7	14	21	21A	21A
INDIA	7	14	14	7B	7B	7B	7B	7	14	7B	7B	7B
JAPAN	21A	14	14	7B	7	7	7	7	7	7B	7B	14
MEXICO	21	14	7	7	7	7	7	14	21	21	21A	21
PHILIPPINES	21A	14	14	7B	7B	7B	7B	7	14	14B	14B	14
PUERTO RICO	14	14	7	7	7	7	14	21	21A	21A	21A	21
SOUTH AFRICA	14	14	7	7	7B	7B	14	21	21A	21A	21A	21
U. S. S. R.	7B	7	7	7	7	7B	7B	14	14A	14	7B	7B

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	14	7	3A	7	7	3A	7A	14	21	21A
ARGENTINA	21A	14A	14	7	7	7	7B	14	21	21A	21A	21A
AUSTRALIA	21A	21A	21	14	7B	7B	7B	7B	14	14	21	21A
CANAL ZONE	21A	14	14	7	7	7	7	14	21	21A	21A	21A
ENGLAND	7B	7	7	7	7	7	7B	14B	14	21A	14	14B
HAWAII	21A	21A	21	14	7	7	7	7	14	21	21A	21A
INDIA	7B	14A	14	7B	7B	7B	7B	7B	7A	7A	7B	7B
JAPAN	21A	21A	14	7B	7	7	7	7	7	7B	7B	14A
MEXICO	21A	14	7A	7	7	7	7	14	21	21A	21A	21A
PHILIPPINES	21A	21A	14	7B	7B	7B	7B	7	14	14	14B	14
PUERTO RICO	21	14	7A	7	7	7	7	14	21	21A	21A	21
SOUTH AFRICA	14	14B	7	7B	7B	7B	7B	14	21	21A	21A	21
U. S. S. R.	7B	7	7	7	7	7B	7B	14B	14	14B	7B	7B
EAST COAST	21	14	7A	7	7	7	7	14	21	21A	21A	21A

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor
SF = Chance of solar flares

february

sun	mon	tue	wed	thu	fri	sat
				1 G	2 G	3 G
4 G	5 G	6 G	7 F	8 F	9 P	10 F
11 G	12 G	13 G	14 G	15 G	16 P	17 G
18 G	19 F	20 F	21 F	22 P	23 G	24 G
25 G/SF	26 F/SF	27 P/SF	28 P/SF			

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42 **Power Plus!** — a 20-Amp, adjustable, regulated dc supply ... W6YUY

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W2NSD/1
NEVER SAY DIE

editorial by Wayne Green

WHAT WENT WRONG AT THE ARRL?

Yes, I can hear the sighs of resignation from ARRL devotees . . . won't Wayne *ever* stop attacking the ARRL? . . . and why is Wayne trying to kill off the *only* national organization representing amateur radio? What utter nonsense!

The ARRL could and should be an organization which is run for the benefit of radio amateurs everywhere, and one to which all of us should be able to point with pride. The fact is that it is a sorry mismanaged shambles. It is managing to lose money despite the highest membership in history, and despite the most advertising in history in its magazine. To be able to come up with a disastrous deficit in the face of such monumental prosperity indicates either extremely bad management or else a very heavy hand in the till. We're talking about *millions* of dollars.

If the board of directors had any real power to manage the League, one could lay the blame for the problems at their door. One or two fast meetings a year which are almost totally controlled by the headquarters "Mafia" hardly constitute much power to control. I don't think we can really blame the directors, other than to perhaps let them know that we think they should have recognized the problems and gotten together to really do something about them, even if it meant the immediate firing of Baldwin and his cohorts.

THE REAL PROBLEM

The seeds of the disaster presently befalling the League go back many years. The odd situation is that it is the success of the League in drawing in newcomers that has led to things coming apart.

Sometime in the early days of the League, it was decided that everything possible should be done to prevent any other organization ever getting a chance to get started. This would perpetuate a competition-free situation and allow the ARRL to be a dictator in the field. In order to get anything serious going in opposition to the League, it was believed that another group would have to have a publication to use as a medium for communication with its members and for drawing in new members, much as *QST* has been used by the League all these years. To discourage this possibility, the advertising rates of *QST* were set at such a low rate that it was thought no sane persons would try to buck the establishment (ARRL) by competing with them.

Not too long ago, I sat down with a list of the advertising rates of all of the magazines in the country (SRDS) and compared their advertising rates with those of *QST*. I found that few of them had ad rates less than three times those of *QST* for the same approximate number of readers, and most were four or more times the *QST* rates.

If this is true, how is it possible? And how come there *are* some competing ham magazines . . . one of which obviously is doing rather well? The key to the legerdemain by which the ARRL was able to keep their ad rates so low was in their special second-class postage rates as a nonprofit organization. These rates are a tiny fraction of the rates paid by any regular magazine publisher. This means a saving of thousands of dollars a month, paid for by the U.S. government instead of *QST*, and substituted for the income which would normally be expected from advertising.

But, then, how can *73* compete against the low advertising rates and succeed in spite of the ARRL scheme? The secret to this, as anyone who has visited the *73* HQ can attest, is in efficient management. *73* is run from an extremely low-cost part of the country, from a very low-cost building, without the fantastic executive salaries of the ARRL, and almost all functions of the publication except printing are done in house.

No one knows for sure how much the head men at ARRL HQ make except the directors. You won't find it in the annual reports, nor will you even find any listed expenses which will give you a true hint of the salaries. I've been told that some go as high as $100,000 per year, but I doubt if they really are much over $75,000. At one time, the two top people at the League were making more than the entire staff of *73*.

THE CURE

A few years ago, before I got so involved with computers, the smartest thing the ARRL directors could have done would have been to make a deal whereby *73* and *QST* would amalgamate and I would manage the League. I guarantee you the organization would be in the black, our future would have been a lot more secure at WARC, we would have a lot more satellites up and running, and we would still have most of our ham satellite frequencies. The League needs a strong entrepreneurial type of person, not obfuscating bureaucrats who have come up through the ranks by never offending anyone.

Continued on page 170

73 Magazine (ISSN 0098-9010) is published monthly by 73, Inc., Peterborough NH 03458. Subscription rates in the U.S. and Canada are $18 for one year, and $45 for three years. Outside the U.S. and Canada, write for rates. Second class postage paid at Peterborough NH 03458 and at additional mailing offices. Publication No. 700420. Phone: 603-924-3873. Microfilm edition—University Microfilm, Ann Arbor MI 48106. INCLUDE OLD ADDRESS AND ZIP CODE WITH ADDRESS CHANGE NOTIFICATION and send to 73, Inc., Peterborough NH 03458.

LETTERS

BLACK HAMS

The letter by Jack Chancellor W9SON in the November, 1978, issue raised some interesting questions. How many black Americans are hams? How are black hams responded to during QSOs and in amateur radio activities?

I'm a black American ham, licensed since 1954, and in spite of extensive travel in 27 states in the course of my professional activities, I've never met a black ham. I may have worked other black hams on the air, but I've never had a QSO where the other op identified himself as black. (Research shows that recognition of the race/creed/color of a speaker by voice alone is next to impossible.)

Reactions to me by hams here in my hometown who have learned that I'm black have been 100% positive, though I don't doubt that some anxiety has been aroused. One instance bears relating: My first affair with 2 meter FM was quite a mix-up until a local ham straightened me out on the 600-kHz difference between transmit and receive frequencies through the repeater. After many, many QSOs, he agreed to stop by my place to pick up some gear I was donating to the local amateur radio club. Naturally he discovered I was black. Then he had to withdraw an earlier invitation to my wife and I to be his guests at his club (which is a block from my QTH, by the way) because his club does not admit blacks, either as members or guests.

This same local radio club had several blacks enrolled in its Novice code/theory classes. Another local radio club urged my participation in a practice emergency net on 2 meter FM. Any number of individual local hams and I have chewed the fat at length, on and off the air, about every topic under the sun. Never has the question of my race arisen (except in discussions of racial problems in the United States).

Although I've never personally experienced racial prejudice as a ham, I'm confident prejudiced hams do exist who practice their prejudices with varying degrees of directness—from "pulling the plug" the instant they discover the other op is black to adding to their CQ calls "no lids, no kids, no blacks."

I'm equally confident that, as W9SON asserts, there are blacks who believe that amateur radio is not open to them. This is not true objectively, but most blacks perceive reality in terms of the history of the black man in America—slavery, discrimination, and prejudice. Why, they say, should I believe the amateur radio fraternity to be any different from others which are predominantly white and known to be discriminatory.

I don't quite agree with W9SON's suggestion that perhaps ham radio should mount a campaign to dispel such beliefs among potential black hams.

I do believe, however, that our fraternity can, through each of us as individuals, attract the support and participation of many blacks in America if we would act toward them, on and off the air, as we would have them act toward us.

Carlton D. Trotman W3BRX
York PA

SELF-CREATED DOOM

I am writing this letter not so much as a letter to the Editor, but as a message to all hams!

I receive all of the ham magazines. I occasionally read your editorials. I am not too outspoken. However, the more I read about WARC, I decided I would come forth as a loud minority, and not as a silent majority.

I am a black ham, but I have some ground to stand on: nine years in HF communications for the United States Army Signal Corps, in fixed station point to point, Acan Starcom Stratcom and DCA, along with one year at Ohio Bell, and four years at the R. L. Drake Company. My present position (for the past six years) is as a two-way and microwave technician at the Dayton Power and Light Company. I presently hold a First Class Radio Phone and Extra Class license. In addition, I am the past General Chairman for the Dayton Hamvention, and also past Technical Chairman for DARA.

So you see, communications is my business! I cannot sit back and fool myself about what is about to take place. What we should think about is that if the ship sinks, we all go down. Even that guy who claims there's nothing to it. Noah tried to tell people that God was going to destroy the world. They laughed at him until one day they woke up and saw the water rushing upon them.

The hams will sit down and discover there aren't any ham bands anymore! Someone will say, "What in the world has happened?"

I am not going to sit by and let ham radio die because of the lack of exposure in countries that are still using the drum for communications. I want you to know that I am beginning to see the storm clouds. I guess I am a militant ham operator. For what it's worth, this one time I am joining the loud minority.

Another important concern is that, while I don't know about other towns, Dayton has a great deal of deliberate man-made interference. It's outrageous! If the FCC cracks down on ham operators, it's the hams' fault. The ham is destroying himself and the services available to us.

For instance, a guy will walk right out of his office past a phone, enter his car, and use the autopatch to find out whether his wife needs anything from the store!

Ham operators will create their own doom!

Need I say more?

Wallace M. Wright, Jr. AD8N
Dayton OH

HOT TYPEWRITER

I read your editorial entitled "WARC Doom and Gloom" in the December, 1978, issue of *73* and boy, did it strike a nerve! I am one of those operators who still uses his old Novice 75-Watt rig, but many OMs and YLs I QSO with on the air are using new equipment into which they have sunk a considerable hunk of change. Imagine telling these ops that their bankroll has sprouted wings, their beautiful riceboxes are now illegal, and they can resort to the landline for DX!

You could have used half the editorial space for printing the names, addresses, and phone numbers of members of the ITU, the U.S. Congress, the FCC, the ARRL, and anybody else who can help prevent the WARC from becoming a disaster for hams.

Don't worry, the powers-that-be would get mail, radiograms, phone patch calls, personal visits, etc., by amateurs concerned about the future of ham radio.

I wish you would have limited your visions of gloom. Phrases like "if we lose everything" are unsettling breaches of the peace. You are going to get a lot of people riled up with that hot typewriter of yours.

Regarding the ARRL: I quit when incentive licensing came out. Why should we subsidize someone who is taking away our bands? If the ARRL helps us out at WARC, great. If they don't, then how can they justify their existence? We need some people in the ARRL with some common sense, not foolish vindictive mossbacks—without mentioning any names.

I have one last question for you, Wayne, How is *anybody* going to keep millions of low-power CB radios and hundreds of thousands of ham rigs out of reach of curious individuals who want to satisfy that age-old need to communicate?

Bob Wilk WA0OTV
Kansas City MO

A HELL OF A CONTEST

You may not publish this, but this is my opinion of contests: They can go straight to hell. I am referring to the contests of December 9, 1978. Never in my life have I heard a ruder bunch of people on the air. I couldn't carry on a QSO of any kind without some damn fool breaking in and hollering "CQ Contest, 5 by 9 in Oregon, QSL?"

Whoever authorizes this bull ought to be horsewhipped with a linear. If the ARRL is the authorizing source, then the authorizing person needs his or her you-know-what kicked. This isn't my opinion alone, but just one of a whole lot of people who feel the same way. If I want a signal report, I will ask for it during a QSO. While I am in a QSO, I don't want to hear some jerk hollering "CQ Contest."

If people are going to be rude, then they should go back to CB radio where being rude is part of it. Amateur radio doesn't need it, nor do the vast majority of hams I know.

Dale Dishon WD5JRF
Palestine TX

POLAROID POWER

I came across an idea and thought you might want to know, if you don't already.

My father bought a Polaroid SX-70 camera recently and, as you know, it takes the cartridge-type film with the battery built right in the film pack. Every time you put a new film cartridge in the camera, you are putting in a new battery.

I took one of those apart tonight just out of curiosity and discovered that it was a flat paper pack with chemicals sealed inside. I thought that the

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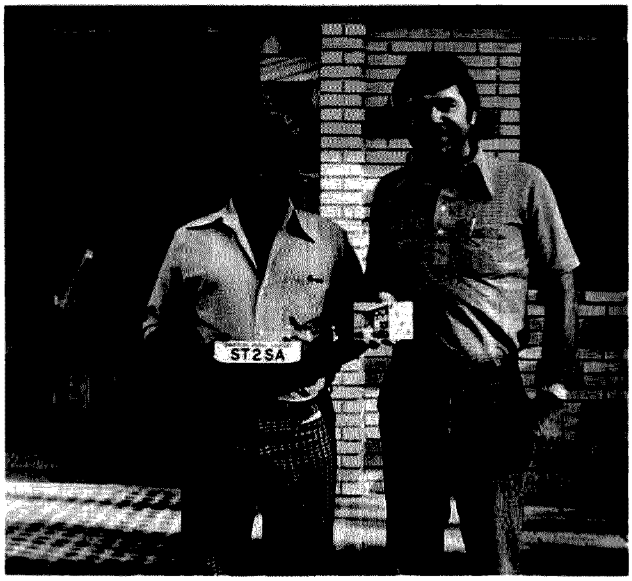


ST2SA and K5YY.

son K5YY racked up some 6,000 QSOs from several of the rarer African spots including ST2SA, ST0YY, 3B8YY, FH8, D68AD, and 5H1.

San's main objective was to activate some areas that had seen little or no CW action and to concentrate on the west coast areas of the United States that generally have poor propagation into the East African and Indian Ocean areas.

The results were 6,000 QSOs, of which 20% were on CW and 68% were with stateside stations. Twenty percent of the stateside contacts were with W6 and W7 stations, including 50% of the contacts made from FH8, where he was really concentrating on the west coast. Although limited to only short stays due to travel accommodations, San managed 800 QSOs from ST0YY in six hours and some 400 QSOs each from FH8 and 3B8 in only four hours of operation at each stop.

An acute fuel shortage in Sudan cancelled all flights for over a week, but San was able to catch a charter flight to South Sudan which had to return to Khartoum the next day. Otherwise, he would have been stranded and the last half of the trip, including D68, FH8, and 3B8, would have been jeopardized. Luckily, it was a weekend and conditions were good.

Travel plans and itinerary had to be constantly changed and updated because of widespread airline flight cancellations. Getting a seat on another flight was nearly impossible and several tickets had to be repurchased because most places did not exchange tickets when flights were cancelled.

San's baggage was lost at FR7 and the last part of the trip was made with just bare toilet articles and only two pairs of shorts and socks. He wore the same clothes for twelve straight days. All his equipment was also lost.

Due to a food shortage at ST and D68, San lost twelve pounds. Upon returning home, he developed a subacute case of malaria, despite having taken all the proper anti-malaria drugs before departing. It was six weeks before he felt back to normal again.

On the bright side, the temperature in Sudan was only 105 to 110 degrees while he was there instead of the 130+ degrees just prior to his visit. Conditions at the Indian Ocean stops—3B8, D68, and FH8—were pleasant but very boring without ham radio.

San reports that the few good experiences included meeting some very nice people on the trip. Sid ST2SA and Alex 3B8DA were especially nice. 3B8CJ was not a big DXer, but he went out of his way to help San obtain the 3B8YY call instead of the 3B8Z calls which are usually issued to foreigners.

FH8OM and FH8YL were extremely nice and San reports that Beatrice FH8YL is very beautiful. Reiner FH8OM is the Honda and Yaesu dealer for the Comoro/Mayotte/Reunion area. Reiner was kind enough to take a day off and fly San from Mayotte to Kenya.

Robin D68AD is chief engineer of the Comoro Cable and Wireless and San says one of the nicest people he has ever met. San stayed with Robin while on Comoro and used his equipment. The FT-101E which had been donated by the Northern California DX Foundation had been left with FH8CY on Mayotte. All the other equipment was lost with his luggage.

San gives special thanks to Jack W2LZX for meeting him at the airport in New York both going and coming, and to Tony WA2EAN, who had finally managed to locate San's baggage which had been on Reunion all the time.

More special thanks to those who contributed equipment and money to the operation. The Northern California DX Foundation, whose contributions of an FT-101E and finances allowed San to go more places and stay longer, also provided the QSL cards. As mentioned before, the FT-101E was left with FH8CY in Mayotte to provide more operating time from that country. MFJ donated a keyer and antenna tuner and Butternut Electronics and Mor-Gain Electronics provided antennas.

Tired once more of the soft life and not one to rest on his laurels, San is planning to head out to more unconquered worlds later this summer or fall. Working once again with the Northern California DX Foundation, San has plans for three spots, all on the top ten needed list. Keep an eye on the DX bulletins for later information.

OBTAINING A VP2V LICENSE

We recently received a letter from Mr. A. M. Swain, Telecommunications Officer of the British Virgin Islands, explaining the procedure involved in obtaining a VP2V license. We are reprinting it here in case anyone might be interested in a vacation/DXpedition this summer.

1. You must possess a current U.S. amateur radio license of General Class or higher.
2. The annual license fee is $15.00, and each license or renewal expires on January 31st in the year following the one in which it was taken out.
3. Provided that a license is first granted after the first day of August, the fee shall be fifty percent of the fee specified.
4. Send a certified copy of your current license, along with a Postal Money Order made payable to the "Accountant General." No personal checks can be accepted. You must also include a 5¢ stamp to cover "stamp duty." Mail to: Ministry Of Telecommunications, Works

K5YY with FH8OM on the left and D68AD on the right.

Continued on page 175

Microcomputer Interfacing

Christopher A. Titus
David G. Larsen
Peter R. Rony
Jonathan A. Titus

Microcomputers are amazing devices, with an endless variety of useful applications. If you've followed the I/O articles in 73, you are probably aware that the key to using microcomputers for practical purposes is the ability to interface them to the real world. Computers are completely useless unless they can be made to accept inputs from devices like keyboards, temperature sensors, or receivers and generate output to devices such as video terminals, fire alarms, or Model 15s.

When we decided that a monthly column was needed to explore the important topic of microcomputer interfacing, we were pleased to learn that such a column was already being written by The Blacksburg Group, authors of the well-known Bugbook Series™. In recent years, the column has appeared in the scientific publication American Laboratory, where it's been quite popular.

While this column will not deal specifically with amateur radio, the interfacing techniques discussed here will benefit anyone who wants to get more out of his micro, including hams.—Jeff DeTray WB8BTH, Assistant Publisher.

INTERFACING DIGITAL-TO-ANALOG CONVERTERS

An *analog-to-digital converter* is an electronic device that converts analog signals to digital signals. Typical commercial converters are based upon the principles of successive approximation, dual-slope integration, staircase-ramp conversion, or voltage-to-frequency conversion.[1] The most common use for an ADC is to convert the output from an analog transducer or analog instrument into digital form suitable for direct observation on a digital display or as input into a computer. All digital panel meters and digital multimeters contain built-in analog-to-digital converters. Modern ADCs provide standard TTL outputs which may be coded in binary, binary-coded decimal (BCD), or perhaps other less frequently used codes.

To illustrate how you would interface an ADC to an 8080-based microcomputer, consider the generalized 10-bit ADC module shown in Fig. 1. In addition to the 10-bit output and analog input pins, our module also contains a START input and a DONE/BUSY output, whose functions will be discussed later. It is not possible to simultaneously transfer all ten bits from the ADC into an 8-bit microcomputer. For the 10-bit converter, the data transfer is accomplished by placing bits D0 through D7 (the ADC's eight least significant bits) in the first input byte and the remaining two bits, D8 and D9 (the ADC's most significant bits), in the second byte.

To gate data onto the data bus and into the 8080, 8212 eight-bit three-state buffer chips are used between the ADC's outputs and the 8080's data bus. A gating scheme is required so that the three-state buffers are enabled only during the time when the 8080 requests data. In the case of the 8212 buffer, the required gate is incorporated within the integrated circuit chip, so all that you must supply is a negative IN control signal and positive 065 and 066 decoded pulses derived from the address bug decoding logic.

The remaining control signals that are used include (1) a START pulse applied to the ADC that resets it and starts the internal conversion process, and (2) a DONE/BUSY ADC output flag which indicates that a conversion has taken place and that the 10-bit digital output is ready. These are important control signals since they synchronize the operation of the conversion process. Analog-to-digital converters are not generally "free-running" devices that continuously convert voltages into digital outputs. These conversions take a finite period of time. It is necessary to pulse or strobe the ADC to start each conversion, and you cannot expect a 10-bit binary value to be output by the converter immediately after the strobe pulse is applied. For the generalized converter in our figure, a 21-microsecond conversion time is required. Inside our ADC, a successive approximation technique is used that converges on the unknown voltage by making successively smaller tests and comparing the results of such tests to the unknown voltage.

The DONE/BUSY flag, which indicates that the converter is either DONE (logic 1) or BUSY (logic 0), is input into the microcomputer as a single bit. Since there are six unused bits at input port 066, bit D7 is assigned to the flag. The START pulse to initiate a conversion must be a short positive pulse. It can be obtained by gating the control signal OUT with a negative device address pulse, 037, using a 7402 2-input NOR gate.

A typical software subroutine used to perform a single conversion is shown in Table 1.[2] The 10-bit binary result of the conversion is left in the B and C registers of the 8080, with the least significant eight bits in register C and the most significant two bits in register B in bit positions D0 and D1. The microcomputer spends time in the TEST loop as it checks and rechecks the flag bit while the conversion takes place. The converter we chose took only 21 microseconds, so

Continued on page 203

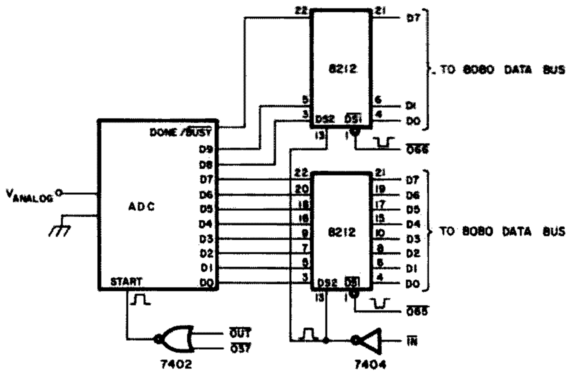


Fig. 1. Schematic diagram of an analog-to-digital converter (ADC) interfaced to an 8080 microcomputer with the aid of a pair of 8212 buffer chips.

```
                    *100 000
100 000 365  ADC,   PUSHPSW /SAVE REGISTER A & FLAGS
100 001 323         OUT     /STROBE THE ADC TO START A CONVERSION
100 002 037         037
100 003 333  TEST,  IN      /INPUT STATUS BIT AND 2 MSB'S
100 004 066         066
100 005 306         ADI     /ADD 1 TO THE FLAG BIT TO CAUSE AN
100 006 001         001     /TO CAUSE A CARRY IF IT IS SET
100 007 322         JNC     /NO OVERFLOW, CHECK IT AGAIN
100 010 003         TEST
100 011 100         0
100 012 107         MOVBA   /OVERFLOW, FLAG=1, SO SAVE MSB'S
100 013 333         IN      /INPUT THE 8 LSB'S
100 014 065         065
100 015 117         MOVCA   /STORE THEM IN REGISTER C
100 016 361         POPPSW  /RESTORE REGISTER A & FLAGS
100 017 311         RET     RETURN TO MAIN PROGRAM
```

Table 1. Typical ADC input routine for a 10-bit analog-to-digital converter.

```
                     *100 000
100 000 373  ADC,    EI      /ENABLE THE 8080'S INTERRUPT
100 001 323          OUT     /START A CONVERSION
100 002 037          037
100 003 311          RET     /RETURN TO MAIN PROGRAM

                     THIS IS THE ADC'S INTERRUPT SERVICE SOFTWARE

                     *000 070
000 070 365  ADCSVC, PUSHPSW /SAVE REGISTER A & FLAGS
000 071 345          PUSHH   /SAVE REGISTERS H & L
000 072 052          LHLD    /GET MEMORY POINTERS INTO H & L
000 073 000          POINT   /SO THE DATA MAY BE STORED
000 074 120          0
000 075 333          IN      /INPUT 8 LSB'S
000 076 065          065
000 077 167          MOVMA   /STORE THEM IN MEMORY
000 100 043          INXH    /INCREMENT MEMORY POINTER
000 101 333          IN      /INPUT 2 MSB'S
000 102 066          066
000 103 167          MOVMA   /STORE THEM, TOO
000 104 043          INXH    /INCREMENT MEMORY POINTER AGAIN
000 105 042          SHLD    /SAVE THE STORAGE AREA ADDRESS
000 106 000          POINT
000 107 120          0
000 110 341          POPH    /RESTORE REGISTERS H & L
000 111 361          POPPSW  /RESTORE REGISTER A & FLAGS
000 112 311          RET     /RETURN TO MAIN PROGRAM

                     *120 000
120 000 000  POINT,  000     /THIS IS WHERE THE ADDRESS OF THE ADC
120 001 020          020     /STORAGE AREA IS KEPT.  IN THIS PROGRAM
                             /THE STORAGE AREA STARTS AT
                             /ADDRESS 020 000.  YOU COULD PLACE YOUR
                             /OWN POINTER ADDRESS HERE, BUT THESE
                             /TWO LOCATIONS MUST BE IN R/W MEMORY
```

Table 2. Typical ADC subroutine for an interrupt-type converter interface. This assumes the converter will interrupt with an RST7 instruction vectoring to 000 070.

New Products

DRAKE WH-7 WATTMETER/COUPLER

Drake's new WH-7 wattmeter/coupler is a through-line wattmeter designed to match the styling of the TR-7 and the rest of the 7-line, but it will make a most useful and attractive addition to your shack regardless of the rig you're using. The instrument has a large, easy-to-read meter with three calibrated scales to measure forward power. There's a 20-Watt scale for low power enthusiasts as well as the more usual 200- and 2000-Watt scales. A fourth calibrated scale provides direct reading of vswr, and is switch-selected from the front panel.

The WH-7 features a frequency coverage of 1.8-30 MHz. The line impedance is 50 Ohms resistive. The wattmeter accuracy is ±5% of reading + 0.2 Watts on the 20-Watt scale, ±5% of reading + 2 Watts on the 200-Watt scale, and ±5% of reading + 20 Watts on the 2000-Watt scale, throughout the 1.8-30 MHz range. Insertion of the wattmeter in the line changes the vswr no more than 1.05:1. The power capability is 2000 Watts, continuous duty.

The wattmeter is installed between the output of the transmitter (or amplifier) and the antenna. Ordinary PL-259 coax connectors will couple directly with the SO-239 receptacles on the sensing element. The sensing element is completely removable for placement in a convenient position. It can be removed by unscrewing the four machine screws on the bottom of the cabinet which hold it in place. In this manner, the sensing element can be installed behind the operating table so that bulky coax need not be brought up. Approximately 3 feet of small, flexible cable connects the sensing element to the meter, allowing a wide range of installation positions.

There are three different types of power to consider when using a wattmeter: forward, reflected, and radiated. The WH-7 reads the sum of the radiated and reflected power, or forward power. True radiated power may be determined with the vswr calculator supplied with the wattmeter. Simply lay a straight edge across the appropriate scales of "FORWARD" and "VSWR", and read "REFLECTED" power on the right-hand scale. Radiated power is calculated by subtracting the reflected power from the forward power.

Vswr measurements may be made easily and directly with the WH-7. Just turn the selector switch to the "SET" position (full CW) and adjust the "VSWR SET" control to align the meter pointer with "SET" at the full-scale position on the meter. Then turn the selector switch to the "VSWR" position and read the vswr directly from the vswr scale.

Once you discover the convenience of a wattmeter like the WH-7, you'll never want to be without it. Whether you're in the process of matching a new antenna, making a fast band change during a contest, or performing any other activity where fast and accurate measurement of rf power and vswr is needed, you'll find your wattmeter to be your biggest helpmate and worth every penny you spent for it.

The WH-7 wattmeter/coupler's main cabinet measures 5-5/16" high, 6-7/8" wide, and 7" deep. The removable sensing unit is 2-1/2" high, 3-3/8" wide, and 2-3/4" deep. Its weight is 2-3/4 pounds, and the selling price is $89.00. Available wherever Drake equipment is sold. *R. L. Drake Company, 540 Richard Street, Miamisburg OH 45342.* Reader Service number D11.

Morgan W. Godwin W4WFL
Peterborough NH

CSC OFFERS NEW 6-MODE MODEL 4001 PULSE GENERATOR

The 4001 offers independently-variable pulsewidth and spacing controls from 100 nanoseconds to 1 second in 7 overlapping decade ranges. Two single-turn verniers provide continuous adjustment in each range. The duty cycle is variable over a 10,000,000:1 range, continuously adjustable from 0.5 Hz to 5 MHz. The control settings are calibrated within ±5% at each end of the vernier ranges. Jitter is held to less than 0.1% + 50 picoseconds.

The six push-button-selectable modes are Run, Trigger, Gate, Single-Shot, Square Wave and Complement. (The pulse spacing control is not active in the Trigger or Single-Shot modes.)

The Run mode is frequency-settable from 0.5 to 5 MHz through the pulsewidth and pulse spacing controls. The Trigger mode accepts dc-to-10-MHz signals from an external source.

The Gate mode starts the generator synchronously with the leading edge of the gate signal. The last output pulse is independent of the falling edge of the gate signal. In addition, the "One-Shot" push-button can manually activate the gate mode.

The Trigger/Gate input is TTL-compatible. It accepts 2-$V_{p\text{-}p}$ sine waves, 1-V_{peak} pulses (with a minimum width of 40 nanoseconds), and a maximum ±10-volt input. It also offers a dc-coupled 10k-Ohm input impedance.

The Single-Shot or One-Shot mode outputs a pulse each time the momentary manual push-button is depressed.

The Square Wave mode operates at up to 2.5 MHz. The square wave frequency is the reciprocal of twice the sum of the pulsewidth and pulse spacing control settings.

The Complement mode inverts the output signal.

A single-turn vernier adjusts the output amplitude over a 0.1-10-volt range. The output exhibits a maximum 400-Ohm impedance at full amplitude. Output rise and fall time is less than 30 nanoseconds.

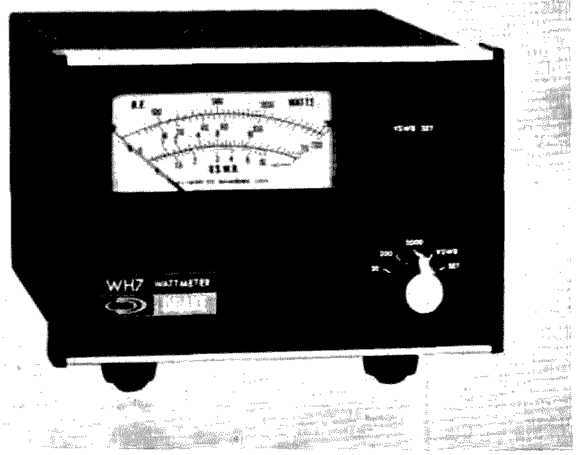
The TTL output offers a fan-out of 40 TTL loads, and is capable of sinking 64 milliamps at a maximum of 0.8 volts. TTL-output rise and fall time is less than 20 nanoseconds.

A Sync output offers a minimum output amplitude of 2.4 volts and a fanout of 10 TTL loads, and will sink up to 16 mA at a maximum 0.8 volts. The output pulse is greater than 20 nanoseconds, with a rise and fall time of less than 20 nanoseconds. The sync pulse lead time is greater than 20 nanoseconds.

For additional information, contact *Continental Specialties Corporation, 70 Fulton Terrace, New Haven CT 06509; (203)-624-3103.* Reader Service number C9.

THE 2 METER BROOMSTICK

Smithe's new fully self-contained 5/8-wave centerfed dipole for 2 meters is rather intriguingly named the Broomstick. Why Broomstick? Well, it does look strikingly like a



Drake's WH-7 wattmeter/coupler.

CSC's new Model 4001 pulse generator.

broom with an SO-239 connector in place of the bristles.

The 2 meter Broomstick is 4½ feet long and an inch in diameter. There are no protruding radials, tuning rings, or appendages of any sort, and it needs no ground system. A small hook on one end enables it to be quickly and easily hung from a drapery rod, closet pole, or picture hook, so that it is unlikely to offend even the most particular XYL or other members of the family.

For the moment, my Broomstick is hung behind the drapes of one of the living-room windows, where it is completely out of sight but still enables me to key up several area repeaters and put out a very respectable signal on simplex frequencies.

The first location I tried with the Broomstick, an inside bedroom (no windows), produced pretty good results on receive but rather poor performance on transmit. Also, for some reason, I was unable to get the vswr to 2.1:1 maximum over the entire band as specified in the manufacturer's literature. However, moving the antenna to the position behind the drapes of one of the living-room windows produced a big improvement on both transmit and receive, and the vswr came down to within the manufacturer's specifications. Although I had no way of precisely measuring the antenna's gain, on-the-air checks support the 4 dBi figure given in the specs.

The 2 meter Broomstick is not only a versatile indoor antenna at home and away, but can be used outdoors as well—it's watertight and looks like it should stand years of rain and sun and whatever else Mother Nature is likely to throw at it. A mobile mounting clamp will be available shortly. If you've been stuck with using a telescoping whip or rubber ducky at home or from hotel and motel rooms when you travel, the Broomstick will give you a very useful signal boost.

Smithe's 2 meter Broomstick is priced at $19.95 and is sold and distributed by *Smithe Aluminum, Box 442, Laurel MD 20810*. Reader Service number S80.

Morgan W. Godwin W4WFL
Peterborough NH

DRAKE DRY DUMMY LOADS

If I were ever limited to a single accessory item for the shack, I'd unhesitatingly choose a dummy load. Whether I'm tweaking up a new piece of equipment I've just built, going through the neutralization process after changing the final amplifier tubes in my transceiver, or simply retuning after changing bands, I find a dummy load indispensible.

Now, with Drake's two new dry (no oil required) dummy loads, the DL-300 and DL-1000, it's easier and more convenient than ever to have a dummy load handy and ready to use whenever needed.

The DL-300 will handle 300 Watts of rf for 30 seconds, with derating curve to 5 minutes. Maximum vswr is 1.1:1 to 30 MHz and 1.5:1 from 30 to 160 MHz. Impedance is 50 Ohms resistive, nominal. Its small size (6.7" x 2.08") and light weight (11 oz.), plus built-in PL-259 coax connector for direct connection to transceiver or transmitter output, makes it perfect for portable, mobile, or fixed station use.

The DL-1000 is larger (14" x 3.6") and heavier (2 lbs.), but it handles 1000 Watts of rf for 30 seconds, with derating curve to 5 minutes. Maximum vswr is 1.5:1 over the 0-30 MHz range. Impedance is 50 Ohms resistive, nominal. When the Drake FA-7 cooling fan is added to the DL-1000 to provide forced air cooling to the resistive element, the unit's rating limitations are expanded, i.e., 90 seconds at 1000 Watts. The DL-1000 is provided with SO-239 coax connector and rubber feet for desk or bench use.

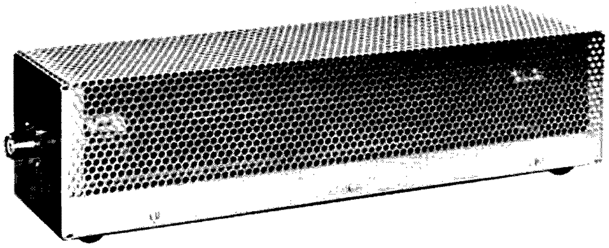
The DL-300/DL-1000 dummy loads should be used in conjunction with the derating curve which comes with the units if power is to be applied for a period exceeding 30 seconds. Allowance must be made for adequate cooling-off periods when needed, to prevent exceeding the rating dictated by the derating curve. Failure to do so will drastically reduce the life of the resistive element. A good rule to follow is to allow one-minute cooling-off periods between use.

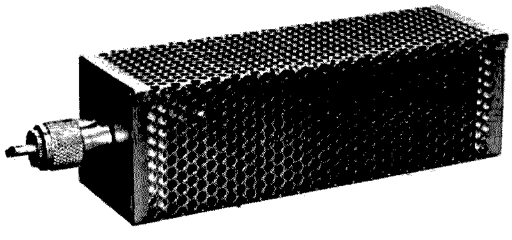
The DL-300 connects directly to an SO-239 connector, eliminating the need for an interconnecting coax cable. The DL-1000 should be connected to the transceiver or transmitter using a convenient length of coax cable.

With one or both of the Drake dry dummy loads in the shack, you'll find that servicing your gear is a lot easier and safer, and you'll be a lot more popular with your fellow amateurs if you use one when matching a new antenna or retuning after changing bands. If you haven't been using a dummy load, try one. You'll like it!

The DL-300 sells for $19.95, and the DL-1000 for $39.95. Available wherever Drake equipment is sold. *R. L. Drake Company, 540 Richard Street, Miamisburg OH 45342*. Reader Service number D11.

Morgan W. Godwin W4WFL
Peterborough NH





Drake's new DL-300 (top) and DL-1000 dummy loads.

NEW DVOM IS RUGGED, CONVENIENT, AFFORDABLE

A new 3½-digit pocket-sized digital multimeter has just been introduced by The Hickok Electrical Instrument Company for electrical/electronic test, calibration, and field service applications. The instrument, designated the LX 303, contains features generally found in more expensive units, including autopolarity, autozero and automatic overage indication. A rug-

Continued on page 173

Hickok's new LX 303 DVOM.

Contests

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

BARTG SPRING RTTY CONTEST
Starts: 0200 GMT Saturday, March 24
Ends: 0200 GMT Monday, March 26

The total contest period is 48 hours, but no more than 30 hours of operation is permitted. Time spent listening is counted as operating time. Off periods may not be less than 3 hours at a time and times on/off must be summarized on the log and score sheets. There will be separate categories for single operators, multi-operators, and shortwave listeners. Use all amateur bands from 80 to 10 meters. Stations may not be contacted more than once on any one band, but additional contacts may be made with the same station if a different band is used. Those on the ARRL countries list and in addition each W/K, VE/VO, and VK call area will be counted as separate countries (but W/K, VE/VO, and VK will be counted once only for QCA purposes).

MESSAGES:

Messages exchanged will consist of:

Time in GMT consisting of a full 4-figure group; the use of the expression "same" or "same as yours" will not be acceptable.

RST and Message Number—the message number must consist of a 3-figure group starting with 001 for the first contact made.

POINTS:

All 2-way RTTY contacts with stations within one's own country will earn 2 points, while those outside one's own country earn 10 points. All stations will receive a bonus of 200 points per country worked, including their own. NOTE: Any one country may be counted again if worked on another band, but continents are counted only once. Proof of contact will be required in cases where the station worked does not appear on any other contest logs received or the station worked does not submit a check log.

SCORING:

Multiply QSO points times total countries worked; multiply total country points times 200 multiplied by number of continents worked. Add these two totals together to obtain your final score. Example: exchange points (302 x countries 10) = 3020; country points 10 x 200 x continents 3 = 6000; final score = 9020 points.

LOGS AND SCORE SHEETS:

Use a separate sheet for each band and indicate all rest periods. Logs to contain: date/time in GMT, callsign of station worked, RST report and message number as sent, RST report and message number as received, exchange points claimed. The summary sheet should show the full scoring, the times off and on the air, and, in the case of multi-operator stations, the names and callsigns of all operators involved with the operation of the station. All logs must be received by May 31, 1979, in order to qualify. Send logs and check sheets to: Ted Double, 89 Linden Gardens, Enfield, Middlesex, England EN1 4DX. The judges' decision will be final and no correspondence can be entered into with respect to incorrect or late entries. All logs will remain the property of the British Amateur Radio Teleprinter Group. Certificates will be awarded to: leading stations in each of the

Calendar

Mar 3-4	ARRL DX Competition—Phone
	YL-OM CW Contest
Mar 10-11*	QCWA QSO Contest—Phone
	Virginia QSO Party
	Commonwealth Contest
Mar 17-18	ARRL DX Competition—CW
Mar 24-25	CQ Worldwide WPX—SSB
	BARTG Spring RTTY Contest
Mar 31-Apr 1	North Dakota QSO Party
	Tennessee QSO Party
	International 10-10 Net Canterbury Chapter QSO Party
	Wisconsin QSO Party
Apr 7-8	ARRL Open CD Party—CW
	QRP QSO Party
Apr 21-22	ARRL Open CD Party—Phone
	ARRL EME Contest
Apr 28-29	PACC DX Contest
May 12	World Telecommunications Day Contest—Phone
May 19	World Telecommunications Day Contest—CW
May 19-20	ARRL EME Contest
May 26-27	CQ Worldwide WPX—CW
June 9-10	ARRL VHF QSO Party
June 23-24	ARRL Field Day
July 4	ARRL Straight Key Night
July 14-15	ARRL IARU Radiosport Competition
Aug 4-5	ARRL UHF Contest

* = described in last issue

Results

RESULTS OF THE 1978 RHODE ISLAND QSO PARTY

RHODE ISLAND

COUNTY	CALL	QSO	PTS.	MULT.	SCORE
Bristol	*WB1DEU/N	57	300	26	7,800
Kent	*WB1DXE	418	844	52	43,888
Newport	*WA1OSL	19	46	7	322
Providence	*WB1EJI	632	1,288	85	109,480
Washington	*K1QFD	76	168	36	6,048
Providence	N1RI/1 multi-op	246	516	42	21,672
Bristol	N1RI	43	90	24	2,160

OUT OF STATE

COUNTY	CALL	QSO	PTS.	MULT.	SCORE
Alaska	*KL7IUM	4	8	2	16
Arkansas	*WA5DTK	5	18	3	54
Connecticut	*W1TEE	14	47	5	235
Georgia	*N4NX	23	62	5	310
Illinois	*WD9ADH	37	120	5	600
Iowa	*WBØUCP	13	42	5	210
Kansas	*WØODT	6	20	3	60
Kentucky	*WA4QMQ	3	6	2	12
Louisiana	*W5WG	22	76	4	304
Maryland	*N3SL	11	38	4	152
Massachusetts	*N1NA	78	274	5	1,370
Minnesota	*W1GL/Ø	27	62	5	310
Nebraska	*NØWB	8	24	4	96
Nevada	*W7HI	9	34	4	136
New Jersey	*WB2HSG	5	18	2	36
New Mexico	*K5MAT	17	45	5	225
New York	*W2HAE	10	36	3	108
Pennsylvania	*WA3JXW	4	8	1	8
S. Carolina	*WB4HLC	15	38	5	190
Texas	*WB5PDQ	10	28	4	112
Virginia	*W4ZRJ	5	18	3	54
Washington	*K7EQ	4	16	3	48
Wisconsin	*WB9PVI	19	62	4	248
Ontario	*VE3KK	14	47	4	188
Kuwait	*9K2FX	15	38	5	190
Greenland	*K3KX/OX	1	2	1	2

TOP THREE—R. I.

*1. WB1EJI	109,480
*2. WB1DXE	43,888
*3. K1BV	8,118

Novice Winner: WB1DEU
Tech Winner: WB1AFQ
VHF Winner: W1EOF
Certificates of Merit Awarded to: K1UXS, N1DM, WB1EHO, and KA1AZ for their help in making the QSO Party a success.

TOP THREE OUT OF STATE

*1. N1NA	1,370
*2. W1FJI	1,345
*3. WD9ADH	600

* denotes certificate winner

three classes, the top stations in each continent, and each W/K, VE/VO, and VK call area.

If a contestant manages to contact 25 or more different countries on 2-way RTTY during the contest, a claim may be made for the Quarter Century Award issued by BARTG for which a charge of 3 dollars US or 15 IRCs is made. Make your claim at the same time as you send in your log. Holders of existing QCA awards will automatically have any new countries added to their records. However, in view of the high volume of work which the contest manager has to deal with, it will not be possible to prepare and send out new awards or update existing awards until the final results of the contest have been evaluated and dispatched.

If any contestant manages to contact stations on 2-way RTTY with all six continents and the BARTG contest manager receives a contest or check log from all of the operators in those six continents, a claim may be made for the WAC Award issued by the *RTTY Journal*. The necessary information will be sent on to the *RTTY Journal*, who will issue the WAC Award free of charge.

INTERNATIONAL 10/10 NET CANTERBURY CHAPTER QSO PARTY

Starts: 0000 GMT
Saturday, March 31
Ends: 1200 GMT
Sunday, April 1

Work each station only once; all contacts on 10 meters. Exchange callsign, name, QTH, 10X number if any, Canterbury Chapter number if held, and your own local chapter name and number if any.

SCORING:

Claim 5 points for working the Canterbury Chapter callsign ZL3ACA. This will be used on a roster basis throughout the party by committee members who will also be using their own station calls. Score 3 points for working a station holding a 10X number and also either full or associate Canterbury Chapter membership. For any station holding a 10X number, but who is not a Canterbury Chapter member, score 2 points. You only get 1 point for working any other station on 10 meters.

ENTRIES:

Logs must be received no later than May 15, 1979. Send to: C. J. Bramley ZL3ME, 198 Greers Road, Christchurch 5, New Zealand. Please write clearly; show your name and address with your 10X number if you have one.

AWARDS:

A handsome first-place trophy to the highest scorer. A pennant to the highest scorer in each US, Canadian, Australian, Japanese, and New Zealand call area; to each Central and South American country; to each European, African, and Asian country; and to three Pacific Ocean zones. Awards are free and will be sent airmail.

NORTH DAKOTA QSO PARTY

Starts: 1800 GMT
Saturday, March 31
Ends: 2400 GMT
Sunday, April 1

This contest is sponsored by the Fargo Repeater Association. Activity will be between North Dakota and out-of-state stations. The same station may be worked once per band and mode. North Dakota mobiles may be worked again with each county change.

EXCHANGE:

QSO number and county for ND stations; QSO number and state, province, or country for others.

FREQUENCIES:

3560, 3895, 7060, 7230, 14060, 14285, 21060, 21355, 28060, 28600, 29005. Novices and Techs will operate in the middle of their bands.

SCORING:

One point per QSO. ND stations multiply total QSOs by sum of states, provinces, and DX countries. Others will use ND counties for their multiplier (53 max.).

ENTRIES AND AWARDS:

Certificates to top scorers in each state, province, and DX country, the top 10 ND entries, and top 5 ND mobiles. Mailing deadline is April 20 and all entries should be addressed to: Fargo Repeater Association, WD0CCL, 2826 Evergreen Road, Fargo ND 58102. Include a large SASE for a copy of the results.

THE 73 BAND PLAN

Channel	Freq.(MHz)
1	28.965 . . . Listening & calling
2	28.975 . . . Autocall monitoring
3	28.985 . . . County hunting—not rag chew
4	29.005 . . . Beacon monitoring
5	29.015
6	29.025 . . . Rag chewing (lowest)
7	29.035
8	29.055
9	29.065
10	29.075
11	29.085
12	29.105
13	29.115
14	29.125
15	29.135
16	29.155
17	29.165
18	29.175
19	29.185 . . . Repeater channel
20	29.205 . . . RTTY
21	29.215 . . . Oscar coordination
22	29.225
23	29.255 . . . SSTV
24	29.235
25	29.245 . . . Repeater
26	29.265 . . . Repeater
27	29.275 . . . Repeater
28	29.285
29	29.295
30	29.305
31	29.315
32	29.325
33	29.335
34	29.345
35	29.355
36	29.365
37	29.375
38	29.385
39	29.395
40	29.405 . . . Oscar listening

TENNESSEE QSO PARTY

Contest Periods:
2100 GMT Saturday, March 31 to 0500 Sunday, April 1
1400 GMT to 2200 GMT Sunday, April 1

The contest is sponsored by the Tennessee Council of Amateur Radio Clubs. You may work the same station on different bands, modes, or counties. Repeater contacts are not allowed. Mobiles compete against mobiles, portables against portables. Single-transmitter entries only. No county line operations for multiple contacts are allowed. Portable stations must use a portable antenna as on Field Day. Phone and CW are all one contest, combined score!

EXCHANGE:

TENN stations give RS(T) and county; others send RS(T) and state, province, or country.

FREQUENCIES:

Approximately 50 kHz up from the bottom of each CW band. Phone—3980, 7280, 14280, 21380, 28580. Novices operate authorized frequencies.

SCORING:

One point per contact: TENN stations multiply by sum of different states plus different VE provinces plus TENN counties. Others multiply by number of TENN counties for final score. Add bonus of 200 points for each county operated from outside of home county with a minimum of 10 contacts.

AWARDS AND ENTRIES:

Plaques to TENN top score, TENN mobile, TENN portable, and out-of-state. Certificates with results to every log showing 15 contacts. Logs must

THE 73 MAGAZINE 10 METER AWARDS

The return of vigorous solar activity means that 10 meters is once again a band to be reckoned with. Ol' Sol's 11-year cycle of sunspot production is about to hit a peak, with the result that QRP 10 meter DX is possible.

Now's the perfect time to convert that old CB rig to 10. American Crystal Supply makes a variety of simple and inexpensive conversion kits, or you can do-it-yourself from the articles in 73. True appliance operators can purchase ready-made rigs from Bristol Electronics or Standard Communications. To give you an added incentive, 73 is offering two nifty Certificates of Achievement for 10 meter channelized communications.

For domestic types, there is the 10-40 Award. This one should be pretty easy—just work 40 of the 50 states. The DX Decade Award goes to DXers who work 10 or more foreign countries with a channelized 10 meter rig. We have endorsement stickers, too—the whole bit.

To give everyone an equal shot at award #1, only contacts made October 1, 1978, or after will be valid.

Well, don't just sit there. Get out your soldering iron, order some crystals, and put that CB rig on 10. This is going to be fun, so don't miss out!

RULES

1) All contacts must be made in the 10 meter amateur band using channelized AM equipment. Both converted Citizens Band equipment and commercially-produced units may be used.

2) To be eligible for award credit, all contacts must be made October 1, 1978, or after.

3) The 10-40 Award is available to applicants showing proof of contact with stations in at least 40 of the 50 United States. A special endorsement sticker will be available to those working all 50 states.

4) The DX Decade Award is available to applicants showing proof of contact with at least 10 foreign countries. Endorsement stickers will be awarded for 25, 50, 75, and 100 countries.

5) A log of stations worked, with the date, time, and type of equipment used for each contact, must be submitted when applying for each award or endorsement.

6) Each application for an award or endorsement must be accompanied by a signed statement that all claimed contacts are valid. No QSL cards need be sent, but they must be in the possession of the applicant.

7) To cover costs, a fee of $5.00 must accompany each application for the 10-40 or DX Decade Award. The fee for endorsement stickers will be $2.00 each.

8) All award applications should be mailed to: Chuck Stuart N5KC, 5115 Menefee Drive, Dallas TX 75227.

show date/time in GMT, station worked, band, mode, exchange, and score. Use separate sheets for each band with over 25 contacts. Submit a cross-check sheet similar to ARRL operating aid #6 if you have over 200 QSOs. Logs must be legible to avoid disqualification. Mailing deadline is May 1. Send business size addressed envelope to: Dave Goggio W4OGG, 1419 Favell Drive, Memphis TN 38116.

WISCONSIN QSO PARTY
Starts: 2100 GMT March 31
Ends: 0300 GMT April 2

Maximum operating time is limited to 24 hours. Phone and CW are the same contest. Any station may be worked only once using all bands 160 to 10 meters. Novices or Technicians sign /N or /T.

EXCHANGE:
WISC stations send RS(T) and county; others send RS(T) and state or province.

SCORING:
Phone contacts count as one QSO point, while CW contacts count as two QSO points. WISC stations multiply QSO points by number of states plus WISC counties; others multiply QSO points by number of WISC counties. Foreign countries other than VE and VO count as additional states. Novices score as above, then multiply total by 2.5 to get final score.

FREQUENCIES:
3550, 7050, 14050, 21050, 28050, 3980, 7280, 14280, 21380, 28580, and 20 kHz up from the bottom of the Novice bands.

AWARDS:
Awards to the highest score per state and the highest club score. Awards to be presented at the Central Division Convention in June in Milwaukee.

ENTRIES:
Logs must show date/time in GMT, band, mode, call, report, and score. Logs must be legible or will be classified as check logs. Logs containing more than 100 contacts must also be submitted with ARRL or similar dupe sheet. All entries must be postmarked before May 1. Send results to: Wisconsin QSO Party, c/o West Allis RAC, PO Box 1072, Milwaukee WI 53201.

WORKED ERIE, PENNSYLVANIA AWARD

This certificate is sponsored by the Radio Association of Erie. In order to qualify for the certificate, an amateur must prove two-way contact with ten Erie amateurs on any band in any mode or combination thereof. A copy of his QSL cards or log entries will be required as proof. A self-addressed, stamped envelope will ensure a speedy return of the award. Send inquiries or information to: RAE, Box 844, Erie PA 16512, or John Lindvay WB3IFD, 908 West Ninth St., Erie PA 16502.

WARC 1979 CW DIPLOMA

On occasion of WARC 1979, the REF is making available the CW Diploma for contacts made between January 1 and December 31, 1979. Necessary are a minimum of 300 QSOs to include: 1 station of the city of Geneva—WARC 1979, 50 French stations dealing a code number with the RST, 10 cantons HB, 5 provinces ON, 25 provinces Italy, 8 districts EA, 5 provinces PA, 15 DOK of Federal Germany, 1 station of G, GI, GM, GW, and 15 other European countries. Apply before April 1, 1980, to REF (WARC 1979), Square Trudain 2, 75009 Paris, France. Include 10 IRCs and a verified list of QSOs. Per country, a rank will be established and the first will be honored with an additional award.

Results

1978 CAN-AM CONTEST RESULTS

TROPHY WINNERS—SINGLE OPERATOR
American Champion, Mixed—David Hachadorian K6LL/7
Canadian Champion, Mixed—Jim Bearman VE5DX
American Trophy, CW—John Hawkins K5NW
American Trophy, Phone—Jack Webb W5JW
Canadian Champion, CW—Lee Sawkins VE7CC
Canadian Trophy, Phone—Sid Kemp VE7BGK

Multi-Operator Champion—Walt Tillner CG3IXE
Club Competition Champion—BC Contest Club

Free one-year subscription to CANADX bulletin LONG SKIP winners are:
Rick Donelly WD5EEF; Gary Fosket W1ECH/1; ARC Urbana III W9YH; Phil Alman WD8DPB; Joe Picior WB4OSN.

MULTI-OP—CW

CG3IXE	ON	302400	607	175*
VE2FU	PQ	291088	633	161*
VE3HBX	ON	185148	470	139
W9YH	IL	137904	477	136*
N5TV	LA	71900	327	100*

MULTI-OP—PHONE

CG3IXE	ON	254184	729	119*
VE1AWN	PE	171304	633	92*
VE3HBX	ON	170646	493	119
N4UF	FL	101822	494	98*
WB3GPR	PA	60277	256	109*
WD5EEF	TX	29475	176	75*
VE3FEA	ON	27090	156	63
N5TV	LA	20944	165	56*

MULTI-OPERATOR
Mixed—Canada/U.S.

CG3IXE	556584*
VE3HBX	355794*
VE2FU	291088*
VE1AWN	171304*
W9YH	137904*
N4UF	101822
N5TV	92844
WB3GPR	60277
WD5EEF	29475
VE3FEA	27090

CLUB COMPETITION
Canada—U. S.
1. BC Contest Club 2683539
2. Toronto DX Club 1369143
3. 807 Contest Club 194184
4. Farout ARC 62399

* certificate winners

TOP TEN—CANADA
Mixed

1. VE5DX	1219884*
2. VE7CC	1134987*
3. VE7BGK	704217*
4. VE7CNY	517310*
5. CG4SW	435778*
6. VE3KZ	397308
7. VE7CMK	288673
8. VE6MP	262071
9. VE4OY	218151
10. CG3FFA	194584

CW

VE7CC	418964
VE5DX	403704
VE7CMK	288673
VE3KZ	238044
VE4OY	176900
VE1AIH	147030
VE1AJP	137475
VE7AV	106272
VE3DRB	105216
VE7DLM	101813

Phone

VE5DX	816180
VE7CC	716023
VE7BGK	704217
VE7CNY	517310
CG4SW	397458
VE6MP	210177
CG3FFA	194584
VE4IE	179634
VE3KZ	159264
VE6AGV	146787

TOP TEN—U. S.
Mixed

1. K6LL/7	727192*
2. W5JW	466150*
3. AA6DX	375756*
4. K5NW	335440*
5. K5UR	295104*
6. WB4SKI	269698
7. WA4HRG/7	186410
8. K8MO	173816
9. WA0LKL	164794
10. K1ZZ	164794

CW

K6LL/7	214240
K5NW	173404
WA0LKL	166995
K1ZZ	164794
W5JW	154624
WB4OSN	142737
AA6DX	109368
WA4HRG/7	109347
K4BAI	105664
WD8DPB	91542

Phone

K6LL/7	512952
W5JW	311526
K5UR	295104
WB4SKI	269698
AA6DX	266388
K5NW	162036
WB6RDA	133245
WB7RFA	99246
WB5TAP	90474
K8MO	85176

Ham Help

I would appreciate it if any Canadian ham who is willing to take his portable rig to school or have about a half-dozen kids visit his shack to talk to students in another province would send a QSL card to me. On the blank side of the card, please list the bands you can use and the modes (AM, SSB, RTTY, OSCAR, SSTV), to help match you to the ham in the other province. Our Ministry of Education "school-to-school" coordinator seems quite interested in helping me match up classes and hams.

Bob Hulme VE3DNG
Box 430
Temagami, Ontario
Canada P0H 2H0

RTTY Loop

Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

Allow me to make a rash assumption: You read *73*. Now, that is not quite so unfounded; I mean, you are reading this column, right? Right. Hello, out there! Unless this is your first issue of *73*, or you are a hopeless tube buff, by now you've read about a little device known as a UART. The reason that this chip (yes, Virginia, it is an IC) is important is the subject of this month's column.

Plunging right to the heart of the matter, Fig. 1 is a pinout diagram of a popular UART, the AY-5-1013-A. Available from several sources advertising in *73*, as well as Radio Shack and Jim-Pacs frequently found in electronic and computer stores, this chip is usually priced under seven dollars. Its rather long designation is frequently truncated to a "1013," and it is pin-compatible with several other UARTs on the market.

"UART" stands for "*U*niversal *A*synchronous *R*eceiver *T*ransmitter." Now before you get all lost in that sea of words back there, let's dissect it a bit and see if we can understand it. Starting from the rear, the first word we encounter is "transmitter." OK, we are all hams, so we know what that means, right? Let's see, the antenna must go here, the key, hmmm, where do you plug in the key? Hold up, hee-haw, WHOA! This ain't that kind of transmitter. This is a data transmitter which, when coupled with its companion receiver, will allow us to convert from serial data to parallel and back again. You remember serial and parallel, don't you? We covered that last year. As you may recall, the most efficient means for transferring data long distances is in serial format. Generation, however, is best done in parallel. Last month we looked into one such technique. But we digress.

Okay, so here we have generated some parallel data, five to eight bits long, and we wish to send it. Some fancy logic and a shift register could put the data out, appending the necessary START and STOP bits, and accomplish the task. But you know, a bunch of chips, all that wiring, and remember Murphy's Law as applied to circuit complexity. No, that would be too messy; let's use the UART. To send data is rather straightforward. The chip must be configured for the number of data bits, stop bits, and parity. Then a clock of sixteen times the baud rate is applied, and the data is presented to the transmitter parallel inputs. Grounding the "send" line momentarily begins the process and, lo and behold, the data flows serially out of the UART.

The *R* stands for receiver and, while basically similar to the transmitter, albeit backwards, there are a few hookers. The data comes into the receiver serially, is converted to parallel, and is presented to the receiver output. A pair of signals is also used to state that there is data ready to be picked up, and that the data has been picked up and new data may replace it. This is frequently termed "handshaking," for what seem to me to be obvious reasons.

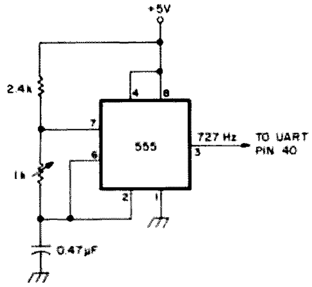


Fig. 2. 727 Hz clock.

This handshaking between the UART and the device using the data brings us to the *A*, standing for asynchronous. Realize if you will that, although the data is going by rapidly, and to your plodding visage continuously, it really is going in a start-stop fashion, with delimiters defining each character. Although bits within each character are being sent at a given baud rate, characters themselves may be sent as rapidly as the system will handle or whenever the operator decides to hit a key. This is asynchronous data flow. If the data were being sent at a known, constant rate, there would be no need for character delimiters. This is called synchronous data, and devices capable of generating either synchronous or asynchronous data are frequently termed USARTs. I'll let you figure that one out for yourself.

The *U*, of course, is for universal. I guess that means they can use them on the *Enterprise*. So that's the UART. At least you've got some idea now of what this multi-legged chip does. Let's see how to hook one up.

Remembering that we need a clock sixteen times the baud rate, dig out a 555 and look at Fig. 2. The baud rate for 60 wpm RTTY is about 45.45, and sixteen times that is roughly 727 Hz. The values shown in the diagram will give that frequency, with the variable resistor used to fine trim the output.

Fig. 3 shows how to hook up the UART itself. We are not using the receiver portion of the chip here, and that half may be safely ignored. The character to be sent is programmed by grounding the space bits on the transmitter. When the "send" line is grounded, the character will be sent out over the output line. Before we leave the UART, note that it requires not only +5 V, but also −12 V at a few mA. Although there are other UARTs not requiring this supply, we are showing it because the 1013 is the most widely available.

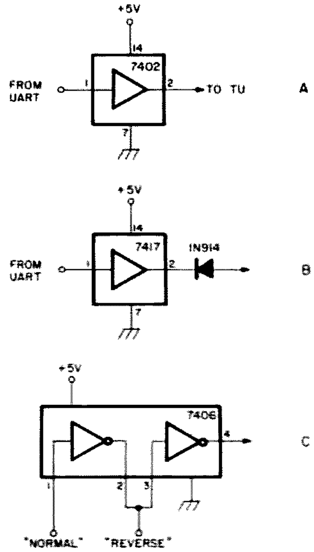
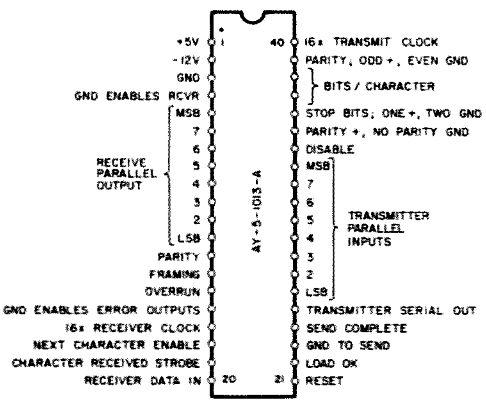


Fig. 4. Output buffers. (a) 7407. (b) 7417. (c) 7406.

The output from the UART is a TTL-compatible line that goes low on space and high on mark. Most keying schemes, including the one shown for the ST-6 a while back, use this convention. To prevent interaction with the TU's circuitry, however, one more chip will be used. A 7407 buffer, wired as in Fig. 4(a), will be used between the UART and the keyer. The 7407 is an "open-collector" buffer. That means that instead of giving a TTL high level during mark, it presents an open circuit. We then obviate the risk of feeding a voltage into a sensitive circuit, be it the ST-6 or a shift-pot keyer. A standard buffer, like the 7417, can be used with a blocking diode, shown in

Continued on page 180



PIN 37	PIN 38	BITS/CHAR
0	0	5
0	1	6
1	0	7
1	1	8

Fig. 1. AY-5-1013-A pinout diagram.

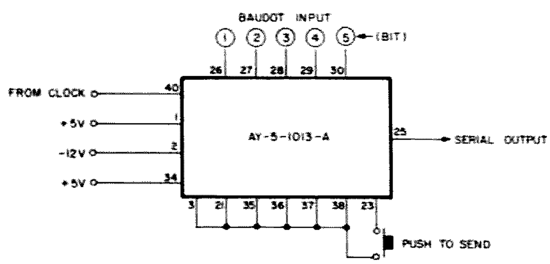


Fig. 3. UART hookup.

RAM Scan Your KDK

—amazing flexibility for $30

This mod was made for you and me.

Art Chapman WB2JHN
30 Cymbeline Dr.
Old Bridge NJ 08857

How would you like to program and scan up to 16 frequencies with your KDK, 7400, 2036 or other synthesized rig? Utilizing six readily-available ICs, this scanner will display the scanned frequencies on your KDK's readout, give you a programmable priority frequency, be no larger than a pack of king-size cigarettes, and cost you no more than $30. Sound interesting? Read on.

The idea struck me one day while reading an ad for the 1-4 MHz scanners for the KDK and 7400. I wondered how many times those scanners would stop at unwanted repeater input frequencies, noise, and other undesirable signals. Why couldn't there be a better solution for less than $100?

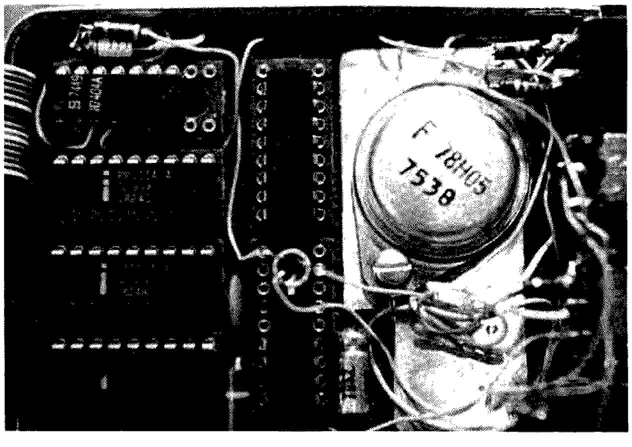
Although this article is geared to the KDK, the concepts and circuitry are adaptable to most other synthesized rigs. An understanding of the various stages I went through developing the scanner should help those with other than KDKs apply it to their radios.

Looking at the KDK's priority channel, which simply ties a set of diodes across the inputs of the decade counters, 146.52 would be connected as shown in Fig. 1.

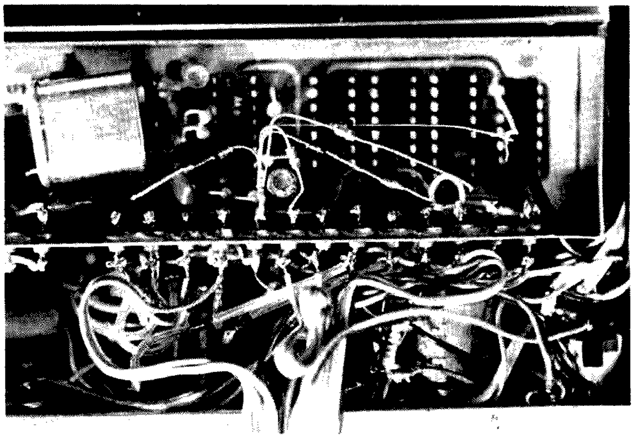
Why, then, couldn't we build a board with a series of diode arrays and scan them? A typical scanning circuit might look like Fig. 2.

With the circuit shown, IC-22S owners could easily scan their rigs. The problems with this scheme are that it takes gobs of diodes and a relatively large diode matrix board. But it still works and works well.

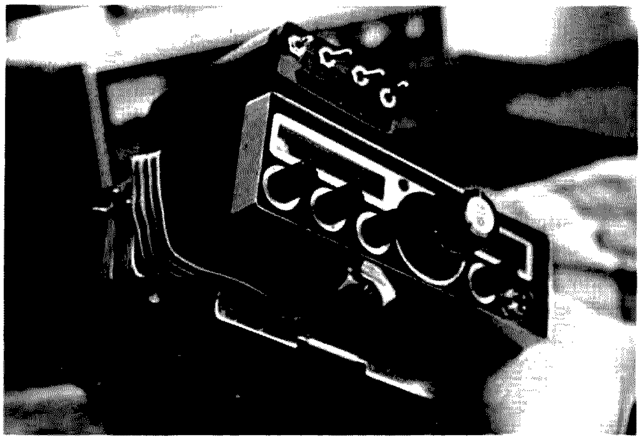
Photos by Jim Stansberry WA2HEN



Close-up of the scanner hand-wired on vectorboard. The clump of components (upper left) and the transistor (center) were a last minute fix to use the KDK's busy light and unlock light for scanner control. Note the heat sink under the 5 V regulator.



View of the tie points for the twelve memory lines into the PLL section. Note the diodes hanging in midair. The common junction of the diodes does not have any wire soldered to it. Object (lower left) in shrink tubing is an ME-3 tone encoder.



The 16-conductor flat cable was routed around the side and through the case at the front molding. The light object at the point of entrance is a folded-over business card used to protect the cable from being pinched.

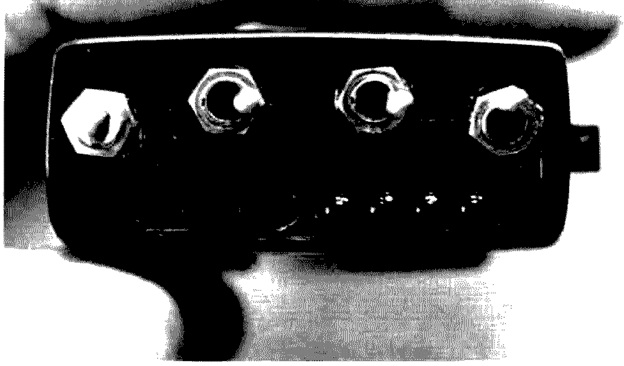
However, why use all the diodes when there is a unique device on the market called a PROM (programmable read only memory). The PROM, when properly programmed, can and does look like a diode array; however, we can put lots of those arrays into a 16-pin chip. Using the 8223 or 82S23 32 x 8 PROM, we could have up to 32 separate arrays. If we consider the 12 bits required to generate a frequency—4 for the MHz range, 4 for the 100 kHz range, and 4 for the 10 kHz range—this system will need 2 PROMs. See Fig. 3.

The PROM should be visualized as a matrix of 32 switch positions, each having 8 diodes (see Fig. 4).

By properly programming the PROM, you actually eliminate the diodes necessary to generate the desired frequency. The PROM must then be addressed in sequence (switched to the desired matrix) to connect the correct array to the 74192 decade counters. The scanner would now look like Fig. 5.

This system worked very well on a prototype, using LEDs to check out its capabilities. Although the 8223s were programmed for 32 frequencies, only 16 were used since the 74161 has 4 output lines and can address only 16 locations of the PROM.

The major drawbacks of this system are in the fact that the 8223 is a bipolar PROM and, once programmed, it cannot be changed. The scanner would now have fixed frequencies to be scanned. To change frequencies, you must replace the PROMs with another pair programmed to your new requirements.



View of the scanner's front panel.

The Final Solution

Enter the RAM (random access memory). The RAM, for those unfamiliar with this type of device, can be programmed like a PROM. However, unlike a PROM, it can be erased electronically and reprogrammed as desired. Its major disadvantage is its volatility—when power is shut off, it loses its program.

For the scanner, the Intel 2111 RAM was used. The 2111 is a 256 x 4 device, which one can again visualize as 256 switch positions of 4 diodes each. The application will use 3 of these devices to give us the 12 bits required. However, we will only employ 16 of the 256 positions. The block diagram can be seen in Fig. 6.

Construction

The final design was built on a 2" x 3" vectorboard using sockets and hand wiring. Layout should not be critical, but, for ease of construction, the memories should be side by side since much of the wiring is repetitive. The LM309 5 V regulator is kept in the scanner to keep the amount of work in the KDK to a minimum. Since the regulator is dropping approximately 7 volts at approximately 250 mA, it does get very warm and requires a heat sink. There are other ways of developing the +5 V, but this was the quickest and dirtiest—warmest, too, I'm sure.

Address	Frequency
0000	146.52
0001	146.55
0010	146.58
0011	146.67
0100	146.70
0101	147.12
0110	154.91
0111	155.19
Unlock light will go on	
1000	147.51—may be bypassed
1001	147.51—will now stop if previously busy
1010	147.54
1011	147.57
etc.	

Table 1.

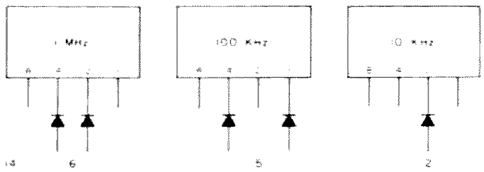


Fig. 1. Binary representation at 146.52.

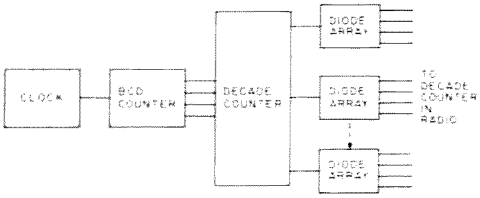


Fig. 2. Simple diode-array-type scanner.

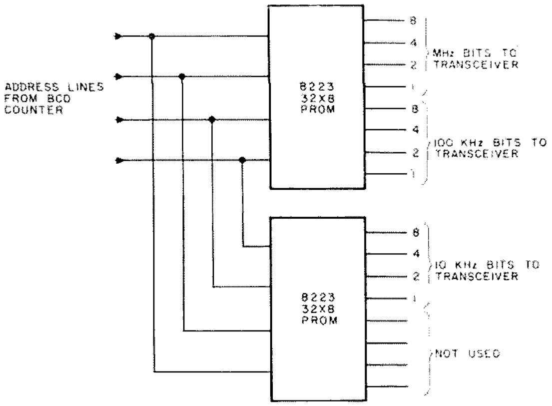


Fig. 3. PROM replacement for diode arrays.

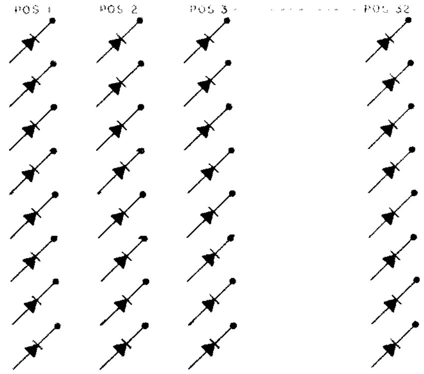


Fig. 4. Switch and diode representation of a 32 x 8 PROM.

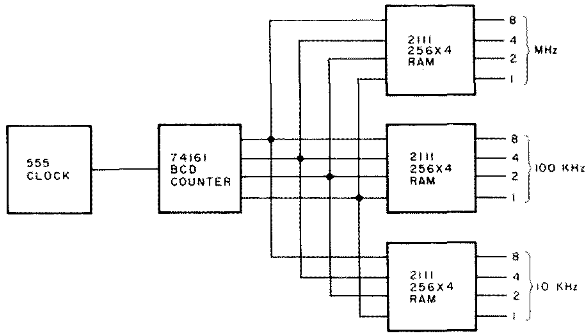


Fig. 6. Block diagram of a RAM-type scanner.

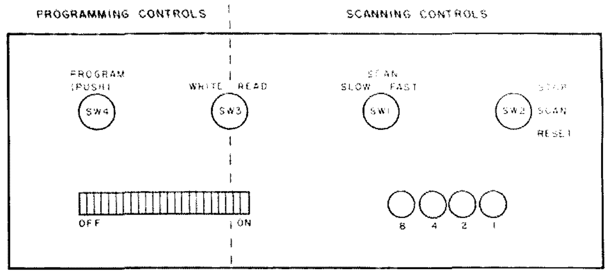


Fig. 7. Front panel layout.

For those of you who recognize it, the case is an old Radio Shack weather radio, the guts now serving as an audio amplifier somewhere else in the shack. With all due respect to Radio Shack, the scanner fits nicely into the case. I use the old volume switch for power on-off only. The other slot was filed out to make room for the address-indicating LEDs. Of course, any other case would work as well.

Try to place the switches in a convenient configuration so you will understand exactly what you are doing during programming and operation. My configuration can be seen in Fig. 7.

The program push-button and the write/read switch are together, since, to program, the write/read switch must be in the write position. To scan, it must be in the read position, thus there is an imaginary dividing line with the writing section to the left and the reading or scanning section to the right.

The 555 timer, running as an astable oscillator, generates the clock pulses for the 74161 BCD counter. The BCD 16-bit count output steps through the address lines of the 2111 RAMs at approximately one step (frequency) per second in the slow rate or all 16 steps (frequencies) in approximately 1.5 seconds. The I/O lines (pins 11 through 14) on the 2111 are tied directly to the 74192 decade counters in the PLL section. When a frequency is dialed up, a corresponding binary count is found on the input lines of the 74192s (TTL level of 1s and 0s). When SW3 is in the read position, the RAMs are in a high impedance mode, therefore having no effect on the circuit. In the write position, data can then be loaded into an address by pushing the program button.

The 7404 hex inverter inverts the address information in order to allow the proper LEDs to light when the address lines are high. (Trying to keep track of the address with negative in-

View of the scanner on top of the KDK. VelcroTM is used to hold it in place.

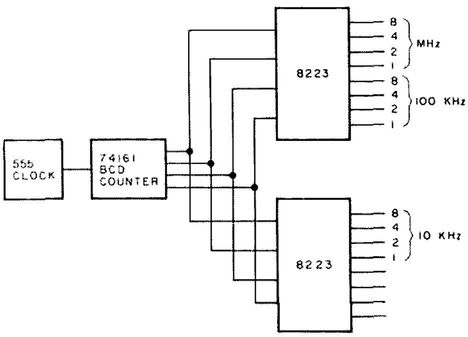


Fig. 5. Block diagram of a PROM-type scanner.

dication on the LEDs can drive you bananas.)

Installation

For those of you who have never opened up your KDK, now's the time. First, find the PLL section. Remove or lift the priority diodes from the feed-through posts. If you choose to leave them in, make sure road vibration won't allow them to move back and touch the tie posts.

Solder 12 wires of the 16-conductor cable to the 12 posts (on the outside of the PLL box) used for priority diode programming. Be sure you don't use the diode common tie point. Actually, the order of wires to the tie point is not critical, since what you put in the memory from a particular pin will come back out of the memory back to the same pin.

Solder one of the remaining wires to +12 V (the power-on switch is convenient). Solder another wire to a convenient ground. Solder another wire to the busy light (not the common line between the busy and unlock light).

Solder a wire to the unlock light (optional). Those of you who modified the KDK to high-band operation as per Al Klein W2PMX (*73*, Dec., 1977, pg. 177) will need this wire. When scanning the 144-148 MHz range, chances are you will never encounter a PLL unlock situation. However, when you scan up to 155 MHz and come back down to 146-147 again, the PLL takes approximately ½ second to lock up. During that ½ second or so, the scanner will bypass the programmed frequencies to follow the high-band frequencies. Thus, this option will stop the scanning automatically until the unlock light goes out, resulting in no bypassed frequencies.

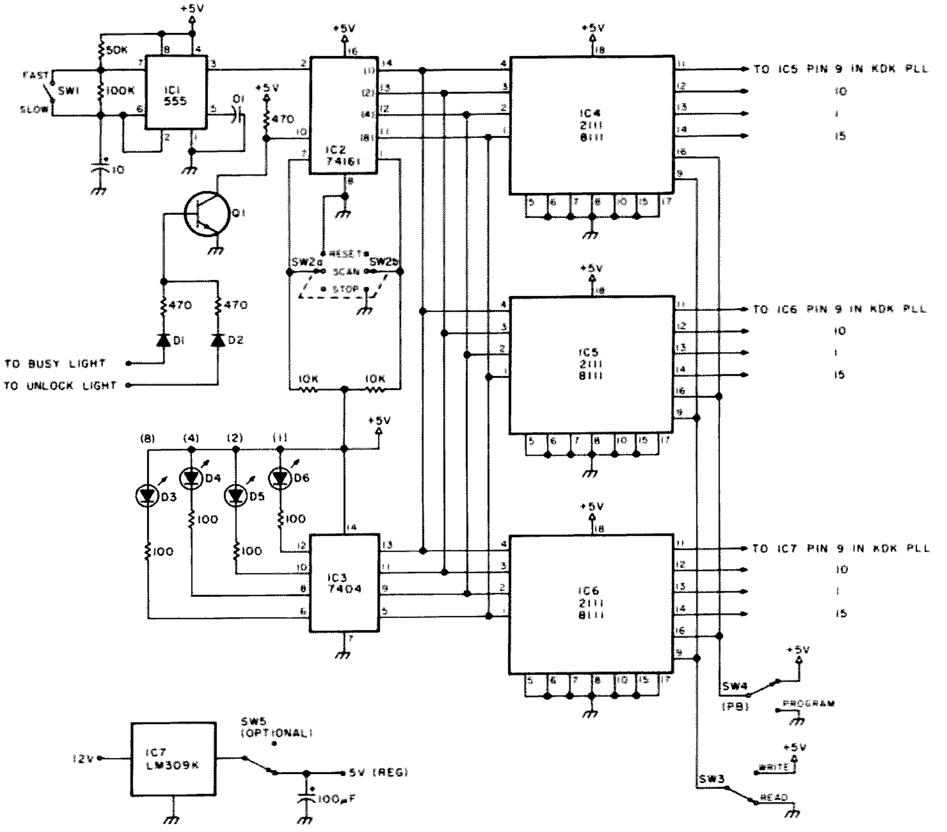


Fig. 8. KDK RAM scanner schematic. Switches are shown in scan mode. Numbers in ( ) are binary data.

Precheck

Prior to connecting the scanner to the KDK, you can power the scanner up and check the system in the following manner: Remove the 2111s from the sockets. Preset the switches: Write/Read—read; Stop/Scan/Reset—scan, Slow/Fast—slow. Turn the power on.

The LEDs should step through in a binary fashion. If not, check that the 74161 is getting a clock at pin 2. If not, check your 555 circuit.

If you're getting proper scanning at the LEDs, turn the unit off and plug in the 2111s. Use caution, as these are MOS devices and must be handled accordingly.

Operation and Programming

Preset the scanner controls to the following: Slow/Fast — slow; Write/Read—write; Stop/Scan/

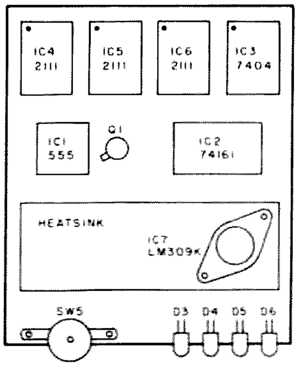
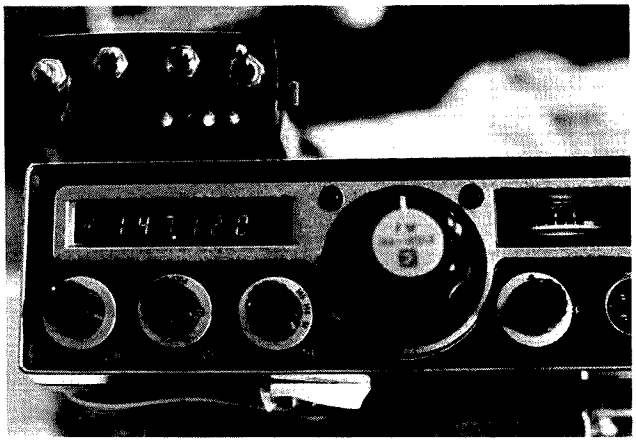


Fig. 9. Vectorboard layout of components.

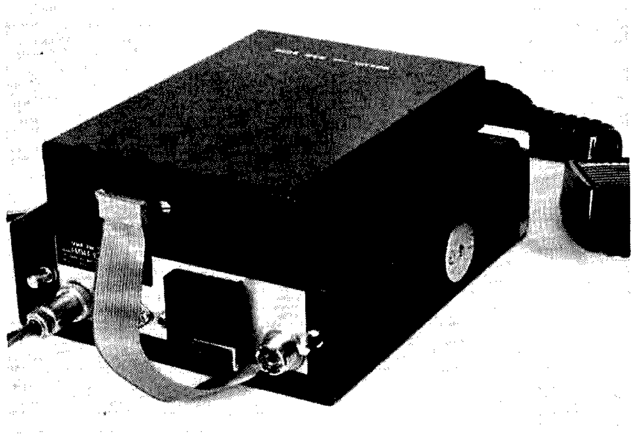
Parts List

IC1	555 timer
IC2	74161 or 74LS161
IC3	7404
IC4-6	2111 RAM (may use 2111A, 8111, 8111A any speed)
IC7	LM309K +5 V regulator
D1, D2	General-purpose silicon diode
D3-6	Any LED
Q1	Any general-purpose silicon transistor
SW1	SPST
SW2	DPDT center-off
SW3	SPDT
SW4	SPDT push-button
SW5	SPST (on-off, optional)

Resistors and capacitors as required per schematic.
16-conductor ribbon cable as required for Interfacing.
Printed circuit boards are available for $9.50 from: Circuit Works, 1118 7th Ave., Neptune NJ 07753, phone (201)-774-1811. 2111 RAMs are available for $3.50 from: Williams Electronics, 1863 Woodbridge Ave., Edison NJ 08817, phone (201)-985-3700.



Close-up view of the scanner on top of the KDK. For those who notice the difference, this KDK is not the standard U.S. import version. The Japanese version covers only 2 MHz and has no repeat mode. Note that the repeat Up-Simplex-Down switch says Lo-Off-Hi. The toggle switch was replaced with an identical MHz rotary switch having 6 positions and two poles. The extra pole was used to high-band the KDK. The rig was modified for repeater use and broad-banded to 4 MHz operation.



The flat ribbon cable is socketed on the back of the scanner and fed between the cover and the rear of the chassis and under the speaker mounting plate where it mates with a mounted 16-pin IC socket. The socket is then wired accordingly.

Reset—reset; scanner Power—on. The KDK squelch should also be on.

Dial up your desired priority frequency. Hitting reset will automatically reset the 74161 to address 0000 in the RAMs, thus giving you instant priority. Immediately flip the switch to stop, and note if address 0000 (no LEDs lit) remains.

Push the program button. Flip the Reset/Scan/Stop switch to scan to allow the LEDs to move to address 0001. Flip back to stop immediately. If the station just programmed is busy, the busy light won't let the address advance. Therefore, dial up the next desired frequency, push the button, and step the address. Continue until you complete all 16 frequencies, if desired.

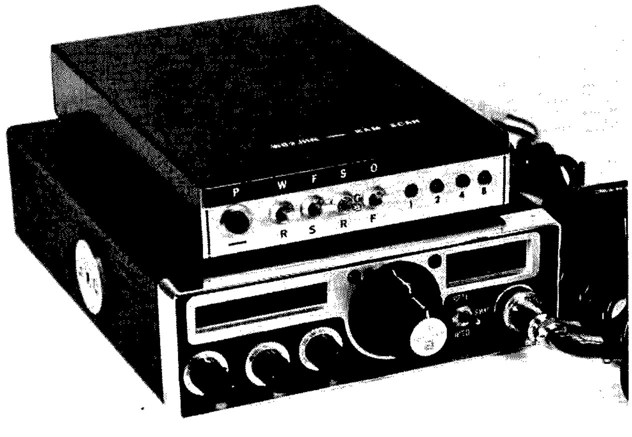
Switch the control switches to the following: Write/Read—read; Slow/Fast—fast; Stop/Scan/Reset—scan. The KDK MHz switch—priority. The scanner should now begin scanning the KDK. The digital display will also show the frequencies while scanning. If there is a desired frequency you wish to transmit on, flip the Stop/Scan/Reset switch to stop, switch in your offset, and transmit.

For those of you who use 5 kHz stations, program 5 kHz low—146.62 instead of 146.625. Instead of scanning in the priority mode, scan in the 144 MHz mode, making sure you are set to 000 on the kHz dials. If the scanner then stops on 146.62 (which it should), simply pull the 5 kHz knob if you desire to stop on that frequency and transmit.

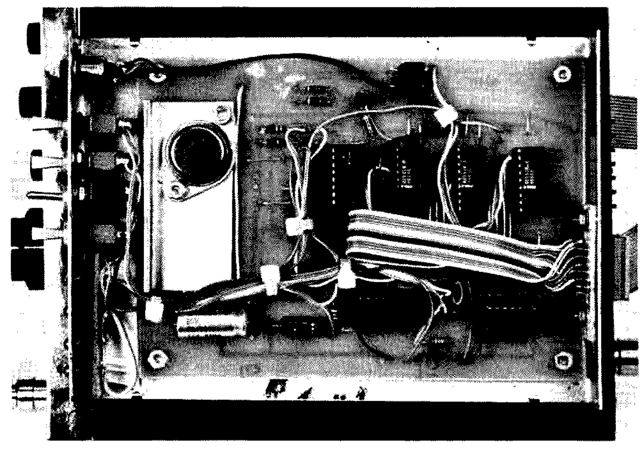
Caution

If the station you just programmed is busy, the busy light will not allow the address to advance. Therefore, you will have to reverse the process for the next frequency by changing frequency first and then stepping the address. It's not as confusing as it sounds.

If you only choose to program a portion of the 16 positions, you will find erroneous data displayed at the unprogrammed addresses. Some of these positions will actually cause the receiver to scan frequencies between 140 and 155 MHz. If this happens and the vco has not been compensated properly, the unlock light will go on and the receiver will stop scanning. So, for all



The scanner built by Felix Foggia WA2OFD. Felix chose the PC board route and housed the unit in a 5" x 7" x 3" enclosure cut down to 5" x 7" x 1".



View of the PC board mounted in the chassis.

unprogrammed positions, program into memory an unused frequency such as 146.00.

An easy way to skirt this problem is to dial in 146.00 and scan at a fast rate while you're in the write position and the program button is pushed. The result will be all 16 addresses programmed in 1-2 seconds. Then proceed with normal programming.

If using W2PMX's high-band modification, which, incidentally, works beautifully with the scanner, you will find that, as previously mentioned, the unlock light may come on if you change too many MHz in one step. Even though the unlock light holds the scanner, I have noticed that the following frequency might not stop the scanner if busy. To resolve this condition, I program the frequency following the last high-band frequency for two addresses. See Table 1 for an example.

Basic Drawbacks

The unit as designed cannot program 5 kHz frequencies. If one really wants to get into the KDK and add a few more gates and another RAM chip, it could be done. I didn't think it was worth it.

There is no delay designed into the system. When a repeater with a short squelch tail drops, or a simplex transmission ceases, the scanner will continue immediately. A delay would add another IC and transistor plus associated circuitry. I have found that a scan rate of 16 channels in approximately one and one half seconds pretty much allows you to return to the dropped channel without missing much, provided no other channel is busy. I resolved this by always leaving the KDK in a simplex transmit mode. When a channel is busy and I want to scan past it, I just tap the mike button in low power. This causes the busy light to drop out and the scanner continues. Actually, the transmitter never gets to turn on, either, so there is no interference.

A final drawback is volatility—semiconductor RAMs lose data when power is disconnected. A nicad pack would eliminate this problem. However, at a current drain of approximately 250 mA, you'll need a hefty battery pack. The computer manufacturers face this same problem—you're not alone.

Applications to Other Radios

I have not had the opportunity to delve into the TR-7400, FM-DX, FM-28, HW-2036, etc., but, if you want to, look for some sort of BCD counters—3 sets, MHz, 100 kHz, and 10 kHz. Using a voltmeter at the inputs, dial up various frequency configurations, looking for TTL voltage level changes. If you have them, the scanner should work for you. The problems you then have to solve are:

1. How can you stop the scanner. If you don't have a busy light, maybe you could use the squelch circuit or S-meter.
2. Since there is no priority channel, you'll have to program your scanner as per the instructions and then dial up 144.00 to scan. The memory will then add data to the binary equivalent, thus giving you the proper frequencies.

Well, there you have it. You should encounter no problems if you wire it correctly. I had no problems getting mine to work during the prototype stages, once I understood what I was doing. Include an SASE with all correspondence, please. ■

Reader Service—see page 211

The NCX-Match

—build something useful

Low cost and high flexibility.

Rick Ferranti WA6NCX/1
215 Herrick Road
Newton Centre MA 02159

The need for a good rugged transmitter matching device seems to be increasing almost daily. More and more advertisements have appeared in *73* and elsewhere detailing ultimate transmatches, miniature transmatches, and transmatches with other goodies thrown in (like swr bridges, power meters, antenna switches, etc.). The one thing that all of these devices have in common is a high price tag. Why should a simple thing like a coil and capacitor be so expensive? After all, it's an easy matter to home brew your own transmatch, and you'll have the joy of using a device you built yourself.

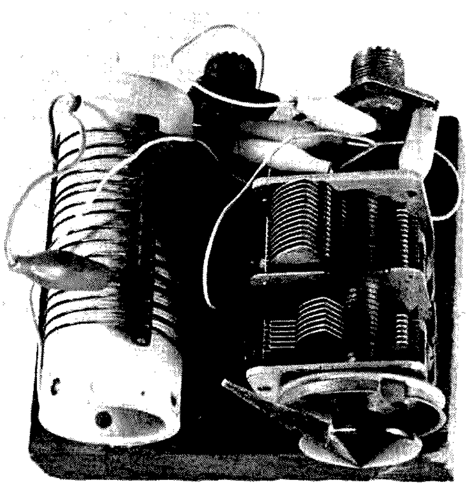


Photo A. Original nonclassy matching unit still works fine after 7 lucky years. When properly adjusted for a 1:1 swr, it will take 200 Watts PEP. Note the plastic dial pointer on the capacitor; this keeps your fingers off the rf voltage when you're tuning up.

The increasing popularity of transmitter matching equipment stems from a multitude of needs: Novices and Techs are on the increase, apartment dwellers need simple antennas requiring a proper match to the rig, solid-state finals require 50-Ohm impedances if they are to work at all, and frequency-limited antennas can often be coaxed beyond their normal bandwidth with a matchbox.

Two models of transmatch will be discussed here; the first is so easy to build that you can use it by the time you finish reading this article. The second is a bit more fancy and much more rugged, with a good deal more aesthetic value thrown in. Both have the following advantages: They'll match anything to anything, they'll take almost any barefoot rig (200-Watt class), they're low cost and the parts are easily available, and they are extremely flexible so that you can do all kinds of experimenting with tuned circuits and antennas.

Simple Beginnings

I'm still using the first transmatch I ever built—you can see this glorious contraption in Photo A. It's seven years old and still going strong. Small and easy to carry or ship, it works just fine. Basically, you wind a coil of wire on any available form (plastic pill bottle, cardboard or PVC tube, ceramic core as in the photo, etc.) and leave space between windings for an alligator clip to clamp to the wire. If you use insulated wire, scrape away the plastic or enamel at the tap points. A pencil or dowel of wood or plastic can be slipped under the windings as you go to raise them up so that the clip can firmly grip the wire. As you can see in the photo, I fit 16 turns of wire on the form, which is 1½ inches in diameter and 4 inches long.

The capacitor part of this simple device is a broadcast-band variable ripped from an old ac-dc tube set, with both sections in parallel, giving about 500 pF total capacity. Blow the dust from the plates so that they won't arc when you use it. If you can, save the plastic pointer which may have come with the radio or epoxy a plastic

tube to the shaft—you don't want to touch the cap when you're tuning up!

The rest is easy. Mount the coil and capacitor on a piece of wood, add two SO-239s (with their grounds tied together), and use clip leads to connect the two components in various configurations. Everything should be clear from looking at the photo and Fig. 1.

Of course, this thing is very flexible. You can hook up various configurations of "L" matches, loading coil or series capacitor matches, or even series or parallel-tuned circuits and traps. Some suggestions are in Fig. 2. I've found that the basic "L" configuration, with the series coil and the cap from antenna to ground, works with almost any long- or random-wire antenna—see Fig. 2(a). Put the swr bridge in the transmitter side of the line, excite the antenna with a little rf (enough to get a reading on the meter—but *listen* before you tune up on the air), and run the capacitor quickly through its range. If you get a shallow dip in reflected swr, adjust the coil tap and try for a deeper null in reflected power while swinging the capacitor around again. Continue until your swr goes down to 1:1. Remember that a low swr will let you run higher power to the matcher without arcing (I've had no problems with my FT-101B), so tune the matchbox on low power first, and then pour on the juice.

Two other things: If you can't get a dip anywhere for any tap on the coil, change the configuration (move the cap to the other side of the coil, etc.) until you get a low swr. The other thing to remember is that no matching device increases the efficiency of your antenna. It only allows your transmitter to see the load it likes so that the thing operates properly. As such, it allows you to load the rig where otherwise you may not be able to do so.

Getting Classy

Of course, I wasn't satisfied with my first transmatch, since it isn't very rugged and doesn't look like anything particularly beautiful. I decided to build something really snazzy, but with little cash outlay. The design includes a sturdy metal case, an infinitely-variable roller inductor coil, high-voltage variable capacitors, a built-in swr bridge, a low-pass filter, a frequency counter or oscilloscope output, and provision for greater flexibility by the addition of external coils, capacitors, or other components. The result, a cross between the rack-mounted monsters of yesteryear and the sleek goodies of today, is shown in Photos B and C.

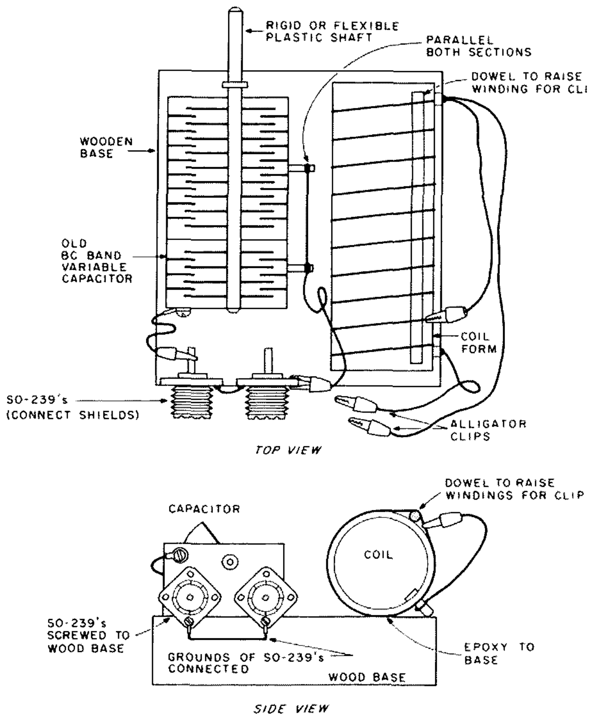


Fig. 1. Construction plans of the simple transmatch.

Parts

The perennial question for any builder is where to get the parts needed at a reasonable price. In this instance, fortunately, the case and many components are readily available on the surplus market. Write a note to Fair Radio Sales Co., P.O. Box 1105, Lima, Ohio 45802, and ask for their latest catalog. In it, they'll

Photo B. The NCX-Match. The swr meter need not be calibrated since you're tuning for a minumum at all times.

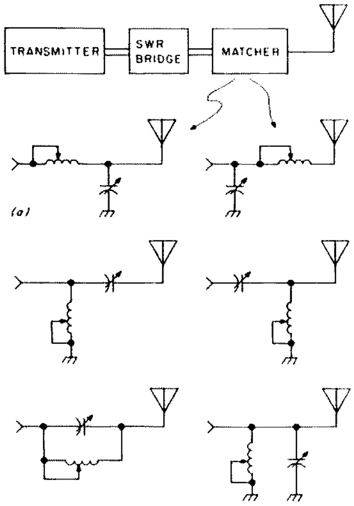


Fig. 2. Hookup diagram and suggested configuration possibilities to match anything to your rig. (a) is the one which almost always works, so try it first.

have just what you need under the heading "Parts Bonnaza" (a curious misspelling which has been in their catalog for years). On page 16 of catalog WS-77, you'll see the plug-in tuning units used in BC-191/BC-375 transmitters. I have a list of the parts in these gems, and the one you'll want to order is the TU-7-B 4500-6200 kHz unit, which has coils, an antenna switch, variable and fixed high-voltage caps, a vernier dial, a right-angle drive, and a beautiful outer case for $5.95 (brand new). It only weighs 15 pounds, so the UPS shipping charge will be around $3.00.

The tuning unit has the two large variables you'll need (each about 120 pF), and two 5000-volt, 400-pF fixed capacitors which you can save as auxiliary plug-in range extenders. Of course, you'll be using the inner case (save the outer one for another project, or use it to make a larger model of this matcher). The only other main components you'll need are the roller coil and a front panel piece.

Fortunately, Fair Radio Sales and local ham flea markets still have the incredible ARC-5 series "Command Set" transmitters. They must have built ten of these things for every man, woman, and child in the U.S.! If you can find the roller coil from the ARC-5 series (this is what I used), you're all set. If not, Fair Radio Sales has them, as well as other roller coils—check pages 9 and 16 of catalog WS-77 and page S77-37 of the catalog supplement. It doesn't matter if the rest of the transmitter is destroyed—all you need is the roller coil—so you may be able to get some junked chassis for a low price, particularly at a flea market table.

Besides the case and the roller coil, you'll also need a ¼-inch-thick aluminum panel for the front of the case. Check around at a scrap or sheet metal place and you should be able to find one and even have it cut to size for a reasonable price. The panel should be fairly thick so that the capacitors and roller-coil dials don't shift around with pressure.

Why do you need a front panel when you already have the case? Simply because you're going to strip all the parts out of the BC-375 unit, and that's going to leave its front panel full of holes. It does make a good template for the six screws which will hold the new panel to the case. By the way, save everything you take out of the tuning unit, including the screws. You need the capacitors and their mounting insulators, the handles, shaft couplings, and fixed capacitors, as well. If you want to do so, you can use that beautiful heavy-duty ceramic rf switch as an antenna switch in the matcher. It's a nice convenience which I probably should have added to my NCX-Match when I built it a few years ago.

You'll notice that the case's top and bottom panels are well ventilated with eight sets of holes drilled through them. I found that dust tends to settle on the caps and coil inside because of this unnecessary ventilation, so I glued thin clear plastic sheets under the holes to block out the dust. The top panel should be the one

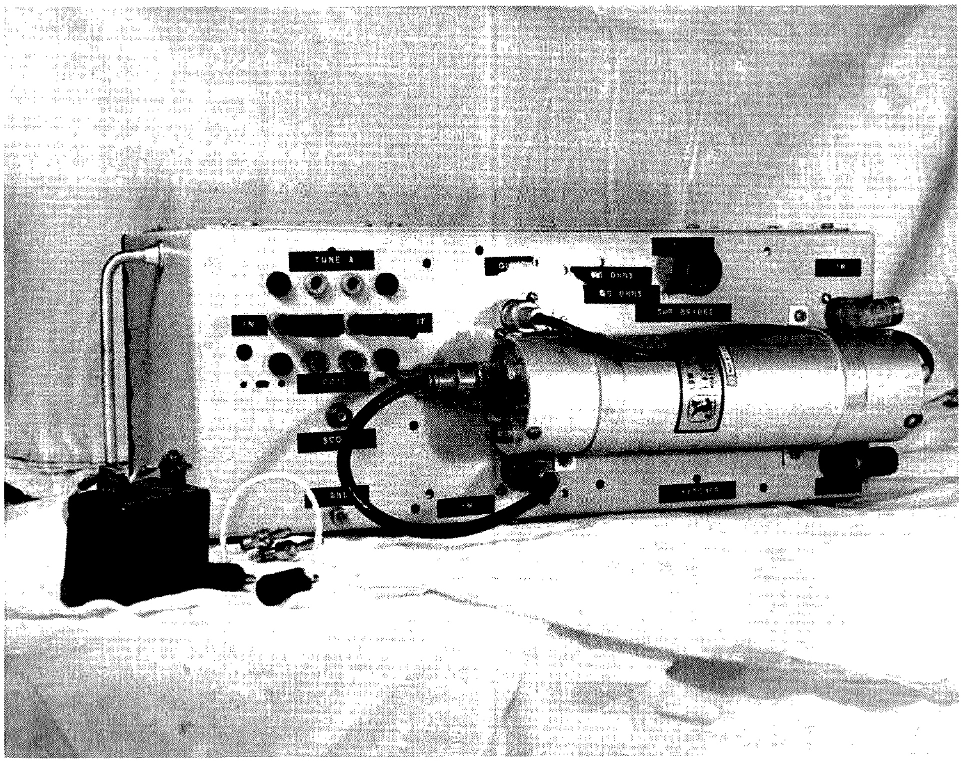


Photo C. Rear view of the matchbox. The large fixed capacitor on the left (removed from the original BC-375 tuning unit) can be plugged in the matcher jack matrix to add 400 pF. The null pot on the swr bridge above the low-pass filter has 50-Ohm and 75-Ohm calibration points marked for easy reference.

with the small notch cut in it, while the bottom panel has a long narrow cutout (originally for the plug-in connector).

You'll need a counter-type dial for the inductor. I found that big dial in the photos at a local surplus store for $2.00. If you can't get a counter dial per se at a reasonable price, just use a crank-type spinner knob. Then you can use a rubber pulley arrangement and the turns counter from an old tape recorder (they're advertised as surplus in *73*, or check out page 56 of the June, 1977, issue for more ideas on how to reset the roller coil quite accurately). The hardest part of building this whole contraption was the mechanical coil arrangement. As you can see in the photos, I used the gears from the original ARC-5 and drilled holes to match things up accurately. Take your time; you'll be rewarded with a smooth-running adjustable inductor.

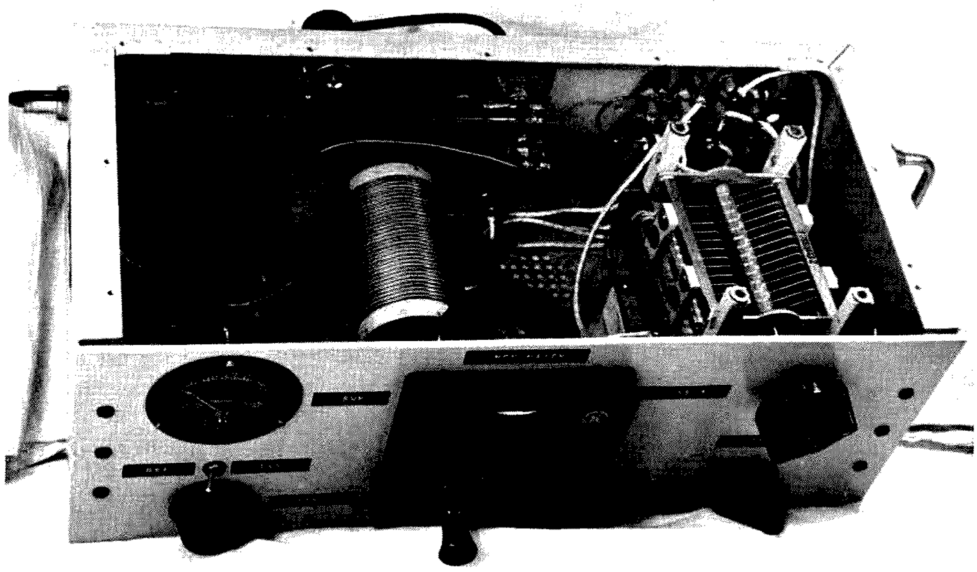


Photo D. Rear view of the matcher showing the swr bridge element, the roller and scope pickup coils, capacitor mounting, and the plug matrix.

I added an swr bridge to my unit, the details of which can be seen in Fig. 3 and Photos D and F. It's a version of the "Varimatcher" in *QST* for May, 1966. The sheet metal can be cut from a cookie sheet, and you can get the ¼-inch copper tubing from a plumbing supply house. Remember to keep things symmetrical and it'll work fine. The hardest part is taking the inner conductor of a piece of RG-58 or 59, soldering a thin wire to its center, and sliding it through the copper tube until the thin wire can be pulled out of the slot you've filed in the middle of the tube. This wire gets connected to the arm and one end of the 100-Ohm potentiometer (carbon—not wirewound!). The schematic in Fig. 4 should make construction a little clearer.

Calibration of the bridge is simple. Put a 50-Ohm dummy load or 51-Ohm, 2-Watt carbon resistor across one SO-239 and apply a Watt or so of power on 10 meters. With the bridge in the reflected position, adjust the null pot for the least indication on the meter. This is your 50-Ohm calibration point. If you want to use the bridge for 75-Ohm lines, simply replace the 50-Ohm resistor with a 75-Ohm unit. I calibrated my bridge for both impedances and can change them with a twist of the knob.

I liked the Varimatcher style because of its ruggedness and versatility. Alternately, other bridge

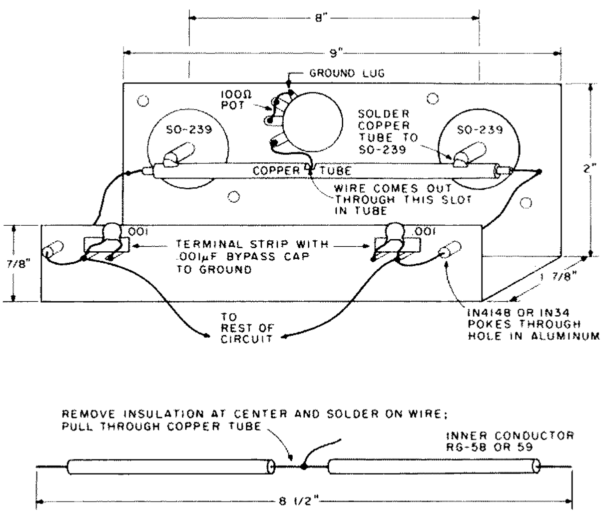


Fig. 3. Sheet metal layout and pickup element plans for the Varimatcher swr bridge.

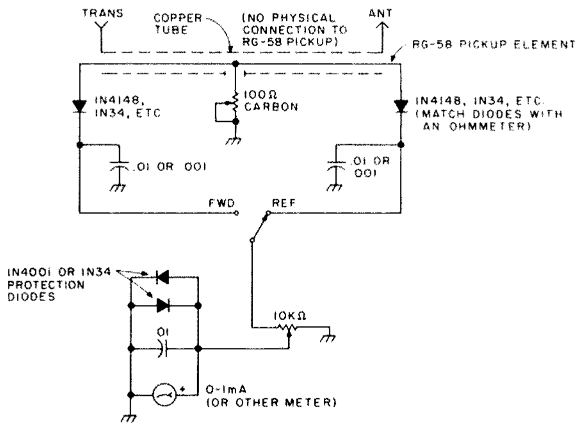


Fig. 4. Schematic diagram of the swr bridge built into the NCX-Match.

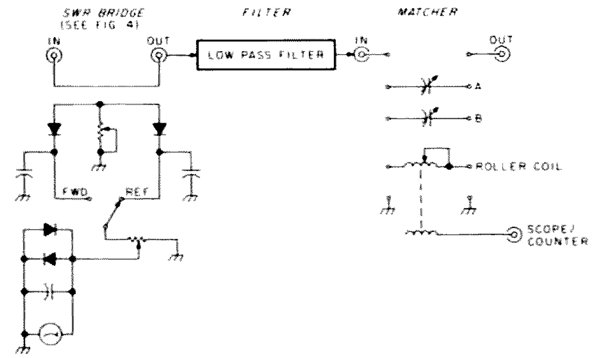


Fig. 5. Schematic of the entire matchbox showing independent swr bridge, filter, and matching elements.

construction techniques could be used, or you could simply dismantle a commercial bridge and mount its innards inside the matchbox.

Mounting and Wiring

As I mentioned before, the hardest part of building the unit is making the roller coil merrily spin as you turn the front panel crank. As you can see from Photos E and G, I mounted the original ARC-5 gear on the shaft of the turn-counter crank and secured the actual roller coil and coil tap to the bottom plate of the case.

The large air-variable capacitors can be mounted to the top and bottom case covers with their original ceramic standoffs. I used an insulated coupling for the front panel shaft of one of the capacitors; on the other, a metal coupling and insulating fiber shaft was used. The point is to keep the rotors of the caps from shorting to the case or from giving you a jolt of rf while you tune up.

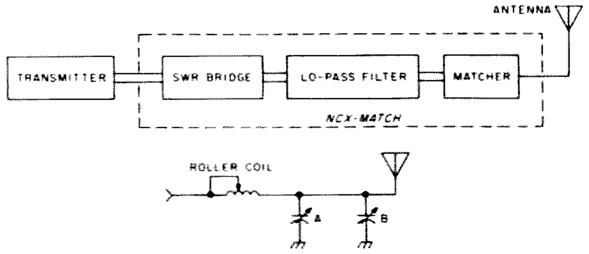


Fig. 6. Hookup diagram and suggested first configuration for the NCX-Match.

The meter was mounted in a large hole cut carefully with a coping saw, as was the counter dial for the coil. It takes a bit of patience to slowly saw through that thick aluminum plate, and the roller dial needed a very odd-shaped hole! The low-pass filter, an E.F. Johnson unit in this case, was mounted to the rear panel with the hardware supplied with it. I secured the swr bridge element to the case with long screws and lockwashers passed through the mounting holes of its SO-239s.

A useful added feature of this matchbox is the scope/counter output visible in Photo C. The smaller coil near the roller inductor and directly below the swr potentiometer in Photo F serves as the pickup element. I simply wound a coil of hookup wire on a Bakelite™ form and glued it near the roller coil so it would sniff a bit of the rf energy flying around inside the case. One end of the coil is connected to the BNC jack on the rear panel, the other end is simply left free on the coil form.

The means I used for switching various coils and capacitors in and out of the line is a matrix of 12 banana jacks spaced the standard 3/4 inches apart, as you can see in Photo C. The four corner jacks (black) are connected to ground, and two others are the input and output of the matcher. Two each down the center of the matrix connect to the two capacitors and the coil. Thus, by jumpering various connectors at the back of the matcher with either stacking shorted double banana plugs (as in the photo) or with wires with banana plugs at their ends, one can make any configuration of the coil and capacitor desired. You may also notice a large fixed capacitor with banana plugs on fly leads fitted to it in Photo C. This can be plugged into the rear panel jacks to add more capacity, or to make even more complex configurations. Of course, external coils can be added in the same manner. Thus, you can make pi networks,

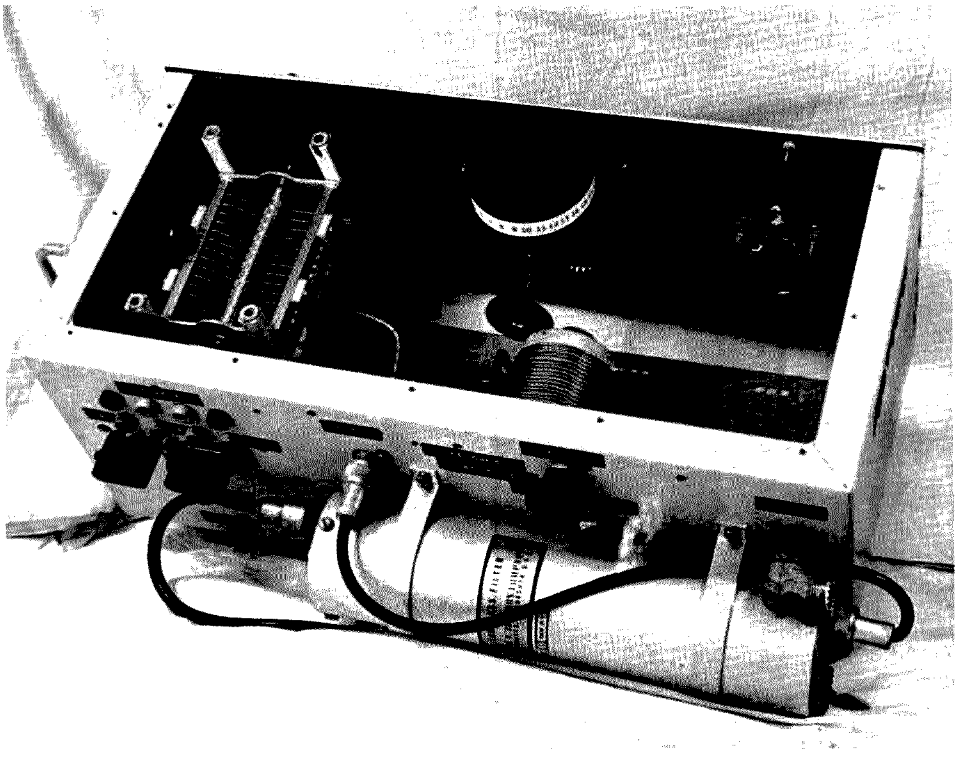


Photo E. Front inside view of the NCX-Match. Notice dual banana plugs installed on the matcher jack matrix (now configured for capacitor B to be in series with the antenna).

tuned circuits, differential capacitor circuits, and all kinds of configurations by simply plugging in jumpers. A glance at the schematic of the matchbox (Fig. 5) makes this clear.

I haven't had to use external components with the matcher since the "L" configuration with both internal tuning caps in parallel takes care of all the capacity needed for most random-length wire antennas. You'll probably find, as I have, that the roller coil has about five times more total inductance than you'll ever need, so external coils aren't necessary at all.

A few notes on the matrix of jacks may be helpful. Once, I was running 125 Watts AM (plate modulated, of course) with a DX-100 on 160 meters, and the insulation on one of the panel banana jacks started to bubble and smoke! I've long since sold that wonderful Heath monster rig, and SSB has since caused no insulation problems. However, if you worry about such things and run a lot of power on RTTY or another continuous mode, you can mount uninsulated banana jacks on a Bakelite™ or Teflon™ sub-panel and attach this so that it pokes through a large rectangular hole cut in the rear panel. Teflon™ or Bakelite™ will certainly solve any dielectric heating problems.

Wiring up the unit can be done two ways: Use heavy solid wire like in the original BC-375, or use stranded heavy wire with fiberglass insulation as I did. I chose the later method because it was easier to do, and because, when I was disassembling the tuning unit, I discovered a 40-year-old cold solder joint between the original solid heavy wire and a capacitor! Not wishing to duplicate such a feat (who were the poor guys who wired up these things anyway?), I used standard wire and a big soldering iron (100 Watts). I've had no problems with arcing with the fiberglass insulated wire.

Don't forget to save one of the original handles from the tuning unit to mount on your new matchbox. It's handy for carrying the thing around on field day. Also, do give the case a good coat of paint before assembly. When I built my unit almost five years ago, the only panel labels I had at my disposal were those embossed plastic jobs. Although they look decent with a symmetrical panel layout like the one you see in the photos, you can do better with rub-on lettering sets, particularly the kind with whole electronic terms already spelled out for you.

Tune-Up and Use

Connect up your matchbox, swr bridge, and lowpass filter between the rig and antenna as shown in Fig. 6, with the matcher configured as in the diagram. The reason for this hierarchy in element order is that the transmitter should be the one to see 50 Ohms as indicated by the swr bridge, and the filter should also see 50 Ohms to work properly. The matcher itself is the thing to fool all those other 50-Ohm devices into thinking that your weirdo antenna is really a dummy load. Hence, it goes closest to the antenna.

As you can see in Photo C, I simply used two short lengths of coax (with connectors attached) to connect the various elements in the matcher. The swr bridge, filter, and matching network proper can all be used independently if desired—an added bit of versatility.

This matchbox is tuned exactly as the previous unclassy model, with the extra convenience of a rotary coil as an infinitely-variable inductor element. Try the "L" configuration first, as suggested above, swinging the capacitors and coils through their ranges while applying low power. Look for a dip in reflected power and tune to minimize the reading. If you can't get a null, change the jumpers at the rear panel and try a new configuration. Soon you'll be able to load up everything from your window screen to a 1200-foot longwire.

This sturdy matchbox drew very flattering comments at a home brew club meeting some time back, and it still looks and works great. If you need a good rugged transmatch and don't want to spend a fortune on commercially available models, give this one a try. You'll have a good time building it up and will be rewarded with a fine piece of useful equipment. You may even want to modify your call so that it ends with an "X"—"X" for "trans"—hence the NCX-Match. ■

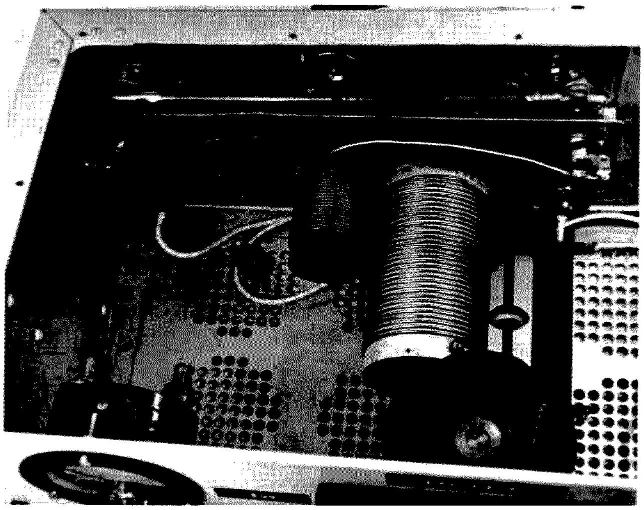


Photo F. Rear inside view with a close-up of the swr bridge and coils.

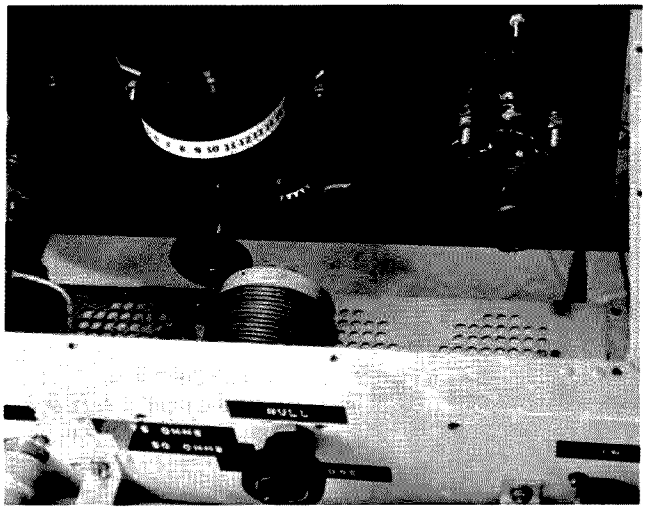


Photo G. ARC-5 roller-coil gear is mounted directly to the dial shaft. Note the protective diodes and bypass capacitor across the swr meter.

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The Memorizer Goes to MARS

—expanded frequency coverage

A step toward the perfect FM rig.

One of the newest offerings in the field of 2 meter FM is the Yaesu FT-227R Memorizer. This unit became available at local dealers in late December, 1977, and I purchased one on December 26 as a one-day-late Christmas gift, although I am normally a little slow to buy new products until they've been proven in the field.

As a member of Air Force MARS, I had hoped for a new rig that would permit operation on our local MARS repeater, but this was unlikely with the new Yaesu, although it did a beautiful job on the 144-148 MHz portion of the band for which it was designed. The rig was engineered to preclude operation out of the amateur band, which seemed like a fact I would have to live with.

The bright red display would clearly read out any frequency from 144 to 148 MHz, but nothing else. After carefully reading through the superb owner's manual, the needed information for a modification finally came to light on pages 18 and 19. The key paragraph states that Q711 (MC14081B) limits the high end of the rig and Q712 (MC14028B) limits the low end of the rig and cut off Q713 (2SC735Y) to prevent transmissions out of the amateur bands. By tracing the circuit through the diagram on page 19, it became apparent that changes were needed to pins 3 and 6 of Q712. The phase locked loop (PLL) board was noted as being on the top side of the rig.

I carefully removed the top of the rig and noted that the PLL board was under a cardboard cover at the front of the rig. This cardboard was lifted by the removal of three screws, and I was looking at the underside of the board. A red wire came from pin 3 and a blue wire from pin 6. These were removed from these pins and resoldered to an adjacent ground, which ends the modification.

Now the crucial test came—to see what had been accomplished. My rig now displays all frequencies from 142.000 through 149.995 MHz, though transmit is possible only from 143.05 through 149.995 MHz. This frequency spread allows me to operate on the AF MARS simplex frequency and to monitor the output of the AF MARS repeater. The modification allows full operation on the Army MARS repeater and should prove very useful to many MARS members.

This is my first Memorizer modification, but it should open the door to other ways to make this the perfect FM rig. I would welcome correspondence on other modifications or further expansion of this modification (enclose an SASE, please).■

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Build a Hybrid Capacity Meter

—digital circuitry, analog display

Test your junk box.

Like many other electronics enthusiasts, I like good buys on bits and pieces of electronic equipment and parts. I also accumulate a lot of "junk." Among these treasures are many unidentified capacitors. This identity problem makes them almost useless.

There are many good circuits for measuring capacity, but most of them use the same design theme—a generator with multiple frequency selecting components. If the tester has 5 ranges, there are 5 capacitors and 5 resistors, probably variable, and the switch to select the desired range. This is an acceptable method, but you may have many components that can change value and affect the accuracy of the measurement.

The circuit described here is similar in some respects to the well-known analog tester, but it uses a different method of frequency (range) selection. In this circuit, I have one clock frequency, approximately 200 kHz, that generates the necessary frequency for the ranges. Instead of using RC circuits for each range, I use 74LS90s for the decade change. The advantage of this is that there is only one frequency-determining RC network, and this is adjustable from the front panel. This means that the instrument can be calibrated on one range and be accurate for the other ranges. With the low cost of ICs, the price of this instrument compares favorably with the other types of instruments.

How It Works

The generator is a 555 oscillating at approximately 200 kHz. The frequency is adjusted by R2 when calibrating prior to use or during use, if a reading is doubtful.

The output of IC1 is used for the 0-to-100 pF range and is also used to clock the first 74LS90. The output of IC2 (pin 11) is the 555 frequency divided by 10. This frequency is used for the .001 full-scale range. The remaining 74LS90s operate similarly. Each division by 10 is the frequency for the next larger decade of capacity. The 74LS00 was added as a buffer. Since it would be wasteful with the other gates doing nothing, the LED circuit was added to give a visual indication that the clock and all dividers are working. There is a definite pulsating of the LED, so the user is sure that the circuit is working.

The accuracy of the instrument is very dependent upon the tolerance of the calibration capacitor, C3. Prior to use, C3 is switched into the circuit and the frequency of IC1 is adjusted by R2 until the meter reading is equal to the value of C3. The drawing shows C3 as being 5100 pF, 1% tolerance. Actually, any convenient value could be used, but the tap on the range switch would have to be changed to make sure the correct frequency is being applied through C3.

The condition of the battery can be checked by pressing S3. When making a battery test, ensure that there isn't a signal path through a capacitor to the meter, as this would give a higher battery voltage reading than really exists. The multiplier resistor will give a reading of .9 on a full scale of 1.

Construction

I like sockets. It makes troubleshooting easier if a chip must be removed, but sockets are not necessary. All 74LS90s are wired the same as IC2. The range switch is wired to make 5 ranges available. The additional position is used as the calibrate position. A separate switch can be used for calibration, but the user has the chance of damaging his meter if the calibration capacitor is a .005 and the range switch is in the 0-to-100 range position. The ICs can be replaced by 7490s and 7400s,

but the current drain is rather high for a 9-volt battery. If a power supply is used, there is no problem using the TTL chips. The meter rectifiers are run-of-the-mill diodes. The meter is a 50 uA meter with a 0-to-1 scale marked off in .1 readings.

Use

Prior to use, the meter should be calibrated to compensate for those variables that cause errors. After calibration, the unknown capacitor is placed across the test terminals and read. A word of caution is offered: Use this meter as you would a voltmeter in a strange circuit. Start on the high range and work down until you get a reading. This prevents pegging the meter and possibly damaging it.

This circuit is easy to construct and use and should give many years of reliable use. ■

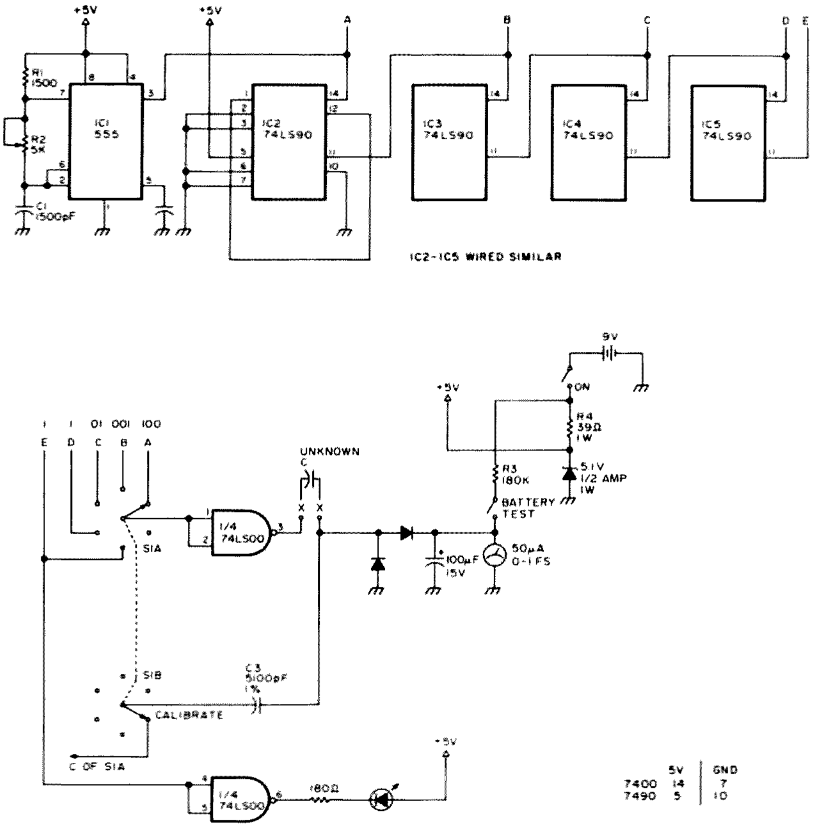

Fig. 1. All resistors are ¼ Watt except as noted.

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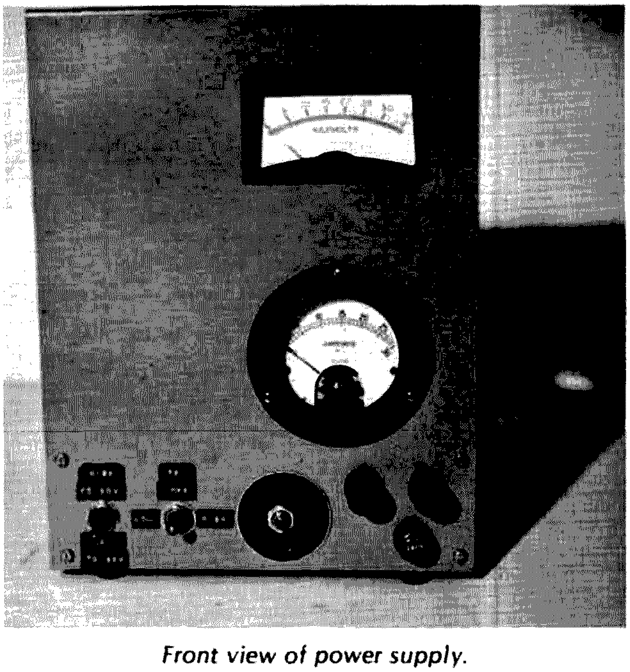
Power Plus!

—a 20-Amp, adjustable, regulated dc supply

Versatility personified.

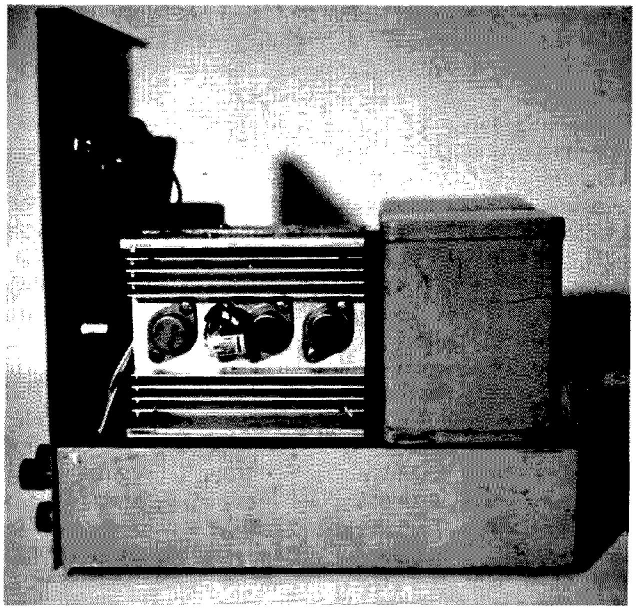
What do you do for a base station regulated power supply after you discover that the amplifier you have just completed requires half again the current you anticipated? The supply described by George Schreyer WB6TOX in the December, 1972, *73 Magazine* is the heftiest I can recall to date described in either *73* or *Ham Radio* magazine. It will supply the 10 Amps as described. I built it with extra heavy-duty components, but could not get acceptable regulation beyond this level. My amplifier requires 17 Amps. After many modifications, many burned-out transistors, and much frustration in attempts not only to increase the current capability but to retain regulation, it was back to the proverbial drawing board.



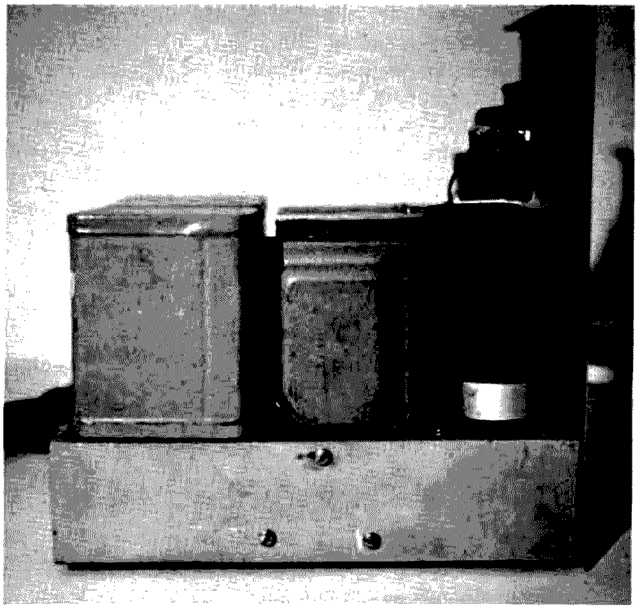
Front view of power supply.

This, then, is an article meant to furnish information that you can add to your pet circuit notebook as well as to provide a circuit and construction ideas for the vast number of hams obtaining bigger and bigger solid state amplifiers. This supply is versatile in that one has a reasonable amount of control over the heat dissipation of the pass transistors despite the amplitude of voltage to be controlled.

Two paralleled power transistors are used as pass transistors; the 2N3772 and 2N3773 might be described as extra-heavy-duty 2N3055s. I use this as a comparison because the 2N3055 is the well-known workhorse. The 3772 and 3773 can dissipate 150 Watts, as compared to the 3055's 115-Watt capacity. These transistors can effectively control voltage amplitudes as low as 1.4 volts. Each 3772 can very safely handle currents to 15 Amperes. The 3773 handles 10 Amperes, again as com-



Left side view of power supply.



Right side view of power supply.

pared to the 3055's 5-Ampere safe capacity. These currents must, of course, be kept within the power dissipation capability of the unit. One would not, for example, attempt to drop 30 volts across a 3772 while pulling 15 Amperes, as this is a 450-Watt dissipation and the transistor has a rating of 150 Watts. Using two of these in parallel, the dissipation capability is increased to 300 Watts. (Even 300 Watts takes a lot of heat sinking to dissipate the heat.)

Refer to the schematic in Fig. 1. Let's examine some practical extremes. Say we wish to regulate 13.0 volts at 20 Amperes, and the input voltage (at the choke output) into the regulators, using the full secondary, is 35 volts; this would result in a drop of 22 volts across the regulators. 22 volts × 20 Amperes = 440 Watts. Obviously, things would start to melt after a very short operating period. Therefore, switches S1 and S2 have been incorporated so that one can obtain the required voltage and current and hold the dissipation within reasonable levels. Thus, setting S2 in the low position, we are only using ¾ of the secondary, or 22.5 V ac, possibly delivering 25 volts (loaded) to the pass transistors. 25 less 13 = 12 volts across the pass transistors, or a total of 240 Watts.

Following this same reasoning, it is apparent that the higher the regulated output voltage, the smaller the voltage drop across the pass transistors and the smaller the power dissipation.

Note that, when using multiple secondary transformers, one has the capability of choosing the appropriate voltages. The switching arrangement shown is the one I use. It may be convenient for some applications to tap the secondaries at other points, i.e., tapping at the 15-volt ac position will result in approximately a 60-Watt dissipation for the above stated example.

Selecting Components

The transformers I used were purchased from army surplus (WW II). They are hermetically sealed units and have an operating ceiling of 60,000 ft. The continuous operating current is called out as 10 Amperes. I have used the supply for over an hour of continuous service at 17 Amperes and the cases stayed at room temperature. The transformers each have two 7.5-volt secondaries. As can be seen in the schematic diagram, I use the windings in series and parallel configurations. The choke possibly can be eliminated with somewhat higher peak voltages being present. Any possible increase in ripple voltage will be smoothed out by the gain in the regulator chip. The

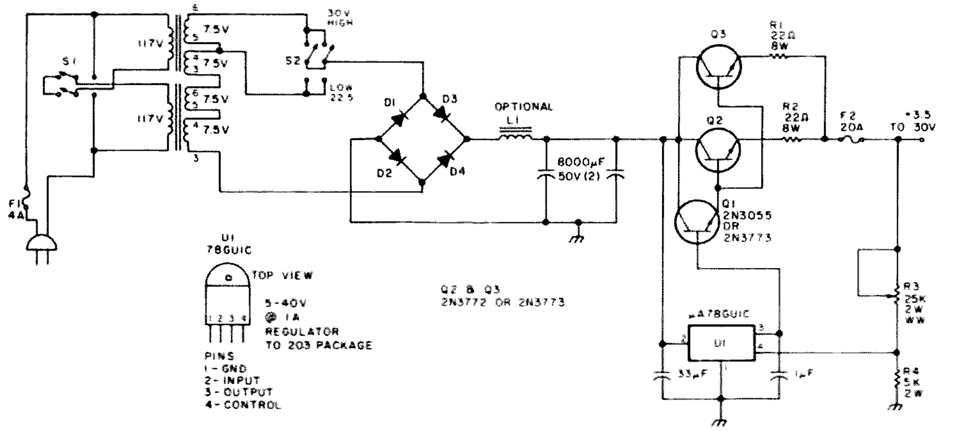


Fig. 1. 17-Ampere super-regulated low-voltage universal power supply —3.5-30.0 volts. S1 and S2—10 Amp contacts @ 120 V; D1-D4—50 V, 30 Amp or equivalent; Q2 and Q3—2N3772 or 2N3773; Q1—2N3055 or 2N3773; U1—µA78GUIC; R1 and R2—paralleled .44 Ω, 4 Watt or equivalent; R3—2.0 Watt, 20k to 25k wire-wound pot; R4—5k, 2 W.

choke was used in a previous unregulated power supply built on this same chassis; therefore, it was retained rather than removed. This choke was built from a Triad filament transformer I had on hand.

Originally, the transformer had four 6.3 V ac 4-Amp windings. The transformer was disassembled, the secondary winding removed, and about 3 or 4 layers of no. 10 or 12 wire wound onto the core. The laminations were reinserted with all of the "E"s in one direction and the "I"s placed at the end.

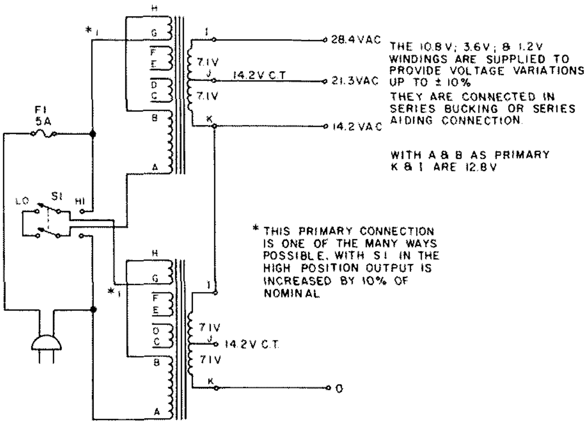


Fig. 2. ITC transformer, part #BP-6242, size 4.5" x 5.0" x 7.0", hermetically sealed, conservatively rated at 20.0 Amperes continuous operation. A pair of these can be substituted for the transformers in the text and offer even more versatility. They are available for $19.50 each from Hiway Company, 305 W. Wisconsin Ave., Oceanside CA 92054.

The regulator chip, a Fairchild uA78GUIC, is the whole key to the success of regulation. It drives a 2N3772; a 2N3773 or even a 2N3055 will work equally well. The rectifiers are 1N3209s, 100-volt, 15-Amp units. They happened to be something I had in my junk box—suitable substitutions can be used. Incidentally, they ran cool at 17 Amps; the heat sinks were cut from heavy aluminum heat sink rails. Two heat sinks were used side by side and isolated from each other, one section for the rectifiers, the other for the pass transistors. For better dissipation, the radiator fins should be vertical. However I have had no problems mounting them horizontally.

Refer to the schematic. The divider composed of R3 and R4 only requires about 1.0 mA of current as the control current to the regulator is only 5 to 8 μA under worst-case conditions. The control voltage is 5.0 volts. The fixed values for a given voltage output at pin 3 can be calculated from the formula Vout = [(R3 + R4)/R4] V, where V control on the 78GUIC = 5 V.

There you have it. Modify as you wish or duplicate as close as possible. The ideas are all there and the supply regulation is super, dropping about 2.0% at any setting up to 24 volts, no load to full load.■

References

1. Fairchild Application Note μA78G, July, 1975.
2. "Versatile Variable Power Supply," W6SLP, *73 Magazine*, June, 1968.
3. "10 Amp Variable Power Supply," George Schreyer WB6TOX, *73 Magazine*, December, 1972.

✓ Reader Service—see page 211

Reaching for the Top

—why stop with the General ticket?

Get that higher class ticket now—and avoid trouble later.

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Amateur radio is in a period of flux these days. Of course, the solar flux index is increasing, a happy sign for propagation, but so is what we might call the regulatory flux index, which comes, not from "Old Sol," but from the puzzling FCC.

Detailed monthly in the pages of *73*, we find many changes in the rules by which our hobby is run. Logging requirements, repeater deregulation, and callsign assignments are examples of significant changes that the FCC has recently wrought. WARC '79, looming directly ahead, poses additional threats to the stability of amateur radio.

Although the future is clouded, some reasons for obtaining an amateur license above the Novice class now, or upgrading to a higher class, are clear. One reason is the very uncertainty of the present. Like the regulations, the amateur examinations are changing. Already in effect are two important changes in the code test.

First, the sending test has been eliminated (except for the Novice); that's one less thing to worry about. Second, the receiving test is not what it used to be. No longer is the subject matter strange stuff about farm statistics in Hawaii or specifications for Coast Guard installations. Now what you are asked to copy at 5, 13, or 20 wpm is one side of a typical amateur QSO. This makes for familiarity and a degree of comfort.

However, instead of copying clear, machine-sent code through headphones, as you may have done before, now you may have to copy from a cassette recorder. There might not be any headphones, and both room acoustics and outside noises may interfere. Adjust your practice accordingly.

You needn't copy one minute correctly any more; in fact, you can just take notes if you want. The examiner measures your comprehension by ten multiple choice questions; you must answer eight correctly. The questions are not tricky, but do thoroughly test whether or not you are able to copy the passage. Hams who have taken both the old and new kinds of code tests loudly praise the new one.

The FCC has indicated that it plans to change the written exam, too. Last year, it issued a new set of study questions. The new test may be easier, and may (like the new Novice tests) be harder. Take the old one if you still can.

If you are going for the Extra class, be advised that the 1 × 2 calls are running out. The new 2 × 1 calls will go fast, so get in there while there is still something left!

Comfort and Confidence

The two parts of an amateur exam, theory and code, vary in kind. You should study for them in different ways, but your goal should be the same for each part—comfort.

Comfort and ease come with mastery of the subject matter. Comfort in turn produces confidence, and confidence is the only weapon you have against that steely-eyed examiner (while others have praised the humanity of certain examiners, I found very little warmth in the last field office I visited).

Comfort and confidence come only with good hard work. You must invest some time—for most of us, quite a lot of time—in learning the code and theory for your test.

Of course, there is another way. For as long as the FCC has been giving exams, there have been peo-

ple who have taken them in much the same spirit that animates the buyer of a lottery ticket: "Maybe I'll be lucky!" The person who thinks this way bolsters himself by studying a cram course or memorizing the answers in the old (not the new) ARRL *License Manual*. He copies a few W1AW code runs and then blithely strolls into the examination room to take his chances.

Very likely we'll see him in the same spot next month, and the following, but after awhile, it will work: Through practice, he'll finally pass. However, by this time he would have been better off doing it the right way from the start, thus gaining some useful knowledge to go with that new ticket.

Study Hard

So, study hard. But it shouldn't be purely a grind. After all, ham radio is a hobby, meant for enjoyment. Your enjoyment should increase as you learn about your hobby. You will not have to mumble when someone starts a modest technical discussion on 75 meters. The process of learning how a radio works should interest you, unless ham radio for you is simply the propagation of your ego across long distances.

Perhaps a class can help you learn more code and theory. More and more clubs are sponsoring classes, not only for prospective Novices, but also for those who want to upgrade. "Ham Help" in *73* or the ARRL can help you find a class.

If you are going for your Extra, or there is no class in your area at the needed time, you may have to go it alone—but don't despair. If you have the right materials, you can learn at least as efficiently on your own as you can in a class, which may move at the speed of the slowest learners. As you work by yourself, you should push yourself hard, but don't go so fast that you fail to learn.

If you, like me, have trouble with the math, check out the series "FCC Math" by WB6CKN, which began in the November, 1977, *73*. It will help.

Learning the Theory

There are two exceptionally useful books to help you learn the theory. One is the new ARRL *License Manual* (the one with the smiling faces on the cover). This has been wholly revised, and is now clearly written and sensibly organized. It follows the study questions released by the FCC. It also contains sample tests to check your knowledge. These tests are as difficult as the actual FCC exam, and therefore provide a pretty good measurement.

The ARRL *Manual* is *not* enough by itself, however. To get beyond the memorization of cloudy "facts" to a real understanding of radio theory, you need a book that goes more deeply into things.

The best of these books are the study guides (Novice class through Extra) which are available from *73*. These originally appeared serially in this magazine, and have helped many amateurs understand radio as they prepared for their tests.

If you are studying for the General class, you can use the *General Class Study Guide*. It is simply written and does a fine job of explaining basic electronic and radio principles to a layman.

But you might consider setting your sights a bit higher. Even if you think you're just General "material," buy the *Advanced Class Study Guide*.

I admit to a special bias toward this book. As a Novice who in real life was a high school English teacher, I saw myself as an anomaly in the ham ranks. I had no training in electronics and was poor at math. I despaired of going higher. On the other hand, my code speed was increasing slowly, and I certainly wanted that higher-grade license. I decided to try for the General.

On the advice of a friend, I bought the *Advanced* guide. Surprisingly, I found it easy to read, even pleasant. Moreover, I found that with some effort I could understand everything in it. What had seemed arcane and unattainable was now within my grasp. When I thought I had it down pretty well, I went into the FCC office in Philadelphia and passed both the General and the Advanced on the first try. Since this method worked so well, I later did the same for the Extra.

The *Extra Class Study Guide* is a superb piece of work. It tells you much more than you need to know for the test, but does it so clearly that you might as well learn it. It is very interesting: Haven't you wondered how TV really works, for instance?

Understanding the material in the *Extra* guide was so confidence-inspiring that I decided to warm up for the Extra exam by trying the commercial radiotelephone tests. I did some cramming on commercial regulations and on a few old concepts like electric motors (which are not covered in the *Extra* guide), using a question-and-answer manual. I passed the Third Class 'Phone easily, and then passed the 100-question Second 'Phone test, but failed the First 'Phone (my third test of the day) by one question.

I don't know what a mild-mannered English teacher will do with a commercial Second 'Phone ticket, but I mention it because it shows the level of preparation provided by the *Extra* guide. The Second 'Phone was much harder than the Extra exam, which I passed with confidence the next day.

Early to Bed

Cultivate regular habits as you study. Set aside a certain time to work. The best time to do this is early in the morning. Ideally, you should study as soon as you are properly awake, a time that varies for all of us. But of course there are other demands made on your time, perhaps by work, children, or school.

Try getting up an hour earlier than usual. Do some exercises. Maybe you will become healthy—a side effect not to be scorned. Then, study for 45 minutes or so.

The material you studied will travel around with you all day. Think about it. Jot down the things that are not clear. Ask yourself questions. At the end of the day, spend half an hour reviewing what you read that morning.

If you can't possibly study in the morning, do it when you can. But the brain becomes weary as the day wears on; learning becomes less efficient. At any rate, study some each day.

Try to put off taking the sample tests until you think you have really mastered the material. If you take them too soon, or too often, your studying will subconsciously aim at answering specific questions on the sample test, and you may miss things that will later appear on the real thing.

Learning the Code

Many articles have appeared on learning the code, and I won't go far into this. One recent article I can recommend is the one

by K6DZY in the October, 1977, 73. The point made there by Boyd is that International Morse Code is a language, and it is learned much as any foreign language is learned. Learning a new language demands exposure (listening) and practice (sending).

The great enemy in learning the code, or improving your speed, is anticipation: guessing what will be sent next. Anticipation causes errors. As speed increases, anticipation causes general confusion and lack of confidence, both of which are destructive to learning.

The way to beat anticipation is to learn to "copy behind." This puts a premium on listening before you write—you are always looking back at what was sent, not ahead at what might be sent.

In his article, Boyd mentions an acquaintance who copied 20 to 30 words behind! If you are trying for 13 wpm, or even 20, copying from one to three letters behind is usually enough. You will be able to recognize words and common prefixes and suffixes, and by concentrating on copying behind, you will prevent anticipation and also be able to correct minor errors.

Learn to copy behind by practicing with cipher groups, or randomly-sent letters, numbers, and punctuation. Wayne Green has made a series of tapes which give practice in this sort of copying. While some of the groups, particularly in the 20+ wpm tape, show evidences of extreme sadism, they are the best tool there is.

This sort of tape has three advantages over other methods of code practice. First, they prevent anticipation by their random nature, and with practice you will get totally out of the anticipation habit. Second, because they are random, you will not find yourself memorizing words in sequence, as you would do if you practiced with plain language tapes. (If you find you have memorized Wayne's tape, it's time for the test. You've mastered the tape, and you'll be able to handle the FCC code with ease.) Third, they are recorded at speeds faster than those required for the FCC test.

To improve at the code, you have to push yourself to a speed which is beyond what you can comfortably copy. Don't be discouraged if you copy very little of the practice tape at first. Begin by listening, and then practice copying what you can, always copying behind. You'll improve, and eventually you'll copy it all. I promise.

Practice the code regularly each day. It needn't take too much time. Half an hour of random groups, divided into four sessions at different times of the day, is plenty. Unlike theory, code can profitably be practiced at night. You'll get a good check of your speed under pressure, with your fatigue approximating your nervousness at an FCC exam. And maybe those "dits" and "dahs" will chase themselves around your subconscious all night.

Slow and Sure

Don't try to rush things. Give yourself all the time you need to study the theory and the code. It may take some time, but keep calm and determined. Remember, if you do it right, you won't miss. If you go into that exam with confidence, you'll walk out with a well-deserved "Interim XX" ticket, and the satisfaction of knowing that you've done a difficult thing well. Good luck! ■

Reader Service—see page 211

73 Magazine *Staff*

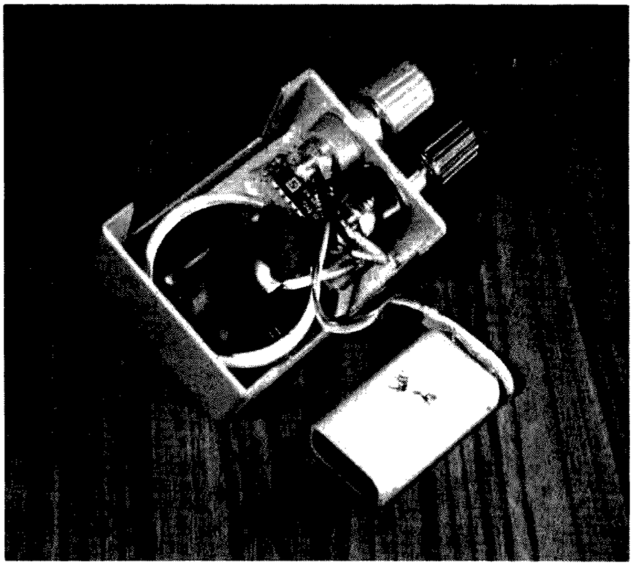
Universal Alarm Circuit

—detects heat, light, moisture . . . you name it

Build your favorite sunbather the ultimate in beach accessories.

Water shortages are not infrequent occurrences in a number of large cities around the world. Tourists get caught off guard sometimes, but residents have learned to cope by immediately filling reserve containers when that first trickle of water reappears after an outage.

The unit described in this article was designed by a staff member while overseas to help the XYL with the water problem by providing an early warning when the water was back again. But, the unit might be more seriously described as a universal alarm circuit. It can be used for a multitude of alarm purposes around the shack by the use of the proper sensor to activate the alarm. A number of such uses are covered here. To turn to the lighter side of things, sunbathers can also use the unit to warn themselves that the tide is coming in and that they are about to be engulfed.



The tester assembles very compactly in a 2" x 3" x 1¾" enclosure. The IC and transistor are under the binding posts and the "speaker" is a 600-Ohm telephone receiver.

The basic circuit shown in Fig. 1 is relatively simple, but yet it has a number of significant advantages:

1. The standby current is less than 10 microamperes! This amount of current is so insignificant that no on-off switch is necessary, and the battery will last for about its shelf life while the circuit is in standby. About 60 mA is drawn from the battery when the alarm operates.

2. The input circuit is quite sensitive, but yet not touchy. For instance, in the water-alarm setup, the "probes" need only be two ordinary pieces of hookup wire. No elaborate interleaving pattern of conductors is required. The probes or sensors can be remotely located from the alarm over considerable distances—50 to 100 feet in many applications.

3. The alarm sounds off when it "sees" less than approximately 120k Ohms at its input terminals. The value of this resistance will vary a bit from alarm to alarm because of the tolerance of the components used for circuit construction. But, for any given alarm constructed, it will have a definite value that will remain constant over wide extremes of temperature. So any sensor can be used with the alarm that provides any resistance less than 120k Ohms when the alarm is to sound.

The heart of the circuit of Fig. 1 is the CD4001 quad NOR gate. The last two gates act as a multivibrator that is turned on when pin 8 goes low. The second gate is an inverter, and the first gate acts as an input stage. Normally, pin 3 is low and pin 4 is high. Activation of the first stage reverses this condition, and the multivibrator operates. The 2N1375 stage provides a bit of high-distortion amplification to drive a 600-Ohm telephone-type receiver unit to a very penetrating output level. A small speaker can be used

instead, but then one has to experiment with some series resistance in the 2N1375 collector lead to limit the current. With the usual 4- to 8-Ohm speaker, something on the order of 47 to 220 Ohms should suffice.

The multivibrator frequency is a function of the 10k and 22k resistors and the .01 uF capacitor. A frequency of about 3,000 Hz appears to be produced, although it is difficult to tell because of the high distortion which makes it sound so penetrating. At any rate, one can scale these RC values up or down so different output frequencies are produced to allow sensing which alarm went off if a multiple alarm setup is used. In addition, one could place an LED or relay in the 2N1375 collector lead to activate a visual alarm.

As was mentioned before, any sensor which provides less than about 120k resistance can be used. Thermistors and photocells would be typical examples for temperature and light sensing. A series resistor can be added to the sensor circuit, so the alarm is activated at the desired point. The unit will function directly as a diode and transistor junction tester and, also, as a crude but effective ohmmeter to check relays, switches, etc.

Voltage and current sensing can be done by simple transistor switch circuits, such as shown in Fig. 2. When the transistor turns on, the alarm circuit will be activated. So one can build a variety of alarms which check for any over-limit condition (excessive swr, line voltage, modulation, etc.) by just sensing any dc voltage available in a transceiver or swr bridge which increases as the function desired to be monitored increases in amplitude. By choosing the resistance values carefully in Fig. 2, very little loading will be presented to the circuit being monitored.

How about checking for under-limit conditions, such as low temperatures, low battery voltage, etc.? All of the foregoing applies. Just bypass the second gate in the CD4001. The alarm will now activate when any sensor presents a resistance which goes above about 120k Ohms. The same outstanding feature of the alarm circuit applies in this mode in that practically no current is drawn from the alarm battery supply until it is actually activated.■

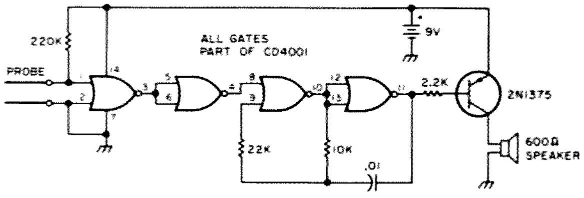


Fig. 1. One IC and one transistor make up a sensitive and loud alarm circuit.

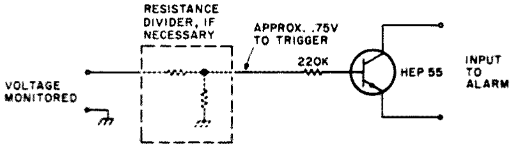


Fig. 2. Simple transistor switch addition allows alarm to monitor a wide variety of circuits for over- or under-limit conditions.

73 Magazine *Staff*

Exorcise Those Unwanted Frequencies

—try coaxial stub filters

Put your problems to rest.

There are times when one might run into the problem of a specific spurious frequency being radiated by a transmitter and causing interference problems, or reception problems caused by a specific undesired signal. The usual approaches to these problems are various types of LC traps, filters, etc. However, there is another approach which is often very useful as well as economical. No involved construction of tuned circuits is necessary, and one can achieve 30 dB or more suppression of an undesired frequency in either the transmitting or receiving mode.

The basic idea of coaxial stub filters is very simple. As shown in Fig. 1, a section of transmission line which is ½λ-long and which is shorted at one end will reflect an electrical short to the other mechanically-open end of the transmission line. This will only occur at the frequency for which the transmission line is ½λ-long. So, if we have a transmission line going to a transmitter or receiver as in Fig. 2(a), and wish to suppress some frequency, we can insert a ½λ-long rejection stub for the frequency to be attenuated. At that frequency, the coaxial transmission line to the receiver or transmitter will electrically act as if it were shorted. Although there are some cases where only a rejection stub can be used, usually it has to be combined with a correction stub as shown in Fig. 2(b). This is because the rejection stub at the desired operating frequency will present some reactance across the main transmission line. The correction stub cancels this undesired reactance so that at the operating frequency the main transmission line acts electrically as though there were no stubs at all on it.

That is all there is to the theory of a coaxial stub filter. The rest of this article is mainly concerned with the practical aspects of determining the lengths of the stubs and special applications. The stub filter idea can be used over a very wide frequency range. The limitations to its application are mainly mechanical, in that at very low frequencies the rejection stub may become too long, and at UHF frequencies it may not be possible to dimension the stubs accurately enough. As was mentioned before, the rejection stub has to be ½λ-long at the frequency attenuated. The ½λ length must be an electrical length, so when you're dealing with coaxial cable it will differ from the physical length because of the velocity factor of the cable. Fig. 3 presents the actual physical length that a coaxial stub should have in order to be electrically ½λ-long at a given frequency. The graph is based on a velocity factor of 0.66, which is the usual one for all common coaxial cables (RG-8, -58, -59, etc.). The graph only covers the frequency range from 10 to 150 MHz, but one can calculate the length of coaxial stub needed at any other frequency from the formula:

$$\text{Length (inches)} = \frac{3897}{F\ (\text{MHz})}$$

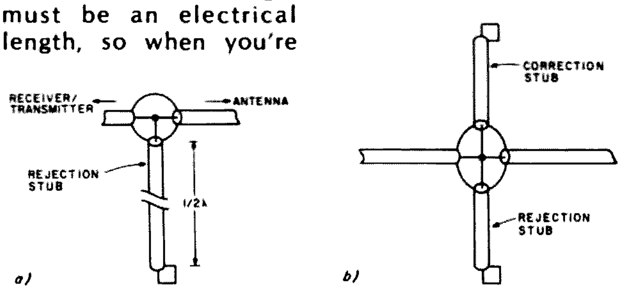


Fig. 2. Placement of rejection stub (a) and rejection stub with correction stub (b). The ends of both stubs are shorted. Although for clarity the shields are shown connected together by jumpers, they should, in reality, be directly soldered or otherwise connected together.

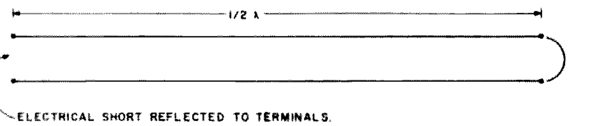


Fig. 1. Stub filters are based on characteristics of a ½λ transmission line.

Remember that the frequency involved in this case is the undesired one which one wishes to attenuate, and not the operating frequency.

In practice, one should cut the piece of coaxial cable several inches longer than called for to allow for pruning. Install the rejection stub reasonably close to the antenna terminals of the transmitter or receiver being used. Various types of coaxial connectors are available to interconnect the lines, but the interconnections can simply be soldered on without connectors for indoor usage. Using a pin or pick, short-circuit the outer shield of the rejection stub to the inner conductor at various points starting from the outer end of the stub until maximum attenuation of the undesired signal is achieved. When the best point is found, cut off the excess cable, fold the outer shield around the inner conductor, and solder them together.

The length of the correction stub will vary from zero to ½λ. Its length can be determined approximately from the graph of Fig. 4. In this case, by knowing the ratio of the undesired frequency to the operating frequency, one can determine the electrical length of the correction stub at the *operating* frequency. The physical length of the coaxial cable used can be determined from the formula previously given for a ½λ-length stub. As in the case of the rejection stub, the correction stub should initially be made longer than calculated. The correction stub is then experimentally shorted until the least attenuation is produced at the operating frequency. If a transmitter is being used, the correct stub length is easily determined by pruning the stub until an swr meter indicates a flat line.

As an example of the foregoing, say we were operating on 21 MHz but had problems with an interfering signal on 26 MHz (in the transmitting case, our operation on 21 MHz was producing some spurious radiation on 26 MHz). The length of the 26-MHz rejection stub would be approximately 150 inches. 26 MHz is about 1.25 F on the graph of Fig. 4, so the approximate length of the correction stub is 1/16λ at 21 MHz, or about 23 inches.

All of the foregoing may seem like a bit of work, but really all it takes is patience and a slight amount of math. The results that can be achieved by the simple application of stub filters are shown in Fig. 5. Those are not bad results for just the cost of lengths of coaxial cable.

There are several special cases that one should be aware of. If the frequency which is to be attenuated is 1/8, 1/4, or 1/2 of the operating frequency, the idea of coaxial stub filters will not work. This is because the rejection stub will turn out to be a wavelength or a multiple thereof at the operating frequency. Therefore, it will present an electrical short across the transmission line also at the operating frequency. Note that the graph of Fig. 4 is broken at several points, e.g., .75 F and 2 F. In these cases, the indicated length of the rejection stub would be ¼λ at the operating frequency. But, a shorted ¼λ stub represents an open circuit, so there is no need for the correction stub at all in these cases. The 2 F case is interesting, of course, since it would represent the second harmonic of a transmitter. By using only a rejection stub, therefore, one could get a nice bit of additional second harmonic attenuation. In fact, it will attenuate all even harmonics.

One can use more than one stub filter or different stub filters on various bands with a switching arrangement. Many combinations are possible, and in some cases only the correction stub may have to be switched on different bands. As a bonus feature of the stub filter idea, note that the shorted end of the rejection stub can be grounded if desired. Thus, one can provide a direct electrical connection to ground for lightning protection, static drain, etc., for an antenna system that does not have to be switched in or out when operating. In a multiple antenna system, one could have a grounded stub for each antenna so that each antenna is continuously protected. ■

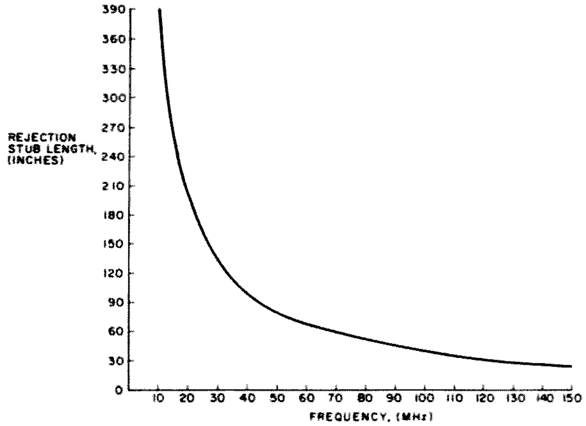


Fig. 3. Graph to determine approximate length of rejection stub.

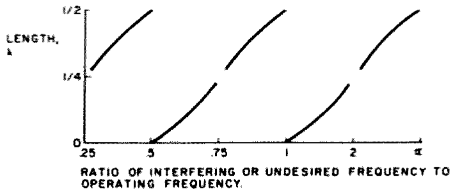


Fig. 4. Graph for determining length of correction stub.

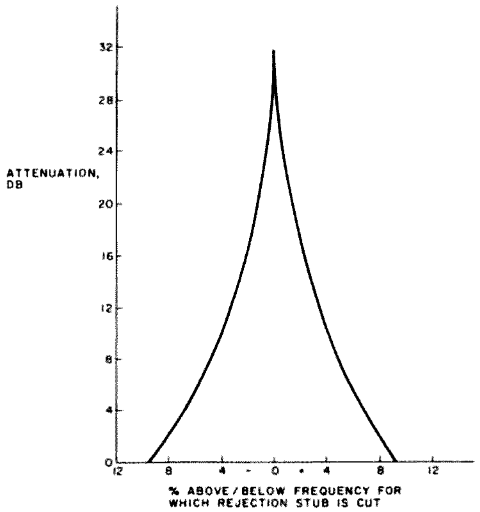


Fig. 5. Attenuation characteristics of typical rejection stub.

Andrew Henry K5XT
Tyra Wilson WB5SXT
5322 "A" Street
Little Rock AR 72205

10¢ Mod for the 22S

—extra channels for $.00455 each

Have you heard of an easier way?

By now you've probably heard of at least a dozen ways to increase the channel capacity of your Icom IC-22S. When we bought ours, we wanted expanded frequency coverage, but we also wanted coverage of all common repeater frequencies, no added switches or complicated gadgets, a system that could be used while driving, and a minimal investment of time, money, and energy.

Channel	Frequency*	
1.	146.01	146.04
2.	.07	.10
3.	.13	.16
4.	.19	.22
5.	.25	.28
6.	.31	.34
7.	.37	.40
8.	146.97	147.00
9.	147.03	.06
10.	.09	.12
11.	.15	.18
12.	.21	.24
13.	.27	.30
14.	.33	.36
15.	.39	.42
16.	.45	.48
17.	.51	.54
18.	.57	.60
19.	146.43	146.46
20.	.49	.52
21.	.55	.58
22.	.91	.94

*Table 1. *The matrix may be programmed for the frequencies shown in the first column. These frequencies will be obtained in the simplex mode with the power switch on low, and the frequencies in the second column will be obtained with the power switch on high.*

Now that everyone else has had his turn, here is the lazy man's approach to the problem. All it takes to convert your IC-22S to an "IC-44S" is a soldering iron, a ten-cent diode, and a spare hour or two. The only drawback to this scheme is that you must confine yourself to high-power operation only. Since our QTH has all the propagation characteristics of a black hole, this was an easy trade-off to make.

The basic principle of our modification is identical to that described by Don Jenkins WA6OAZ in the January, 1977, issue of *73*. The matrix is programmed for frequencies separated by 60 kHz, and a diode is switched into the matrix to increase the programmed frequency by 30 kHz when so desired. The difference is that the need for external switching is eliminated by using one-half of the power switch. Operation is straightforward: When the power switch is in the low position, the base frequency is the programmed frequency, and when the power switch is in the high position, the base frequency is the programmed frequency plus 30 kHz.

The first step in modifying the circuitry is to free the half of the power switch that controls the output level and to wire the circuit board for high-power operation. One side of this DPDT switch is used to supply 13.8 V dc to the rig in both the high and low power modes. From the other side of the switch, three wires lead to the main circuit board below the synthesizer board. Because of the tight location of the power switch, it is much easier to remove the synthesizer board and

access these wires as they connect to the main board than it would be to unsolder them from the switch. This is easily done by removing the matrix board and the three screws and one threaded spacer that hold the synthesizer board and an underlying metal tray. With the synthesizer board set aside, find the brown wire leading from the center position of the lateral half of the power switch to the main circuit board at a point marked W15 on the foil. This point is in the right rear corner as the rig lies inverted and is viewed from the front. Next find the purple wire leading from the switch contact nearest the synthesizer board and the side of the rig to the main board at point W-16. Cut the brown wire so that the segment extending from point W-15 is just long enough to connect to the foil at point W-16. Unsolder the purple wire from the foil and solder the brown wire from point W-15 in its place. Now find the pink wire leading from the switch contact nearest the true top and the side of the rig to the main board at point W-17. Cut this wire at the foil and tape the end, as it will not be used. Now you should have a connection between points W-15 and W-16, two wires leading from the power switch that are shorted together when the switch is in the high position, and a third wire from the switch that is not used. Replace the metal tray and the synthesizer board, but leave the matrix board free.

The next step is to add one diode to the matrix board in the D1 file and to connect it so that 9 V dc is applied across it with the power switch in the high position. The diode, a 1N4148, 1N914A, or equivalent, is inserted cathode-first from the diode side of the matrix board into a hole in the D1 file in the rank corresponding to channel 1 or 2. Solder the purple wire to the anode of the diode. Connect the brown wire to the matrix board at the point marked 9 V dc. You may need to extend these wires a few inches to reach the matrix board. The circuit modifications are now complete.

The matrix can be reprogrammed for any frequencies as long as diodes are not used in the D1 file (as this would cause redundancy), and all 22 channels must be programmed. Mr. Jenkins points out that if the extra diode is switched into the circuit and the selector passes an unprogrammed channel, the rig will lock onto this blank channel until the power is momentarily switched off. I chose to program my rig in the same fashion as Mr. Jenkins demonstrated, and those channel frequencies are repeated here for any unfortunates having no back issue of *73*. This is only a guideline; you may wish to include 15 kHz split-channel repeater frequencies or your own clandestine frequencies. If you run short of diodes, a trip to Radio Shack with a dollar in hand will get you ten more.

In the time we have used the IC-22S with this modification, we have not heard of an easier way to increase the channel capacity of this versatile rig without drilling holes, adding switches, or constructing things more complex than we dare to try. We can't brag of access to all 133 possible channels, but we rarely need them all anyway. ■

Reader Service—see page 211

The 10-GHz Cookbook

— monster article

Stick to your Gunns.

John Roos K6IQL
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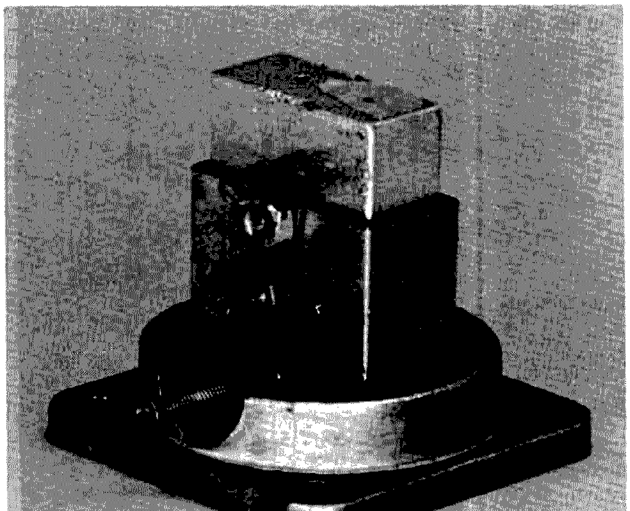


Photo A. The breadboard Gunn-diode oscillator. The waveguide flange is relieved to clear the 2-56 frequency adjustment screw. The positive supply connection is to the turret terminal of the diode mount.

The amateur 10 GHz band offers many fascinating opportunities for both communications and experimentation. Antennas of very high gain are of practical size so that many tens of miles may be spanned with good reliability. The band is a natural for linking of VHF and UHF repeaters, control of repeaters, or control of remote base stations. Activity in the band has been limited by the lack of a good low-cost rf source. A number of transmitters and receivers have been built using surplus klystron tubes, but since surplus items are not generally available to everyone, these designs are difficult to duplicate. In addition, the development of repeater command links or interties requires that the equipment be reliable and compatible with other solid-state gear. Klystron-based designs with the necessary high-voltage dc supplies are certainly not desirable. Gunn-diode oscillators offer an attractive alternative. Properly applied, they will provide up to several hundred milliwatts of stable low-noise rf power.

Gunn-diode technology has been with us for about ten years. In that time, the device has moved from a lab curiosity to a mainstay of microwave engineering. There has always been both commercial and military demand for an inexpensive solid-state microwave rf source. In response to this need, the technology has been pushed rapidly and the price of the diodes has fallen to the point where commercial applications such as radar intrusion alarms, speed meters, and door openers are common. The price of a 10 milliwatt X-band diode is now less than ten dollars. More powerful devices

cost more but are still quite reasonable. Actually, some very practical systems may be built with a 10-milliwatt transmitter. Using a 3-foot dish with 36 dB of gain and a 10-milliwatt source, one obtains an effective radiated power of 40 Watts! That is more than ample for most applications.

My objective in writing this article is to create some interest in X-band operation and to show how easy it is to get started. I will describe the operation of Gunn diodes and present a practical oscillator design. The oscillator tunes the entire 10.0-10.5 GHz band with a power capability of more than 20 milliwatts. The oscillator is easily reproduced and is very reliable. One unit has been operating for almost three years and several others have been built. They all have worked perfectly, so I have a lot of confidence in the design.

This is a new area to many amateurs, so I will describe some tests and trade-offs that may be made to optimize a Gunn-diode oscillator for particular applications. The effects of load mismatch upon the power output and frequency of the oscillator were measured and data was taken for two diode types. I will describe both the tests and the results obtained. Afc or phase locking requires electronic tuning of the oscillator. The frequency of Gunn-diode oscillators may be controlled to a limited extent with the dc supply voltage. I made some tests to determine how useful this can be and will discuss the results. Applications for this design are numerous and my objective is to give as much practical data as possible to aid you in putting the circuit to work in your system.

So much for science! Making a Gunn oscillator is fun only if you can do

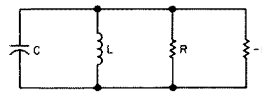


Fig. 1. Negative-resistance oscillator. L and C are the resonant circuit elements. R represents all losses, including output power. The negative resistance of the Gunn diode is represented by −R.

something with it. Part of the article describes a simple transceiver which may be made by adding a mixer to the basic oscillator. This is an ideal device for getting started on the band. It has two immediate uses: as a simple transceiver for communications, and as a Doppler radar. A Doppler-radar processor is included. The processor turns the transceiver into an effective speed meter, door opener, kid watcher, intrusion alarm, or whatever.

The transceiver may be used as a wideband FM link by modulating the dc bias supply and using an FM tuner or receiver as an i-f strip. The basic oscillators are useful as transmitters or as receiver local oscillators in either wideband or narrowband FM systems. Hopefully, someone will use the design as a starting point for an operational repeater command link or other X-band system application.

Gunn Oscillator Operation

Gunn oscillators are negative-resistance oscillators. Fig. 1 is a schematic of a negative-resistance oscillator modeled as a conventional LC oscillator. If the L and C were truly lossless and no power were taken from such a circuit, it would continue to oscillate once started. Real components do have losses and these are lumped into the loss resistance, R, of Fig. 1. Any output power taken from the circuit is also a loss, and that is also

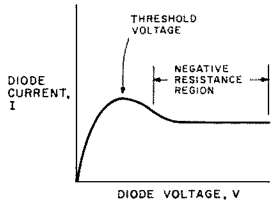


Fig. 2. Gunn-diode voltage-vs.-current plot. Above the threshold voltage, the curve reverses and the current decreases with increasing voltage.

included in R. The effect of a negative resistor is to provide rather than consume power. This is a theoretical concept, but one that can be realized in practice. An LC circuit having more net negative resistance than positive loss resistance will provide sustained oscillations at the resonant frequency of the tank. In practical circuits, the negative R is supplied by tunnel diodes, Gunn diodes, Impatt diodes, and some transistor connections. A Q multiplier is an example of the negative-resistance concept. As the Q is increased, the circuit suddenly breaks into sustained oscillations; more negative R is being introduced into the circuit than there is loss and the circuit takes off.

A Gunn-diode oscillator is simply a microwave cavity resonator to provide the LC circuit and a negative resistance in the form of a Gunn diode.

Gunn diodes are made of gallium arsenide. The GaAs material can have electrons in either of two conduction bands. The electrons in one band happen to have much higher mobility than in the other band. Electron mobility is the measure to the rate of travel of electrons in the material. Greater mobility means higher velocity. In the absence of an applied electric field (voltage across the material), electrons are in the high mobility band. As the voltage across the material is in-

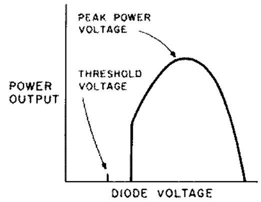


Fig. 3. Gunn-diode oscillator power vs. diode voltage. The peak power voltage will be different at different frequencies.

creased, more move to the low-mobility band. The electron mobility in the material as a whole then becomes the average of the high and low mobilities. This means that the average velocity of an electron drops. Increasing voltage drops the velocity further.

Electric current is the measure of the number of electrons passing a point per second. In positive resistances, the current increases with increasing voltage. In other words, the average electron velocity increases with voltage. In GaAs, the velocity drops with increasing voltage. This means that the current also drops as the voltage is increased and we have a negative resistance.

The electric field intensity where the current begins to decrease is called the threshold field. Fig. 2 shows the current-vs.-voltage curve for a Gunn diode. The current initially rises as the voltage is increased. At the threshold voltage, the curve reverses and the current starts to fall. This occurs at a field intensity of 3200 volts per centimeter in GaAs.

This seems like a lot of voltage, but the active region of the diode is made quite thin and the threshold field occurs at applied voltages of only a few volts in actual diodes. The negative-resistance region occurs just above the threshold voltage, and somewhere above that point oscillations will start.

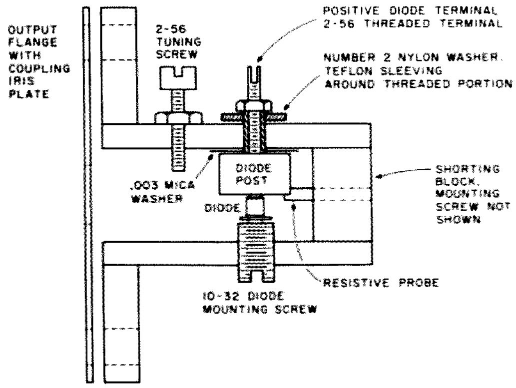


Fig. 4. The Gunn-diode oscillator assembly. Note that the flanged end of the diode (the cathode) is grounded by the diode-mounting screw.

There is one catch. The thickness of the diode must be made to match the travel time of the electrons at the desired frequency of oscillation. This is to ensure that the proper phase relations occur between the electric field and electric current. The diode thickness must be one "transit time length," so that the electron travels the length of the diode in one rf cycle. In other words, the diode thickness must be chosen with the operating frequency in mind, and not any diode will work at any frequency. This is not as bad as it seems. While diodes are characterized at a particular frequency, they will work over ranges of up to two to one.

As explained above, the applied voltage varies the electron velocity. Thus a diode of a given thickness may be voltage-tuned to optimize operation at a particular frequency. In effect, the transit time is changed by adjusting the electron velocity rather than the diode thickness. It is this mechanism which makes the Gunn oscillator tunable with supply voltage.

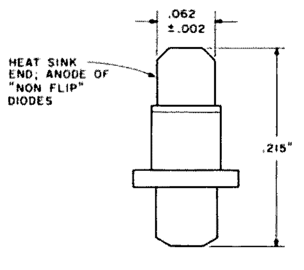


Fig. 5. Gunn-diode package.

Fig. 3 shows the effect of supply voltage upon the power output of the oscillator. At some voltage above the threshold, the electron velocity is appropriate to supply negative resistance to the tank circuit. Oscillations start. As the supply is increased, the optimum transit time velocity is obtained and a point of maximum power output occurs for that frequency. If the tank is tuned to another frequency, a slightly different supply voltage will yield maximum power output. Above the maximum power voltage, the power drops off and oscillations finally cease. A typical low-power X-band diode will have a threshold voltage of 3 or 4 volts and will operate from 6 to 10 volts.

Changing the transit time by adjusting the supply in effect "pushes" the resonant frequency of the tank circuit. The diode wants to make negative R at a different frequency than the tank, but the high Q cavity resonator dominates and only a slight frequency shift is obtained. This is enough to be practical for some afc purposes. Frequency changes of more than 20 MHz can be obtained with a 2-volt supply change. Some amplitude change also occurs, but most FM communications systems or mixer LOs can handle amplitude variations of up to 3 dB with no problem.

Gunn diodes have a problem with low-temperature starting. Both the power peak voltage and starting voltage increase as the diode temperature is lowered. Be sure to operate an oscillator well above the room-temperature starting voltage if low-temperature operation is intended.

Building a successful Gunn oscillator reduces to the essential problems of selection of an appropriate diode and installing it in a suitable resonator. Either coaxial- or waveguide-cavity resonators may be used. Low-stability designs having several GHz of tuning range are generally done in coax cavities. High-stability designs tend to use waveguide because of the higher cavity Q which may be obtained. One major factor in getting an oscillator to work is the suppression of spurious resonances in the cavity. The Gunn device has negative resistance over a wide bandwidth and will oscillate easily at resonances other than the desired one if care if not taken. Resonances in the bias chokes or feedthrough capacitor, higher-order waveguide modes, and coaxial modes involving the diode mount are all possible culprits. An effective cure for some of these problems is the inclusion of a lossy material in the cavity at a point where energy is dissipated only by the undesired resonance. This solution was applied to my oscillator in the form of a piece of pencil lead positioned to absorb energy from a coaxial resonance in the diode mount at 13 GHz. Without the loss material, the oscillator went weakly at 13 GHz and no output was obtained in the amateur band. With the parasitic suppressor present, it always works at the correct frequency and starts easily.

Oscillator Construction

The Gunn oscillator is constructed from standard 1.0" by 0.5" X-band waveguide. The EIA and JAN designations for this guide are WR-90 and RG-52/U respectively. The oscillator cavity is a one-half-wavelength resonator with a circular output-coupling iris. Fig. 4 is a side view of the internal oscillator assembly. The diode is mounted across the narrow dimension of the guide and is parallel with the electric field in the cavity. The diode and its mount effectively short the guide in the plane of the diode-mount centerline. Thus the resonant length of the cavity extends from the center of the diode mount to the plane of the coupling iris. The presence of the iris lowers the resonant frequency of the cavity slightly. To ensure that the band may be tuned, the cavity is made about 10 percent short. The cavity is then tuned to the desired frequency with the 2-56 tuning screw. This is located at a point one-quarter wave from the iris. The electric field intensity is greatest at that point and the screw has the most effect. The cavity tunes the 10.0- to 10.5-GHz band and several hundred MHz above and below with the dimensions given.

Gunn diodes come in a variety of package styles. Most use an internal "flip-chip" construction to make the heat sink the cathode. This permits use of positive-bias supplies with respect to the heat sink. This does, however, increase the package cost.

Low-power diodes can be made in "non-flip" packages provided a means is provided to remove heat from the anode. To do this, an effective but dc-isolated heat sink is required. This oscillator is designed to use "non-flip" diodes while having the desirable feature of a positive power-supply input with respect to waveguide ground. For "non-flip" diodes such as the Alpha type DGB-6844C or Microwave Associates type 49508 used in this oscillator, the anode is the heat-sink end of the package as indicated in Fig. 5. The cathode is the end with the sealing flange. Fig. 4 shows the cathode (flanged) end of the package inserted in the grounded diode-mounting screw. If other diodes are tried in the oscillator, be sure to determine which end of the package is the anode. Remember that unless a diode is designated a "non-flip" type, the cathode will most likely be the heat-sink end of the package.

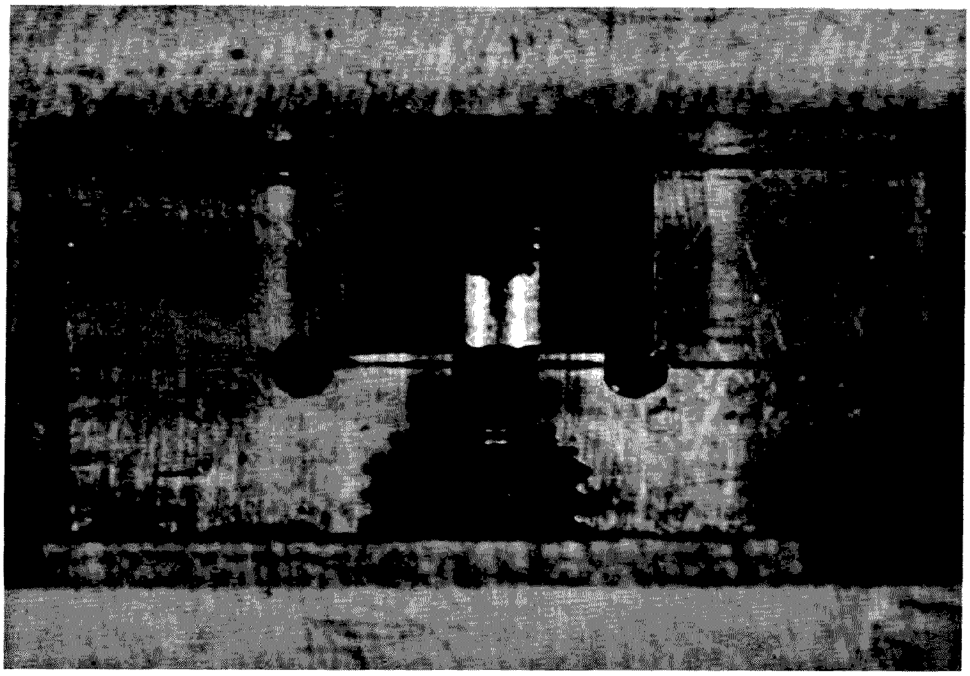


Photo B. Interior view of the oscillator cavity. The Gunn diode is mounted between the heat-sink post and the 10-32 diode-mounting screw. The end of the resistive probe is to the right of the mounting post. The 2-56 frequency adjustment screw protrudes into the cavity from above and in front of the diode-mounting post. The hole in the shorting block to the left of the diode mount is for a trial loss probe location.

Fig. 6(a) is a detailed drawing of the waveguide cavity. The diode mount is installed in holes B and C. Be sure to hold the dimension from these holes to the face of the flange to ensure that the cavity will resonate in the band. There are several varieties of waveguide flange. The intent of the cavity drawing is to use a flange such as a UG-39/U. The waveguide will pass through the flange and should be flush with the face. This will maintain the proper dimension from diode mount to the output iris.

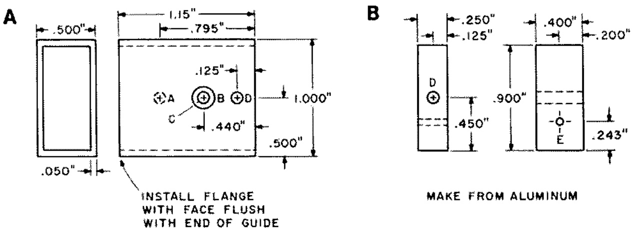
The shorting block, Fig. 6(b), is made from a piece of aluminum. The photo of the breadboard version of the oscillator shows a slightly longer shorting plug. This was to provide a handle for ease of adjustment during the initial design. Make your short as indicated in Fig. 6(b), as it is correct. Hole "E" in the shorting block is for insertion of a resistive probe of common mechanical-pencil lead, as shown in Fig. 4. This is the lossy material which suppresses the undesired spurious oscillation at 13 GHz. An alternative approach to the shorting block is to use a simple plate soldered in the plane of the inner surface of the block. This may be somewhat easier to build, but the probe installation is more difficult. This option applies to the oscillator only. The transceiver version described below requires that the short be removable and the block shown should be used.

The diode mount is shown assembled in Fig. 4 and the detail parts are sketched in Fig. 7. The mount has to do several things at once—match the low diode impedance to the cavity, dissipate heat from the diode, and apply dc bias to the diode while keeping the rf inside the cavity. The heat-sink post, Fig. 7(b), is made from 0.312-inch aluminum rod. It is first drilled through with a number 52 drill to clear the anode end of the diode. This gives a minimum clearance hole diameter for improved heat sinking. It is then drilled at one end only to a depth of 0.100 inch and tapped for a 2-56 thread.

The diode heat-sink post is mounted in the cavity with a 2-56 threaded turret terminal which will be the positive supply connection. Insulation is by means of a nylon washer on the exterior of the guide, Teflon™ sleeving on the threaded portion of the terminal, and a mica sheet insulator between the diode post and the interior wall of the waveguide. The mica forms the insulator of a parallel plate capacitor consisting of the diode post and the interior wall of the waveguide. I used .003-inch mica cut from a TO-3 transistor insulator. The capacitance is more than 20 pF and it is essentially a short circuit at 10 GHz. No rf leakage occurs. A small amount of heat-sink compound should be applied to each surface of the mica insulator. Clean off the excess after assembly as it could cause power loss or frequency drift if left in the cavity.

The 10-32 diode-mounting screw is made from either brass or aluminum. Brass is permissible from a thermal standpoint because most of the heat flow is from the anode end of the diode.

The waveguide output flange is soldered to the output end of the cavity waveguide. Take care that the surface of the flange is flush with the end of the waveguide. Spacing it back will increase the length of the cavity. One caution: Choke-style flanges should not be used on the oscillator. They will not properly clamp the output iris plate and this may change the effective cavity size. Flat



Hole Data

Hole	Data	Function
A	Tap 2-56 far side	Cavity tuning screen
B	Tap 10-23 near side	Diode-mount ground screw
C	Drill #35	Diode-mount dc input terminal
D	Drill #32	4-40 short mounting screw
E	Drill #60	Resistive probe

Fig. 6. Oscillator cavity details. (a) Waveguide cavity. Make from standard .500 x 1.00 X-band guide, EIA WR-90 or JAN RG-52/U. (b) Shorting block.

flanges should be used.

The intent of the removable output-coupling iris plate is to permit easy adjustment of the output coupling. Some applications, such as receiver local oscillators, require only a few milliwatts of power. The power may be reduced and stability greatly increased by using a smaller iris.

The iris plates may be made from ten- to forty-thousandths copper or brass sheet. I used 10-thousandths copper sheet. The iris hole is the waveguide centerline. The output hole diameter may be either .290 or .320 inches as discussed in the section on testing. Smaller diameters can be used to reduce power output. If the iris is much larger than .320, the cavity Q becomes very low and the oscillator does not work below 10.5 GHz.

Assembly of the oscillator should be done in the following order. First, solder the output flange to the cavity and remove all flux. Next, install the diode-mounting post as described above. Do not install the diode itself. Install a resistive probe of .040-inch soft pencil lead in the hole in the shorting block. It should extend into the cavity 0.150 inches. It may be held in place by means of tape on the outside surface of the block until the oscillator is tested. After testing, secure the probe with a drop of glue. The shorting block is next inserted into the cavity and fastened with 4-40 hardware. This hardware should be tightened to the final torque prior to installing the diode. If it is tightened after the diode is installed, the resulting deformation of the cavity may break the diode. Now install the diode. Put a tiny amount of heat-sink goo on the diode anode and cathode pins. Remember the heat-sink end goes to the capacitive mounting post. The flanged end is the cathode and goes to ground. Tighten the 10-32 screw so it is just snug. If a lock nut is used, hold the 10-32 screw from rotating while the lock nut is torqued. This will prevent crushing the diode package. The final steps are to install the tuning screw and the output iris. The iris is clamped between the output flange and the flange on the mating waveguide. Start out with the .290-inch-diameter iris. The oscillator is now ready for test.

Operation and Test

Upon completion of the oscillator, it may be put to use in your particular application. My objective in writing this article was to give an easily-reproduced design which could be used for a variety of applications from receiver LOs to simple transmitters. The test equipment to completely characterize a microwave oscillator is not all that complex, but it certainly isn't found at your corner electronics outlet. Some amateurs have access to commercial or surplus test gear which is of great aid in getting started on X-band. Others have only a scope and VOM and will build this oscillator or the transceiver version described later on as a first project in X-band.

In order to ensure that the design was sound and to obtain enough information to help others apply the circuit to their projects, I took a lot of data to characterize the circuit. With this information, the oscillator may be used with some advance knowledge of how it will behave. The description of the tests performed is provided in case others who can get ahold of the gear wish to repeat the tests or test their own oscillator designs, and to indicate to those who will just build the circuit how the data is obtained. Before getting into the rf testing, here are a few cautions with regard to dc power supplies for Gunn oscillators.

Dc power must be applied to Gunn diodes with some care. The negative-resistance effect extends down to dc, as illustrated in Fig. 2. This can cause dc supply regulators to misbehave. Generally, a series-pass regulator gets very confused when decreasing the voltage increases the current being drawn. The regulator may oscillate and overshoot. The Gunn device may well disappear in the ensuing excitement. Fig. 8 shows a safe method of powering the oscillator. A current-limited supply is used. In shunt with the supply is a husky zener diode which limits the maximum voltage which can be applied to the oscillator to a value of a volt or so above the operating voltage. This will prevent burnout on turn-on transients or if the

Minimum and Maximum Power into 2 to 1 vswr vs. frequency

Diode #	Current mA	10.0 GHz	10.1 GHz	10.2 GHz	10.3 GHz	10.4 GHz	10.5 GHz
1	140	15-29 mW	17-28 mW	18-32 mW	15-35 mW	20-34 mW	22-34 mW
2	150	18-34 mW	20-34 mW	20-34 mW	19-30 mW	18-34 mW	18-48 mW
3	150	17-25 mW	17-28 mW	20-35 mW	18-38 mW	21-37 mW	20-35 mW
4	100	9-22 mW	9-19 mW	10-25 mW	10-22 mW	10-22 mW	10-22 mW
5	125	9-20 mW	7-21 mW	9-18 mW	12-24 mW	14-25 mW	25-12 mW

Table 1. Oscillator performance vs. load vswr and frequency. This table indicates the oscillator power output for five different diodes at frequencies from 10.0 to 10.5 GHz. The load vswr was varied through all phases of a 2 to 1 mismatch. Diodes 1 through 3 are Alpha type DGB 6844C operated at 8 volts. Diodes 4 and 5 are Microwave Associates type MA 49508 operated at 7 volts.

supply oscillates. A series RC circuit consisting of a .1 μF capacitor in series with a 33-Ohm resistor keeps the supply impedance down in the low megacycle region and prevents low-frequency breakup of the oscillator output. With the diodes specified, the heat-sink end of the package is the anode and the diode is installed with this end inserted in the capacitive mounting post. The flanged end of the diode is the cathode and is grounded to the waveguide with the 10-32 mounting screw.

A word about current limiters. The threshold current of the Gunn device is much higher than the operating current. The current limiter on the supply should be set well above the threshold current. For the diodes used here, 500 mA is a good setting.

If the current limiter is set at the operating current, the supply will limit on the low-voltage side of the threshold voltage and the operating voltage will not be achieved. From Fig. 2 it may be seen that there are two points at which the diode will draw the same current, one above and one below the threshold voltage. Don't worry about protecting the diode from excessive current. In this case, lowering the voltage *increases* current, so a normal current limiter does not help. Just set up the supply for the proper voltage and make sure the current limit is set to 500 mA. Then connect the Gunn-diode circuit. If the current limiter is set as above, it is okay to just switch the supply off and on with the power switch. Do not turn up the voltage slowly because the diode will be subjected to more current than if power is suddenly applied. Using these methods, I have yet to lose a Gunn device. Supply oscillations may be checked by connecting a scope across the supply. If the dc line has only dc on it, you can assume that all is well. If oscillations are present, they are generally of high amplitude (several volts) and are easily detected. If this does occur, one fix is to adjust the R and C of Fig. 8. Reduction of the hole in the coupling iris plate may also help. No difficulty was encountered with supply oscillations for a variety of Gunn diodes tried in the cavity provided the circuit of Fig. 8 was used. Dc supplies included commercial and home-built bench supplies and the three-terminal regulators used in the Doppler processor described below.

To set up the oscillator for test, there are only three adjustments: the tuning screw to set the frequency, the output iris diameter which determines load stability and power output, and the depth of the parasitic suppression probe. The tuning screw should be set at minimum penetration of the cavity. The resistive probe should penetrate about .150 inches into the cavity. With the .290-inch iris installed, the oscillator should make at least 10 milliwatts of output. If it does not appear to be oscillating or if it is oscillating weakly (a −20 dBm output), insertion of the resistive probe to a greater depth is indicated because the diode-mount resonance at 13 GHz may be in the act. The three models of the oscillator worked fine with the probe at .150-inch penetration, so you should not have to adjust it. It is not very critical. Once oscillations are obtained, the tuning screw is used to set the operating frequency. The unit will easily tune the 10.0- to 10.5-GHz band with either diode installed.

The selection of output iris diameter depends upon application. To determine which diameter is best for

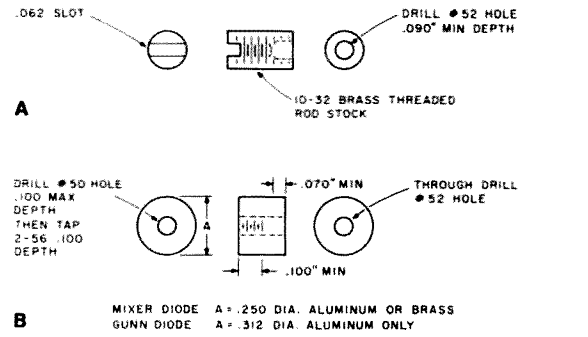


Fig. 7. Diode-mount details. (a) Diode-mounting screw. (b) Diode heat-sink post. The diode heat-sink post is first drilled through with a number 52 drill. The hole is then enlarged to a number 50 size and tapped for the 2-56 turret terminal. The number 52 diameter must be maintained for a depth of at least 0.070 inches to assure proper heat transfer from the diode.

your use, review the tests and test data I obtained.

A shift in load impedance will change both the frequency and power output of any oscillator, crystal, LC, or a microwave type. I made several tests to evaluate the effect of load shifts on this circuit. In addition, the ability to tune the frequency of the circuit with the supply was tested. I found that if the load vswr is less than 2 to 1 and its phase is stable, the frequency will pretty well stay put. If the vswr is controlled and it is less than 2 to 1, the supply may be used to make corrections in the oscillator frequency of up to 20 MHz.

Fig. 9 is a sort of schematic of the waveguide setup I used to test the oscillator. The setup allows the power output and frequency to be measured and a vswr of any desired magnitude and phase to load the oscillator. The oscillator is connected to the main line of a cascade of three directional couplers. The first coupler samples the output power and frequency. The power is detected and displayed on meter M3. A cavity wavemeter in the line absorbs power at its resonance and causes a "suck-out" or dip on M3 when tuned to the oscillator frequency. The next two couplers form a reflectometer which reads the forward and reflected power from the load as seen by the oscillator. M1 reads forward power and M2 reads reverse power.

At the output of the last coupler, a device called a slide-screw tuner is connected. This is followed by a matched waveguide load.

The slide-screw tuner is a simple way to get an adjustable vswr of any phase. It is useful in load tests such as this or as an impedance-matching device. The VHF equivalent is a single-stub tuner which may be moved along the line. Mechanically, the slide-screw tuner consists of a probe through the broad wall of the waveguide (often a screw) which travels in a slot in the waveguide wall. The probe is supported by a slide plate on the outside of the guide. The probe when inserted into the guide is equivalent to a capacitor, the value of which is proportional to the depth of penetration. The depth of penetration controls the magnitude of the imaginary part of the vswr thus created. The position of the probe along the guide controls the phase. The real part of the load is sup-

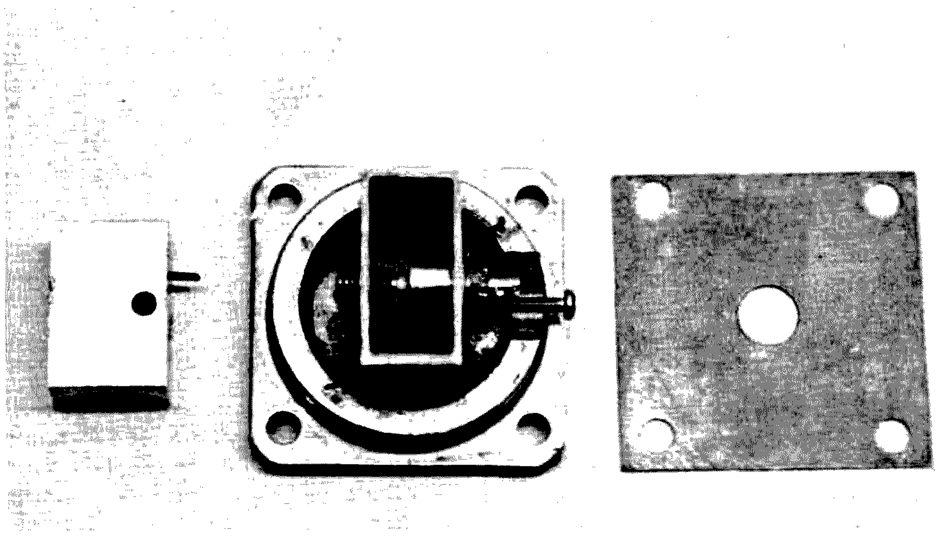


Photo C. The partially-assembled oscillator. The breadboard version of the oscillator is shown with the shorting block and iris removed. The lossy resistive probe extends from the shorting block into the cavity. The removable iris plate permits the output coupling to be easily adjusted.

plied by the waveguide load beyond the tuner. By moving the probe along the guide, a fixed vswr load is effectively rotated through all phases.

I tested my oscillator with load vswrs of 2 to 1. Most waveguide circuits into which such an oscillator will operate may be tuned below a 2 to 1 vswr without much difficulty. In addition, the phase of most loads will stay put. A 2 to 1 vswr of variable phase is probably the worst load that might be expected in most applications.

The first test I made was load pulling. This measures how much the power output and frequency shift as the load vswr is rotated through all phases. The setup of Fig. 9 is used. The oscillator was connected and the center frequency set by means of the tuning screw.

The slide-screw tuner was initially completely out of the waveguide, so the oscillator load was only the matched waveguide termination. To obtain a 2 to 1 vswr, the slide screw was inserted into the guide until the reflected power indicated by M2 increased to a level 9.5 dB below the forward power indicated by M1. A ratio of forward to reflected power of 9.5 dB corresponds to a 2 to 1 vswr.

The shift in load impedance caused the reading on M1 to change also as the probe was inserted into the line. The idea is to get the 9.5 dB difference with the probe inserted. The initial value of M1 is not of concern, as it will always change as the probe is inserted. I then had a 2 to 1 vswr load on my oscillator. The next step was to move the probe of the slide-screw tuner along the line and record the extremes of power and/or frequency. During these tests, a spectrum analyzer was often used in place of the wavemeter to speed the measurement process, but the wavemeter approach works fine. It just takes longer.

First, I measured the effect of load vswr on the oscillator power output for 5 different Gunn diodes. Three Alpha type DGB 6844C diodes were tested at their normal operating voltage of 8 volts. Then two Microwave Associates type 49508 diodes were tested at 7 volts. Table 1 shows the data for 10 to 10.5 GHz in 100 MHz steps. In my oscillator, the Alpha diodes gave slightly more power output. An average output was obtained of about 25 milliwatts for most Alpha diodes at most frequencies. The average for the MA devices was a bit less, about 15 milliwatts. Diodes could be substituted in the oscillator with no adjustment and the frequency would change only a few MHz. This data was taken with a .320-inch iris installed on the oscillator.

In order to determine the effect of various iris sizes, I next made a set of tests with different iris diameters and used the same diode. Iris sizes of .290, .320, and .380 inches in diameter were tried. The pulling was again tested with a 2 to 1 vswr. I found that the effect was considerable. Table 2 shows the results. Increasing the iris hole size increased the output power by about 2 dB. The effect on the frequency stability and cavity Q (determined from the amount the oscillator can be pulled) was significant. The pulling increased from 21 MHz with the small iris to 80 MHz with the large iris. In addition, the oscillator would not operate below about 10.4 GHz. At the heavy loading caused by the large iris, insufficient negative R was available and the oscillations stopped. This is because the optimum operating frequency for this diode was above 10.5 GHz for the particular dc voltage applied.

The .320-inch diameter turned out to be a good size. High power output and pretty fair stability were obtained. The data indicates how a little rf power can be traded for a lot of frequency stability. For low-power applications such as receiver local oscillators, I would use a small iris. The improvement in frequency stability for varying loads is certainly worth it.

The dc supply voltage may be used to adjust the oscillator frequency slightly. This is a simple way to make an afc system if done carefully. The tuning range is not as great as can be obtained by putting a varactor diode in the cavity, but it is an easy approach. The tuning range is limited by the amount the supply can be changed before the oscillator quits. For small diodes such as those used here, a variation of plus or minus 1 volt from the nominal supply of 7 or 8 volts seemed reasonable. Lower voltage increases the current and power drops. Increased voltage will also drop the power and the oscillator will eventually quit as the electrons are slowed from the optimum transit-time velocity.

I tested the oscillator into a matched load and measured the degree of frequency "pushing" that could be obtained. The smallest iris was used since an afc system would require that the best oscillator load-stability option be used.

The three Alpha diodes were used for this test. I set the cavity to 10.5 GHz with the dc supply at 8 volts. The voltage was then changed plus and minus 1 volt in one-half steps and the frequency shift noted. The data is in Table 3. All diodes behaved the same. The frequency could be shifted down about 15 MHz and upward about 8 MHz. The power variation was only 4 milliwatts out of about 15 milliwatts average. This is quite acceptable for most applications.

After making this test, I began to wonder what effect the load vswr would have on the frequency "pushing" sensitivity of the oscillator. An especially unfortunate change in load could pull the oscillator so far that it could not be returned to the correct frequency by "pushing" with the dc supply. In order to cut down the time to take the data, only a single diode sample was tested. The great similarity of results for the other tests indicates that these results are probably valid for the other diodes. Alpha diode number 1 was used with the .290-inch iris on the cavity output. First, I varied the supply voltage as before and noted the frequency shift obtained with a matched load. Table 4 shows the data. Next, the vswr was increased to 2 to 1 and the frequency was pulled up the band as far as possible (the dc supply was returned to 8 volts during this adjustment). Next, I varied the supply again and noted the frequency relative to the *original* 8-volt center frequency. Finally, the oscillator was pulled down the band as far as possible with the load vswr and the data was taken again.

From the data, it may be seen that the range of adjustment with a matched load is −15 to +8 MHz. With the frequency pulled high with load vswr, the range is −25 to +17 MHz. The oscillator passed through the reference frequency somewhere between 7.0 and 7.5 volts. In this case, the supply could be used to afc the oscillator back to the starting frequency. With the oscillator pulled below the operating frequency, the range of adjustment with the supply was from −25 to −6 MHz. Nowhere in the range of supply-voltage adjustment did the oscillator return to the initial frequency. In this case, an afc loop could not correct the frequency shift due to load pulling. It could only approach within 6 MHz and would "hang up" on the low side as indicated in the fourth column of Table 4.

One other factor is evident from these results. The modulation sensitivity varies a lot as a function of load. For the matched load case, the shift for a 0.5-volt change from 8.5 to 9.0 volts is only 3 MHz. With the oscillator pulled high, the change in frequency as the supply is varied from 7 to 7.5 volts is 30 MHz. With the oscillator pulled low (column 4), the frequency change for the same supply-voltage shift is only 7 MHz.

My conclusion is that an afc or phase-lock system that uses the supply voltage is feasible, but with a few cautions. The load vswr that the oscillator sees should be low if at all possible, and it certainly should be controlled.

If this is not done, the loop may lose range or go unstable. When setting up an afc system, the oscillator should be mechanically tuned to the desired frequency while monitoring the supply voltage so that it may be centered with the loop closed. Because the amount of tuning that can be obtained is so limited, this approach will ensure that all of the range is available to cope with thermal drift. If the load changes significantly, the loop may well lose control.

The real key is to keep the load vswr as low as possible. This will minimize the effect of changes in load phase upon the oscillator frequency.

This concludes the test data I obtained. Hopefully, it is complete enough so that the oscillator may be put to use in your X-band command link or whatever.

X-Band Transceiver

I added a simple mixer to the basic oscillator to make an effective X-band transceiver. My application was for Doppler radar, but the device is equally useful for communications. When mated with the Doppler processor described in the next section, the unit will provide positive detection of man-sized targets at ranges up to 100 feet or so.

A number of the commercial Doppler radars used for door openers, speed meters, or intrusion detection use a simple "diode in the guide" mixer for reasons of cost. In this approach, a mixer diode is simply placed in a section of waveguide between the Gunn oscillator and the antenna-mounting flange. No ferrite circulator is used for transmit-receive signal separation. At best, this approach is 6 dB poorer in performance than if a circulator is used, but it is simple to make and works quite well for many applications.

In operation, a portion of the transmitted energy is intercepted by the mixer diode. For communications, this serves as the local oscillator, and in a Doppler system it serves as the zero-velocity frequency reference. The amount of energy that is coupled to the diode must be controlled so that there is something left to radiate. In my design, this was done by offsetting the diode from the centerline of the waveguide. The electric field intensity is maximum at the centerline of the guide and falls off toward

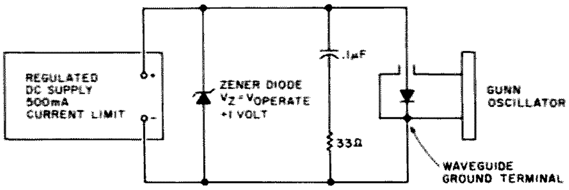


Fig. 8. Dc power-supply circuit for testing Gunn-diode oscillators. The zener-diode voltage should be about 1 volt more than the intended operating voltage for the oscillator.

Iris Diameter Inches	Power Output Milliwatts	Frequency Pulling MHz peak to peak	Loaded Q
.290	15 to 32	21	250
.320	22 to 40	40	131
.380	35 to 45	80	65

Table 2. Effect of iris diameter. This table shows the effect of iris diameter upon the power output and frequency stability of the oscillator as the load is varied through all phases of a 2 to 1 vswr. The test frequency was 10.5 GHz. Diode number 3 was used for this test. The oscillator would not operate below 10.4 GHz with the .380-inch iris.

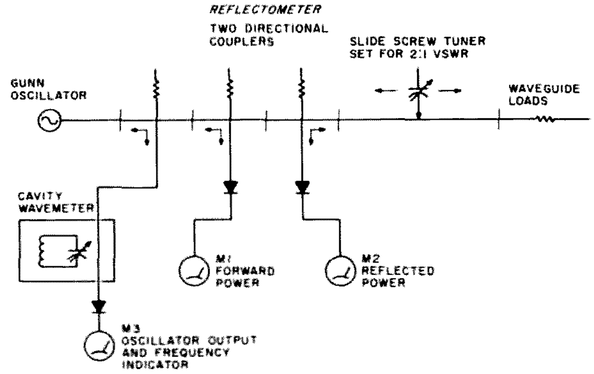


Fig. 9. Schematic of the Gunn-oscillator test setup.

the sides. It is zero at the side walls since they effectively short the field.

I positioned the diode mount 0.250 inches from the outer wall of the waveguide. At this location, about one-half of the energy from the Gunn oscillator is intercepted by the diode. The rest continues down the guide to the antenna.

The iris on the Gunn-oscillator output port is not a perfect short, but it does present a very high vswr to the guide. This is fine for the oscillator coupling because the goal is to mismatch the oscillator so that it is decoupled and the cavity Q remains high. It also effectively shorts the guide behind the mixer diode for energy entering the transceiver from the antenna. The presence of the iris means that the electric field will be maximum about one-quarter wave up the guide from the iris plate because it has to be nearly zero at the iris.

I placed the mixer diode three-quarters of a wavelength from the plate. Since impedances repeat every one-half wave, the three-quarter-wave position is equivalent to the quarter-wave location. This was done to put the diode far enough from the iris for the energy from the oscillator to return to the normal TE_{10} mode pattern. I was concerned that the desired coupling to the diode might be difficult to obtain near the iris and didn't want to spend a lot of time in optimization of the circuit.

The mixer diodes used in my transceiver were chosen because they are in a package similar to the ones housing the Gunn diodes. The same sort of mount is used and all of the pieces are the same with the exception of the post, which is smaller. I purposely avoided the 1N23 type of package because it is hard to mount and a second set of hardware would have to be designed for it.

Dc supply voltage	Diode #1 Freq. Shift	Diode #1 Pout mW	Diode #2 Freq. Shift	Diode #2 Pout mW	Diode #3 Freq. Shift	Diode #3 Pout mW
7.0	−15	14.2	−18	20	−15	19
7.5	−7	14	−10	17	−8	21
8.0	0	14	0	16	0	20
8.5	+5	15	+6	17	+6	19
9.0	+8	15.5	+10	18	+10	17

Table 3. Frequency pushing with supply voltage. This data shows the effect of supply voltage upon the oscillator frequency with a matched load. The iris diameter was .290 inches. The oscillator was tuned to 10.5 GHz with the supply at 8 volts to establish the initial reference frequency.

Diodes in the small (double prong or MQM) package are made by Microwave Associates, Alpha Microwave, and Hewlett-Packard, to name a few vendors. I used the H-P 5082-2711 diode in my transceiver. This is a Schottky barrier type. Other diodes which should work include the Alpha type DMF 6106 and the MA type 40006. These are also Schottky types. A point-contact type which may prove cheaper to buy is the Alpha type D5523C. The point-contact diodes will work as well as the Schottky diodes in most applications. Remember when ordering these diodes to get ahold of a data sheet because they are graded for noise figure. The numbers above I selected for worst noise figure and lowest cost. By changing a suffix or adding one, the noise figure gets better and the price gets worse. No diode listed above has a noise figure of more than 9 dB. You can get 6.5 dB, but boy, it will cost!

Transceiver Construction

Photo F shows the breadboard version of the transceiver. Photo D shows the final version which eliminates the two flanges coupling the oscillator to the mixer. It is mounted upon the Doppler processor box. The integrated version of the transceiver is made from a single section of X-band waveguide. The oscillator section is identical to the separate oscillator circuit just described. All of the internal details are the same with the exception of the coupling iris; it is soldered directly into the guide.

Two flanges are eliminated and a nicer assembly is achieved. To install the iris, first cut through three of the four walls of the waveguide, as indicated in Fig. 10. One broad wall and the two narrow walls are cut. Make up the iris plate from copper or brass sheet somewhat thinner than the saw blade. Install the iris in the saw cut and solder into place. Take some care in this. All four walls of the guide must be soldered to the iris plate on both sides. If not, you will create a truly marvelous slot antenna! Remove all flux after soldering.

The mixer diode is installed in a mount similar to the Gunn-diode mount. The mount parts are as indicated in Fig. 7. The mixer post is made from 0.250-inch rod stock rather than the .312-inch-diameter stock used for the Gunn diode. The mixer-mount parts are assembled into the guide in exactly the same manner as the Gunn-diode mount. There is one difference. No heat-sink goo is required for the mixer diode. Hole A on the mixer side of the iris is for a ground lug to return the mixer load resistor to the guide. This resistor is used to prevent static burnout of the mixer diode during initial testing.

In assembling the transceiver, first cut the guide to length and then drill and deburr all holes. Tap holes as required. Make the saw cut and install the iris. Solder the output flange to the mixer section as indicated in Fig. 10. Use a large C-clamp to heat sink the iris area when installing the output flange. This will prevent the solder holding the iris plate from running. Remove all flux. The two diode mounts may be installed next. Then install the shorting block with lossy probe in the end of the oscillator cavity. Install the tuning screw. Install the Gunn diode. Connect a 5k resistor from the mixer-diode output terminal to the ground lug. Now install the mixer diode using care not to damage it with static. Pick up the transceiver body with one

hand while holding the diode in the other. This will put the transceiver and the diode at the same potential. Then install the diode in the transceiver. The Gunn diode is more rugged and may be handled normally, so these cautions do not apply to it. In my version of the Doppler radar, I located the .1 μF capacitor and 33-Ohm resistor components of the Gunn-diode dc supply circuit on a small tie strip. This tie strip is mounted to the waveguide by the same screw that holds the shorting block in place. These parts are visible in the photo.

The transceiver is now ready to be tested.

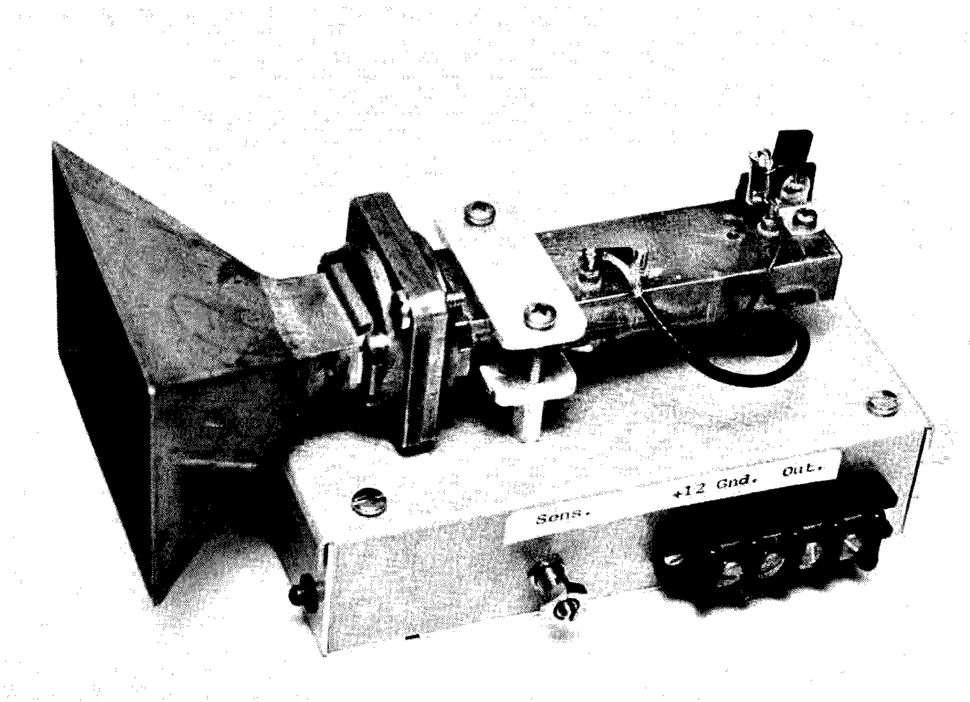


Photo D. The Doppler radar assembly. The final version of the X-band transceiver is mounted to a box which contains the Doppler processor to form a self-contained Doppler radar. The 10k-diode load resistor may be seen to the rear of the coax cable which connects the mixer output to the processor card. The 33-Ohm resistor and 0.1 μF capacitor are mounted on the small terminal strip and connected to the Gunn-oscillator dc input terminal. The 2-56 cavity frequency adjustment screw is not installed in this photo. One of the two LEDs used for adjustment is visible under the horn antenna.

Transceiver Test

Arrange a power supply for the Gunn diode as described previously. Apply power and test for supply stability with a scope. If everything is okay, the oscillator should be operating. Connect a voltmeter (20,000 Ohms/volt) to the mixer-diode output. Do this with care. Ground both meter leads to the waveguide and then connect the positive lead to the diode output. The diode should be rectifying some of the rf energy and a voltage of a few tenths of a volt will be present. If the diode voltage is negative with respect to ground, the diode is in backwards. This is of no concern in most applications.

If no voltage is measured, there are three possibilities: The diode is no good, the Gunn is going at 13 GHz and no power is coming out of the oscillator, or perhaps the tuning screw is in too far and is shorting the cavity. First, back out the tuning screw until it is out of the guide. Next, try another mixer diode. If this doesn't help, remove the shorting block from the cavity and verify the pencil-lead probe insertion. If it is okay, then make sure that it is soft pencil lead, which has more carbon in it. Reassemble the oscillator without the probe. Set up as before and apply power. Observe the voltmeter on the mixer diode and slowly insert the lossy pencil-lead probe into the cavity through the hole in the shorting block. If a diode-mount oscillation was the problem, the mixer diode will suddenly indicate the presence of rf when the probe kills the spurious oscillation.

Once things are going, some interesting tests can be made. The open waveguide flange is not a bad antenna. The gain is about 5 dB! Point the business end of the transceiver out into the room and connect a scope across the mixer-diode output. With the scope gain at 10 to 100 millivolts per division and ac coupling, the Doppler shift on moving people is quite readily seen. Adding a good antenna will greatly increase the return. Hooking the mixer output into a hi-fi amplifier with a good low-frequency speaker is also entertaining. People, fans, and cars make really strange Doppler noises.

If you build two transceivers or an oscillator and transceiver, the following test is interesting. Set them up about 6 feet apart with the waveguides pointed at each other. Observe the mixer output of one unit on a scope while tuning it across the frequency of the other. The diode-mount capacitance measures about 13 pF, so a bandwidth from dc to several megacycles is obtained without tuning the mount at i-f. As the frequency of one unit approaches that of the other, the beat may be seen on the scope. This is the i-f frequency created by mixing the two X-band signals. As the frequencies are brought closer, the beat frequency drops and then it will suddenly vanish. This happened at about one MHz with my units. At first this seems strange, since the mixer mount will work down to a dc i-f frequency.

The answer is that the two oscillators have locked together and are now on the same frequency. Further tuning will eventually pull them apart. This is an example of injection phase locking. In some high-power sources, injection locking is used to obtain more power than a single diode will supply by locking several units together. As you can see, not much power needs to be injected to lock one to another.

Communications

The transceiver may be used for communications.

mixer: −86 dBm
Sensitivity: −100 dBm

Output carrier-to-noise ratio: +14 dB

The actual signal-to-noise ratio will be somewhat better because of the FM improvement resulting from the high modulation index if the full 75 kHz deviation is used. By going to a pair of 3-foot dish antennas, a gain of about 36 dB is obtained. This will improve each end of the link by 16 dB for a total gain in SNR of 32 dB over the case above. Of course, the improved SNR can be traded for greater range at the rate of an additional 6 dB of loss for each doubling of the distance.

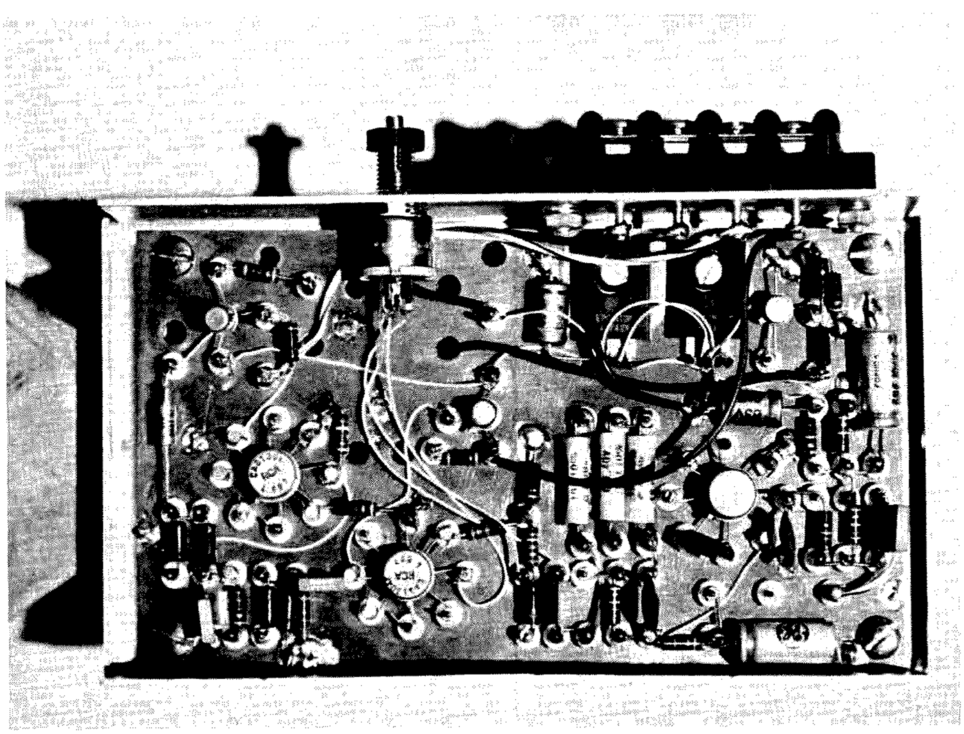


Photo E. The Doppler processor card. Signal flow is from right to left across the bottom of the card. U1 is located at the lower right, U2 in the center, and U3 at the left of the card. The analog pulse-counter circuitry is in the lower left-hand side of the card below U3. The voltage-regulator circuits are at the upper right near the input/output terminal block.

An FM tuner makes a good i-f strip for getting started. Most of the tuners have a pretty fair noise figure, but getting a proper match to the mixer is also important if good results are to be achieved. Most modern microwave receivers solve this problem by putting a preamplifier right at the mixer. I recommend doing the same. A good low-noise dual-gate FET preamplifier will overcome any deficiencies of the FM radio and will enable the mixer to be matched to a well-controlled amplifier input impedance. The preamplifier can then drive a cable to the receiver.

The i-f impedance of the mixer will be a function of the diode current and will be from 200 to 500 Ohms. The diode mount has a capacitance of about 13 pF. This should be tuned out with an inductor which also serves as the dc return for the diode, as in Fig. 11. The inductor and diode-holder capacitance should be resonant at the i-f frequency. The resulting real impedance is then matched into the preamplifier.

FM modulation of the Gunn diode is simply a matter of modulation of the power-supply voltage. Be sure to limit the peak-to-peak excursion of the supply to prevent damage to the diode. A good modulator approach would be to ac couple the audio into the reference source for the dc regulator. This will offset the reference and force the dc voltage from the supply to follow the audio. The supply must be capable of moving at audio rates. This means that giant filter capacitors on the output cannot be used. In addition, some form of modulation limiting should be provided so that deviation is controlled. Remember, the oscillator can be deviated several MHz per volt of supply change. If a standard FM radio is used as your i-f strip, only 75 kHz of peak deviation is needed. So only a few hundred millivolts of audio are required on the dc supply.

The communications range that you can get with this transceiver is very much dependent upon the antennas used. The noise figure is fairly decent, and, with a 200 kHz bandwidth FM tuner for an i-f strip, sensitivities of −100 dBm or so should be obtained. The path loss at 10 GHz for 10 miles is 136 dB.

As an example, consider the use of a pair of 20 dB gain horns and about 10 milliwatts of power. The power at the receiver mixer and output carrier-to-noise ratio are:

Transmitter output: +10 dBm
Transmitter antenna gain: +20 dB
Receiver antenna gain: +20 dB
Path loss (10 GHz & 10 miles): −136 dB

Power at the receiver

Doppler Processor

The X-band transceiver may be used as an effective Doppler radar for protecting the goodies in your ham shack from burglars by adding the Doppler processor section described next. Doppler radars respond only to moving reflectors, and, if properly employed, can provide nearly foolproof protection against intruders. The trick is to achieve a very low false-alarm rate so the circuit is not continually "crying wolf."

The Doppler effect refers to an apparent shift in the frequency of a radio signal which occurs if the transmitter is moving relative to the receiver. The amount of frequency offset that occurs is determined by both the transmitter frequency and the velocity of the transmitter relative to the receiver. The frequency shift is given by the simple formula: $F = f_0 \times V/C$. F is the shift. f_0 is the transmitter frequency. V is the velocity difference and C is the speed of light. The frequencies are in Hz and the velocities in meters per second. In the radar case, the signal experiences the Doppler effect in

both directions of propagation, to and from the target. Here, the resulting shift is doubled from the values given by the formula.

The Doppler effect is used in a variety of radar applications where measurement of speed or separation of moving from stationary targets is desired. The police speed meters are one example, of course, but others include air search radars which use Doppler to reject ground clutter (ground doesn't move) and accept airplanes (which always move).

If an intrusion-detection radar operates at 10 GHz, the maximum Doppler shift obtained with a walking person as a target is about 40 Hz. The lower end of the Doppler range extends to very low frequencies. I used 4 Hz as the lower band edge of the processor after observing the Doppler output of the transceiver on a scope and determining that there is a lot of energy near dc; some of us don't move all that fast! In any event, the 4-40 Hz processing bandwidth seems to work well in practice.

The objective in the processor design is to obtain positive target detection with a low false-alarm rate. The circuit has to have some "smarts" so that it does not trip on the first cycle or two of 4-40 Hz audio to come out of the Doppler mixer. In order to obtain an alarm output, the processor requires that a large number of cycles of Doppler occur within a relatively short span of time and that more recent events be given greater weight than those which occurred many seconds earlier. This feature prevents noise from causing single-event false alarms, and, as a consequence, the circuit almost never produces a false output. An alarm output on a real person is obtained in about 2 seconds.

The processor has four major sections: an input preamplifier, a squaring amplifier, a pulse counter, and an output threshold detector. It also contains a power supply for the processing circuits and a regulator for the Gunn-diode oscillator. Two LED indicators are provided to aid in setting the circuit sensitivity. One blinks when Doppler is present; the other indicates an alarm-decision output. Fig. 12 is a schematic diagram of the circuit.

The input preamplifier has a 4-40 Hz bandpass which is obtained by RC rolloffs in the input and feedback networks. The op amp, U1, is an RCA type CA 3130 FET input op amp. I used this part in all three stages of the processor because it has a number of advantages for this type of circuit. The high-input impedance permits good low-frequency response with small (0.1 μF) capacitors. If a 741-type amplifier were used, some truly huge values would be required to obtain response to 4 Hz. The FET input stages also permit the CA 3130 to run from a single-ended supply with the common-mode input voltage at the inputs as much as one-half volt below ground. This was handy in the last stage. Finally, the output section of this chip is a CMOS inverter used as an amplifier. This permits the output to swing within 50 millivolts or so of the supply voltages. Thus the circuit will interface directly with CMOS and, in the case of the squaring amplifier stage, will provide an output swing equal to the supply voltage. This saved some parts.

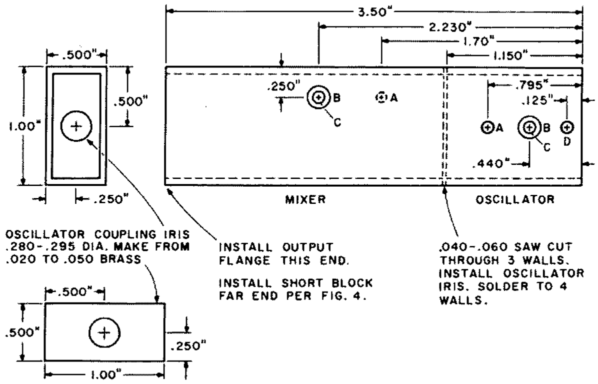


Fig. 10. X-band transceiver waveguide. The function and size of the lettered holes are the same as in the table in Fig. 6.

The noninverting input of U1 is biased at +5 volts by the voltage divider, R3 and R4. Input capacitor C1 and resistor R1 form a high-pass filter with a 4-Hz corner frequency. R2 and C2 form a 40-Hz low pass. The amplifier gain is set to 60 dB by feedback resistors R5 and R6. Capacitor C5 is used to obtain a 40-Hz high-pass rolloff in the feedback network. The 68 microfarad capacitor, C4, in conjunction with R6, causes the gain to decrease below 4 Hz. The amplifier gain is unity at dc so the output sits at the input bias point of +5 volts in the absence of an input signal. High-frequency compensation of the preamplifier requires a 100 pF capacitor from pin 1 to pin 8 as indicated.

The second stage of the processor, U2, also uses the CA 3130. Positive feedback around the amplifier is employed to obtain a squaring amplifier. The objective is to turn the complex sine-wave Doppler audio into a series of 10-volt peak-to-peak square waves. The input circuit of U2 is a bit novel and requires some explanation. The voltage divider consisting of R7, R8, and R9 forms the reference for both the inverting and noninverting inputs. This reference voltage is about 5 volts. The 6.8-Ohm resistor, R8, ensures that the voltage at the inverting input is always about 34 millivolts more positive than the noninverting input. In the absence of an audio input signal (which is ac coupled), the op amp is always driven to ground potential because of the intentional 34 millivolt offset introduced between the inverting and noninverting

Dc supply voltage Volts	Frequency shift matched load vswr 1.1 to 1	Frequency shift osc. pulled high with 2 to 1 vswr	Frequency shift osc. pulled low with 2 to 1 vswr
7.0	−15 MHz	−25 MHz	−25 MHz
7.5	−7 MHz	+5 MHz	−18 MHz
8.0	0 MHz	+10 MHz	−14 MHz
8.5	+5 MHz	+13 MHz	−7 MHz
9.0	+8 MHz	+17 MHz	−6 MHz

Table 4. Effect of load vswr on frequency pushing. This table indicates the effect of load vswr upon the center frequency and tuning sensitivity of the oscillator. Note that when the frequency was pulled low, the initial frequency could not be restored with supply voltage. Diode number 1 was used with a .290-inch diameter iris.

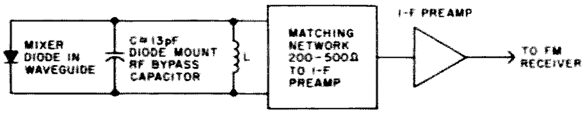


Fig. 11. Connection of an i-f preamplifier to the X-band transceiver. C is the shunt capacitance of the diode mount (about 13 pF). Inductor L tunes the mount capacitance to the i-f frequency and provides a dc return for the crystal current. A 3N200 or similar dual-gate FET would make a suitable preamplifier.

inputs. This offset is sufficient to overcome the worst case input offset of the op amp and ensures that the output voltage always swings to ground. This is done so that the LED driver, Q1, is normally off.

The particular configuration used was chosen because it is independent of both supply-voltage and resistor variations. No precision parts are required.

The Doppler signal is coupled into the squaring amplifier input from the preamplifier stage via capacitor C6 and gain control R10. When R10 is set to full gain, less than 50 millivolts of Doppler at the input to the squaring amplifier is sufficient to obtain a 10-volt peak-to-peak square wave output from U2. The presence of Doppler causes LED −1 to flash at the Doppler rate.

The circuitry following U2 is the heart of the processor. It is here that the low false-alarm rate is obtained. In effect, the circuit is an analog pulse counter with a short memory. The first section, consisting of C7, R13, and CR1, is a rectifying differentiator. It converts the square waves from U2 into a series of short positive-going pulses. The shunt diode rectifier clips all negative-going edges so only the positive pulses remain.

These positive pulses charge C8 through R14. The series 1N914, CR2, prevents the accumulated charge from discharging back through R13 to ground. The effect of R14 is to make the narrow positive pulses into a current source. As a result, the voltage accumulated in C8 is a function of the number of input pulses. The circuit is essentially a pulse counter with an analog voltage output.

This approach is simpler and cheaper than a digital counter and can be made to "forget" at any rate desired. The objective is to have the circuit slowly reset itself if an insufficient number of pulses are counted. This is a way to give more recent events more weight in determining if there is an intruder present. Two groups of pulses separated by a short interval in time should set off the alarm. Similar groups spaced widely apart in time (several minutes apart) should not. The "forget-it" function is obtained by R17, which slowly discharges C8. Adjustment of R17 allows the circuit to have any memory time required.

The output of the analog pulse counter is applied to U3, another CA 3130 op amp. U3 functions as both a high-impedance comparator and as a one-shot multivibrator. The inverting input of the amplifier is referenced to +2 volts by R15 and R16. The voltage from the analog pulse counter is applied to the noninverting input. When this voltage is less than +2 volts, the output of U3 is 0 volts. When the input exceeds +2 volts, the output of the CA 3130 goes to +10 volts and the circuit becomes a one-shot.

The one-shot functions as follows: C9 is initially discharged via CR4. CR3 is reverse biased, which effectively disconnects C9 from the input to U3. Thus, the only capacitor in the pulse counter circuit is C8. When the output of the CA 3130 goes to +10 volts, CR3 becomes forward biased, and since C9 is essentially discharged, the voltage at the noninverting input of U3 is nearly 10 volts. This positive feedback holds the output of U3 at +10 volts. C9 starts to charge through R17 and the voltage at the noninverting input falls toward ground at a rate determined by the R17 and C9 time constant. C8 is also in the act, but to a lesser extent because of its lower capacitance relative to C9. Eventually, the voltage at pin 3 drops below +2 volts and the circuit resets. The output voltage from U3 then returns to ground potential. The output pulse width is more than one second with the values shown. The arrangement of the circuit is convenient in that longer pulse widths may be obtained by increasing the value of C9 without any effect upon the analog pulse counter. In one version of the circuit, the output pulse width was increased to 3 minutes by increasing C9 to about 60 μF. In this application, the output pulse operated an alarm circuit directly for a 3-minute interval.

The LED drivers, Q1 and Q2, are 2N2222 or similar NPN transistors connected as emitter followers. Just about any LED will work. I used the high-efficiency HP 5082-4650 types which make a lot of light from only 10 mA of current. If lower-efficiency LEDs are used, the 820-Ohm resistors, R18 and R19, may be reduced in value to obtain more current. Note that the LED driver collectors are returned to the unregulated +12-volt line and not to the +10-volt regulated supply. This is intentional. The current pulses created by the LED drivers could get back into the low-level input stages and cause an oscillation via the +10 supply line. By using the connection indicated, the voltage regulator isolates the low-level stages from these current pulses.

The Doppler processor operates from a nominal 12- to 15-volt dc input. Higher voltages can be used if the heat sinking of the supply regulators is improved. A 10-volt supply was chosen for the op amps to ensure sufficient "overhead" to maintain the voltage regulator in regulation. The CA 3130s require at least 8.5 volts to really work well. The regulator for the Gunn-diode oscillator supplies +7 volts and is compatible with the Microwave Associates Gunn diodes. The 8-volt Alpha parts will also work from this voltage.

The regulator circuit was designed to supply the 7- and 10-volt requirements using standard 5- and 8-volt 3-terminal regulators of the MC7800 series. Seven volts is obtained by offsetting the common terminal of U4, a MC7805 CP, 2 volts above ground. This is accomplished with emitter follower Q3, which has its base referenced to a divided sample of the 7-volt regulator output. The sample is derived from divider R22-R24. Resistor R24 is a select in test value and is used to adjust the circuit to exactly 7 volts of output. The divider cannot be fixed because of the wide output-voltage tolerance of U4 and the variations of V_{be} of Q3. The +10-volt regulator is made by referencing the common terminal of an 8-volt three-terminal regulator chip to the +2-volt source at the emitter of Q3. The current from the common terminal

to ground for both chips runs through Q3. An emitter follower was used rather than a simple resistive divider to provide a low-impedance constant voltage sink for this current and to avoid the necessity for high-dissipation low-value resistors in the voltage-divider network.

Doppler Radar Construction

The complete Doppler radar is packaged in a 5.5" x 1.5" x 3.0" minibox as indicated in the photos. The X-band transceiver is mounted to the top exterior surface of the box with a clamp which grips the waveguide. The Doppler processor card is mounted inside the box and attached to the same surface as the waveguide. The card is mounted with number 6 screws and spacers. This arrangement makes it possible to remove the bottom cover for test or servicing without disturbing any wiring. The sensitivity control and input/output terminal strip are mounted on one side of the box. The LED indicators were mounted on one end of the bottom cover and connected to the circuit card with long leads to permit easy removal of the cover.

The Doppler processor card is constructed using copperclad PC board and push-in standoff terminals. Wiring is all point-to-point. There is no particular magic in the layout except to keep the signal flow in one direction. The circuit does have a lot of gain, but no difficulty with oscillation was encountered. Just keep the output portions of the circuit from being routed near the preamplifier input. Signal flow is from right to left in the photo of the circuit card. U1 is in the lower right-hand corner of the card and U3 is in the lower left-hand corner. The three large parts to the left of U1 are capacitors for a 120-Hz notch filter that was deleted from the circuit. They are not required and are not indicated on the processor schematic. The voltage regulator chips, U3 and U4, are mounted to the circuit card. This arrangement provides sufficient heat sinking for the power dissipated at input voltages up to 15 volts.

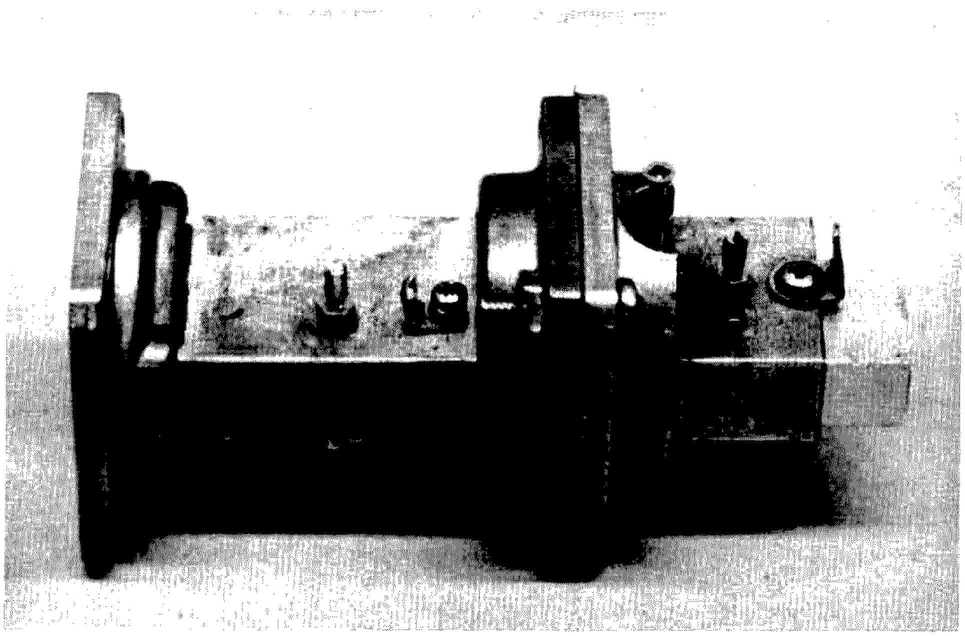


Photo F. X-band transceiver breadboard. The X-band transceiver was developed by adding a simple "diode in the guide" mixer assembly to the breadboard oscillator. The coupling iris is clamped between the mating waveguide flanges.

The output from the Doppler mixer is connected to the processor input at terminals T5 and T6. Shielded cable is used to prevent noise pickup. The mixer diode on the X-band transceiver has an output terminal and a ground terminal. A 10k resistor should be connected from the output terminal to ground. This serves two purposes: It provides a dc return for the Doppler mixer and it serves to ensure discharge of the coupling capacitor, C1, in the Doppler-processor preamplifier. The output terminal of the mixer is connected to input terminal T5 on the processor via the shielded center conductor of the input cable. The ground terminal on the mixer is connected to T6 on the processor with the coax cable braid.

The connections to the mixer from the preamplifier should be made prior to final installation of the mixer diode. This is done to reduce the danger of diode burnout during the soldering operation.

The Gunn-diode oscillator portion of the X-band transceiver is powered from terminal T7, the 7-volt output of the processor voltage regulator.

Doppler Radar Operation and Test

Some initial testing of the Doppler processor may be performed independently of the X-band circuitry. This is useful to isolate any problems with the processor.

After checking the wiring, apply 12 to 15 volts dc to the processor supply input terminal, T3. Load the +7-volt regulator with a 50-Ohm, 1-Watt resistor. This will draw 140 mA from the oscillator supply and will simulate the Gunn-oscillator load. Measure the +7-volt regulator output. It will not be exactly 7 volts. Adjust the select in test resistor, R24, to obtain 7 volts within a tolerance of plus or minus 250 millivolts. The voltage at the output of the +10-volt regulator should be checked and will be pretty close. 9.5 to 10.5 volts is acceptable. Voltages less than 9.5 will cause performance of the op amps to degrade. If all is well, the voltage at the emitter of Q3 will be just about 2 volts. If this is the case and the 10-volt supply is wrong or inoperative, the problem is with U3. If both supplies are wrong, the problem is with U4 and Q3.

Once the dc supply is operating, the rest of the circuit may be tested. When power is first applied, the large capacitors, C3 and C4, must charge. U1 will be inoperative for about 20 seconds, so do not worry if things don't work immediately after power-up.

Apply a 20-Hz audio signal to the preamplifier input. Use plenty of attenua-

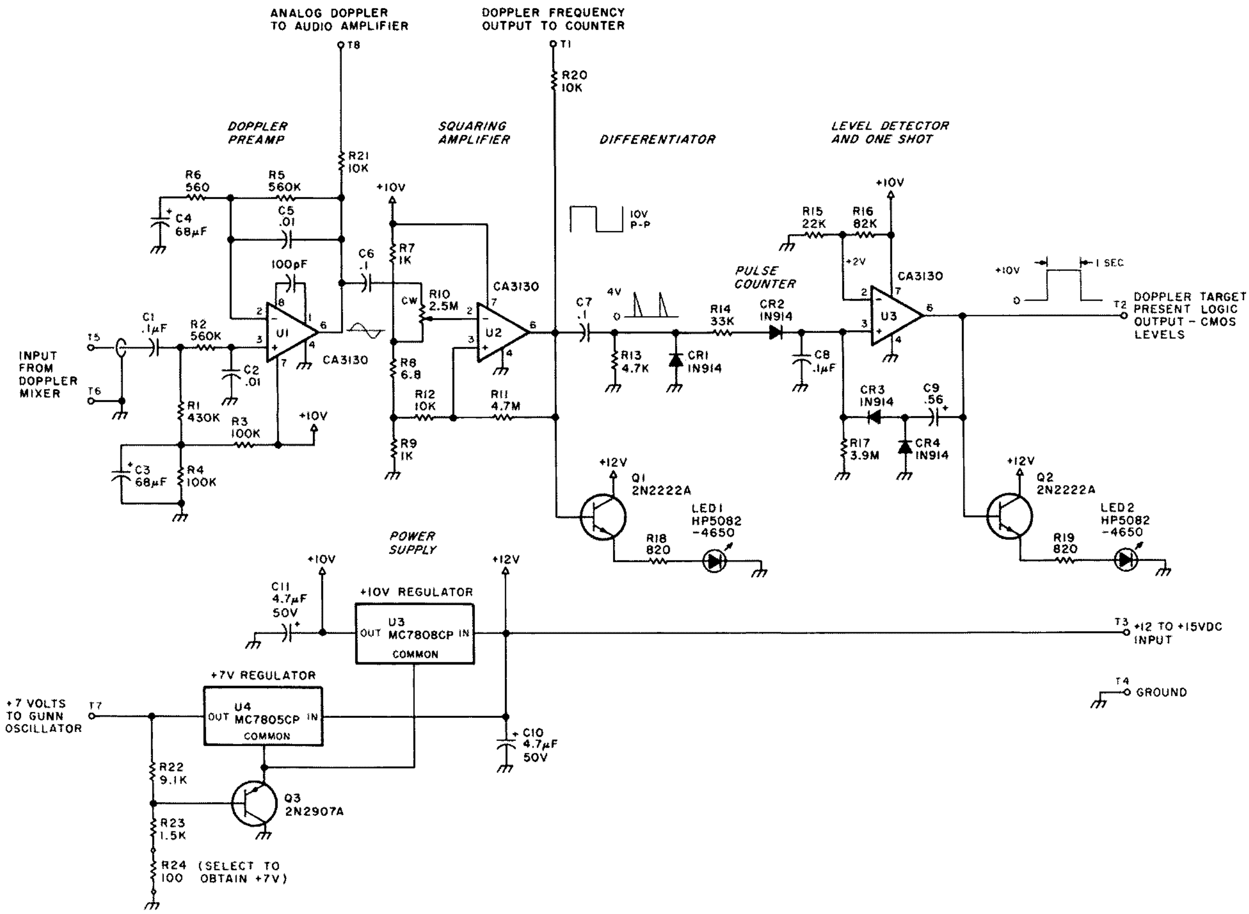


Fig. 12. Doppler-signal processor schematic. This circuit provides a 10-volt CMOS-compatible logic output when a Doppler return is received. The output stage will provide up to 2 mA of output current to an external load.

tion. 50 or 100 microvolts rms should be sufficient. U1 has a gain of 1000 (60 dB) and will easily provide the 50 millivolts of input required to drive U2 to full output.

Increase the input to U1 until 50-100 millivolts is obtained at test point T8. Set R10 for maximum sensitivity and check for a square wave at terminal T1. The amplitude should be 10 volts peak-to-peak.

At this point, LED indicator 1 should be illuminated. Removal of the audio input or a decrease in gain adjustment will cause the LED to go out. If it remains on, check to see if pin 6 of U2 has returned to ground. If pin 6 is at +10 volts instead of ground, then there is a problem in the input bias/offset circuit of U2.

With the square wave present at T1, a series of sharp pulses should be observed at the junction of C7 and CR1. The pulses should be positive-going and have an amplitude of several volts. The pulse will be in phase with the positive edge of the squaring-amplifier output. A small negative-going pulse will occur in phase with the falling edge of the square wave, but will be clamped to −0.8 volts by CR1.

If all of this is working, then U3 will have decided that a target is present and will have a +10-volt output at T2.

Remove the audio input. T2 should go low in a few seconds. Apply the audio input. T2 will go high in about 2 seconds. If the voltage at pin 3 of U3 is observed on a scope or very high impedance meter, it will be seen to rise slowly upon application of audio input. If the input is removed prior to reaching the +2-volt threshold, it will be seen to decay as R17 discharges C8.

If the 2-volt threshold is reached, the monostable trips and the voltage at pin 3 will jump up to nearly 8 volts as the positive feedback is coupled from C9 via CR3.

LED 2 should be illuminated whenever a signal has been applied for more than 2 seconds.

Upon completion of testing, the processor may be operated with the X-band transceiver. When first connecting the transceiver to the processor, be sure to observe the cautions with regard to connection of the mixer diode. Do ensure that C1 is discharged and make the mixer-diode connections with the diode removed from the mount or with the mount shorted. Also, be sure to check for oscillation of the Gunn-diode supply regulator. I encountered no difficulty as long as the .1 μF capacitor and 33-Ohm resistor oscillation suppression network was used at the Gunn-oscillator power terminals.

Place the unit in operation and connect a scope to T8 and a dc VTVM to pin 3 of U3. Walk in front of the waveguide output and observe the Doppler waveform on the scope. The dc voltmeter will indicate the charge and discharge of the pulse-counter circuit. LED 1 will blink whenever there is motion and LED 2 will be illuminated when enough Doppler cycles have been counted to give an alarm indication.

For these tests, the open-ended waveguide is sufficient antenna. The gain is about 5 dB. A range of 10 feet or so will be obtained with this antenna.

The Doppler frequency may be counted by connecting a frequency counter to T1. Use a gate time of one second. The count accumulated will be the total number of Doppler cycles averaged over the one-second interval. Observation of the scope will confirm that the Doppler waveform is complex and is not a single frequency.

The processor output is a CMOS-compatible logic level that goes from 0 to +10 volts when a target is detected. In my application, CMOS logic was used to process inputs from a number of sensors. The output may also be interfaced directly with other devices. The CA 3130 output stage will source or sink 5 milliamperes, which is sufficient to drive an output buffer or relay driver for higher current loads. Fig. 13 is a suggested buffer for loads of up to 2 Amperes.

If the radar is to be used as an intrusion detector, set it up for a couple of weeks in the intended location. Connect an electromechanical counter to the output to record false alarms. This will permit optimization of the sensitivity setting and installation without creating a lot of bothersome false alarms. The circuit has plenty of sensitivity and will see a person at up to 100 feet with a 20 dB gain antenna.

Avoid installations which look directly at a street. Autos have a large radar cross section (as most of us know by now) and are detected at a greater distance than people. What you definitely do not need is a noisy device which informs you that your neighbor is backing out his car!

The unit may be installed in a wood cabinet and will work right through materials such as one-quarter-inch paneling or plywood. Wallboard and plaster attenuate the signal and tend to mitigate the effects of passing autos if the unit is properly positioned.

Antennas

I use a small horn having a length of 2.5 inches and an aperture of 2.3 and 3.0 inches. This is not an especially good horn design from a sidelobe standpoint, but it serves the purpose. Horns are easy to make and have the advantage that their gain and beamwidth are easily calculated. You can make a horn which will almost exactly cover the area to be protected.

Conclusion

In writing this article, I have tried to inspire interest in X-band microwave projects at several levels. The theory of Gunn-oscillator operation and a basic oscillator design are there for those who want the "how-to" information to build one into a communication system of their own design.

The X-band transceiver presented is far from an optimal gadget (especially in terms of noise figure), but it does provide a simple and inexpensive vehicle for experimentation in both X-band communications and Doppler radar. I would like to see someone mount two transceivers at the focus of a pair of 3-foot dishes and have a QSO or two. A number of years ago, a friend sent fast-scan TV over a 1000-foot path using a similar arrangement. By adding attenuators at the receiver, a 10-mile path was simulated with good results. X-band offers plenty of opportunity for TV experiments and for truly secure command links for repeaters.

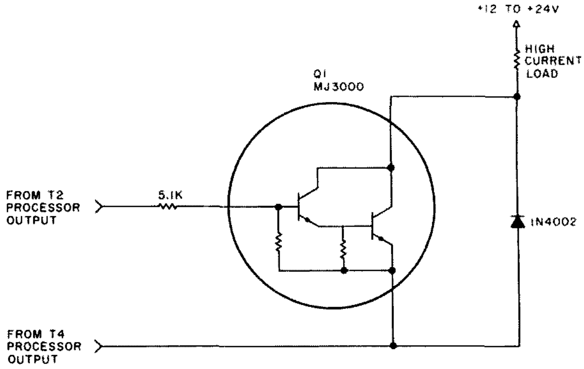


Fig. 13. High-current driver. This circuit uses a high-current Darlington power transistor (Motorola MJ 3000) and will boost the output capability of the Doppler processor such that loads up to 2 Amps at 24 volts may be driven. The diode is to prevent inductive kickback damage to the transistor if inductive loads are connected. The two unlabeled resistors are included on the monolithic Darlington chip.

Doppler radars are interesting projects in themselves. The Doppler processor presented in this article is a practical design I developed to deal with real intruders. Two such units have been in operation for several years with satisfactory results. I am sure that someone will find other uses for this handy form of motion detection.

This article would not be complete without a word with regard to the "radiation hazard." Much has been written of late which alleges a "microwave radiation hazard." A lot of this is uninformed speculation. It has been known for years that microwaves (and lower-frequency rf) cause heating of tissue and that high-power sources such as radars are hazardous.

A major difficulty occurs in attempting to extrapolate the observations for short exposure to high-power sources to long exposure to low-power sources. At present, the permissible level for *continuous* exposure to microwaves or low-frequency rf is not known. Certain standards have been proposed (10, 1, or 0.1 milliwatts/sq. cm) in an attempt to be super safe until more data is accumulated.

Conservative standards are one thing. The real question is this: What precautions should be observed in amateur microwave activities? I apply the same rules that I have used and observed as a working microwave engineer in industry for the past 15 years. They apply equally to microwave projects as to your 2 meter kilowatt. Do not stay in situations of high-power density for long periods. Do not stare into the output of a waveguide source for any period of time at short distances. The level falls off rapidly with distance and is negligible beyond several inches for low-power X-band sources. Remember that a high-power VHF transmitter is equally hazardous if you insist in holding the antenna or standing within a wavelength of it. Time is also a factor. The low-power density recommendations assume exposure on a continuous basis. This is seldom the case in a hobby activity. In short, use common sense.

I hope that this article has provided a starting point for some interesting projects. I will look forward to hearing from anyone who either builds the equipment or who has further questions. ■

Legalized ASCII! The Quad-S System!

—even the FCC approves

At last.

Editor's Note:

Ed Sommerfield W2FJT developed this clever techinque for sending ASCII signals via SSTV back in 1977. Naturally, there was some doubt as to the legality of the scheme, since Section 97.69 of the FCC Rules and Regulations permits only five-level (Baudot) radio teleprinter signals. Ed began a long correspondence with the FCC concerning his development, and in October, 1978, his efforts finally bore fruit. Below is an excerpt from a letter dated October 12, 1978, written to George Enuton of the FCC's Personal Radio Division:

> **Regardless of the type of information transmitted under this scheme, the actual modulation of the transmitter and subsequent transmitted signal is classified as an F5 emission and legal for transmission in the amateur service, subject to the . . . restrictions (of Sections 97.61 and 97.65).**
> **(signed) John A. Reed**
> **(approved) Julian T. Dixon, Chief, Research and Standards Division, FCC**

For reference, Section 97.61 is the table of authorized frequencies and emissions while Section 97.65 deals with (among other things) the bandwidth of F5 emissions.

So here we have it: a technique for transmitting ASCII on the ham bands which carries the FCC stamp of approval. Now, let's get some systems on the air.

E. H. Sommerfield W2FJT
49 Spring Road
Poughkeepsie NY 12601

The FCC does not permit amateur radio Teletype™ transmission of other than five-level Baudot start/stop code. I have not been able to find any restriction, however, on the content of an SSTV picture. Of course, alphanumeric characters are presently being sent via SSTV. These characters are formed by many lines of white/black information, which is the same method I am using to transmit ASCII.

The problem with the existing SSTV character transmission system is that, although displayed characters are easily interpreted by humans, they are absolutely not interpretable by another machine, be it a computer, TTY, or otherwise. A need exists today, and that need will grow tomorrow, to transmit 8-level binary and ASCII data. Nothing in the present FCC rules, however, says that binary or ASCII cannot be translated into single lines on an SSTV picture and sent as FSK video.

This article describes how I translated 8-level ASCII code into crystal-controlled SSTV pictures. Also described are some easily-achieved transmission standards.

Overview

The Quad-S (Slow Scan Start Stop) adapter was designed to accept a character of up to 8 bits (byte), from sources such as an 8-bit Teletype™ or microcomputer, and to translate these bits into a single line of an SSTV picture. The picture is transmitted via FSK (Frequency Shift Keying) FM, line by line (character by character), and detected by either a standard SSTV monitor from which the binary signal can be extracted, or by a microcomputer cassette interface modified for the appropriate mark and space frequencies. Use of

	Frequency	Duration
Horizontal sync	1,200 Hz	greater than 5 ms but less than 30 ms
Vertical sync	1,200 Hz	greater than 30 ms
Maximum white	2,300 Hz	
Maximum black	1,500 Hz	

Table 1. SSTV standards.

fb/20,480 (÷ 16 ÷ 16 ÷ 16 ÷ 5)	= 15 Hz line freq.
fb/8	= 38,400 Hz
38,400 Hz/18 (÷ 9 ÷ 2)	= 2,133 Hz mark
38,400 Hz/24 (÷ 12 ÷ 2)	= 1,600 Hz space
38,400 Hz/32 (÷ 16 ÷ 2)	= 1,200 Hz sync
fb/2,048 (÷ 16 ÷ 16 ÷ 8)	= 150 Hz serial-out (10 bits)

Table 2.

the recovered binary data depends upon the application. In my application, the binary data was fed into a special UART for computer processing. A block diagram of my ASCII/SSTV transmitting system is shown in Fig. 1.

Generating the Transmitting Signals

The selection of SSTV modulating frequencies was determined by the following factors: 1. Are there existing standards? 2. Can crystal control be applied? SSTV satisfies the first requirement; reasonable standards do exist. See Table 1. Now that we know the range of frequencies from which the sync, mark, and space frequencies can be chosen, let's examine two ways controlled frequencies can be generated.

A vco (voltage-controlled oscillator) requires adjustment. A crystal oscillator does not require adjustment. I selected the crystal method since not all readers have the necessary equipment for precise frequency adjustment. The basic crystal frequency selected was 307,200 Hz, which we will call fb. The various frequencies derived from fb are shown in Table 2. All frequencies except 2,133 Hz and 1,600 Hz are derived from repeated divisions by 2, and therefore will be locked in phase with the 150-Hz serial-out clock. Both mark and space can be viewed on any SSTV monitor, and this can be helpful for signal checking.

Now that the mark, space, and sync frequencies have been assigned, let's discuss duration. We're going to use one of the crystal subfrequencies to define the number of pulse groups per SSTV line. At least eight are needed for a binary byte. The nearest exact crystal subfrequency for this purpose is 150 Hz, or ten times the line frequency of 15 Hz. Thus, the SSTV line time of 66.66 ms will be divided into 10 equal segments of 6.66 ms. Since we only need eight segments, the

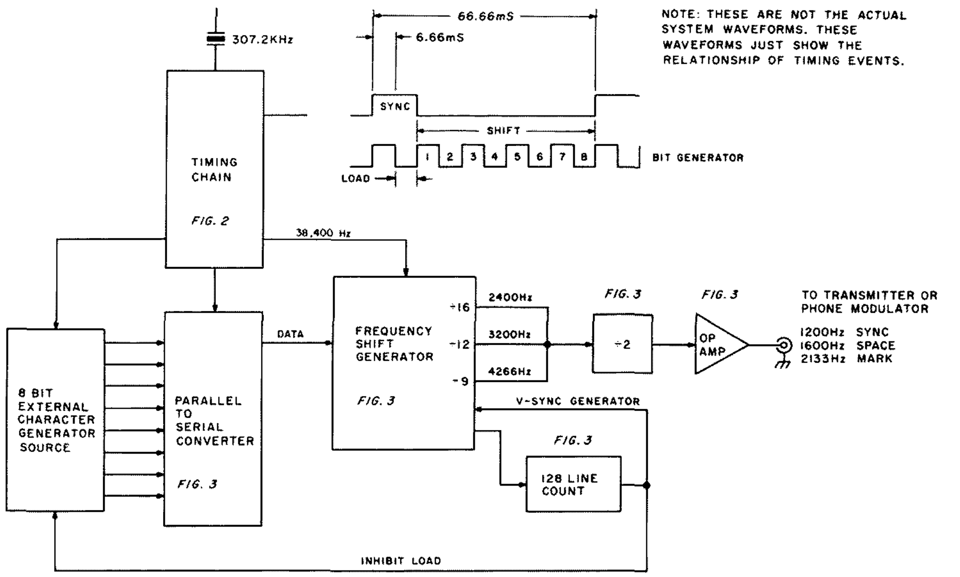


Fig. 1. Overview of the transmitting system.

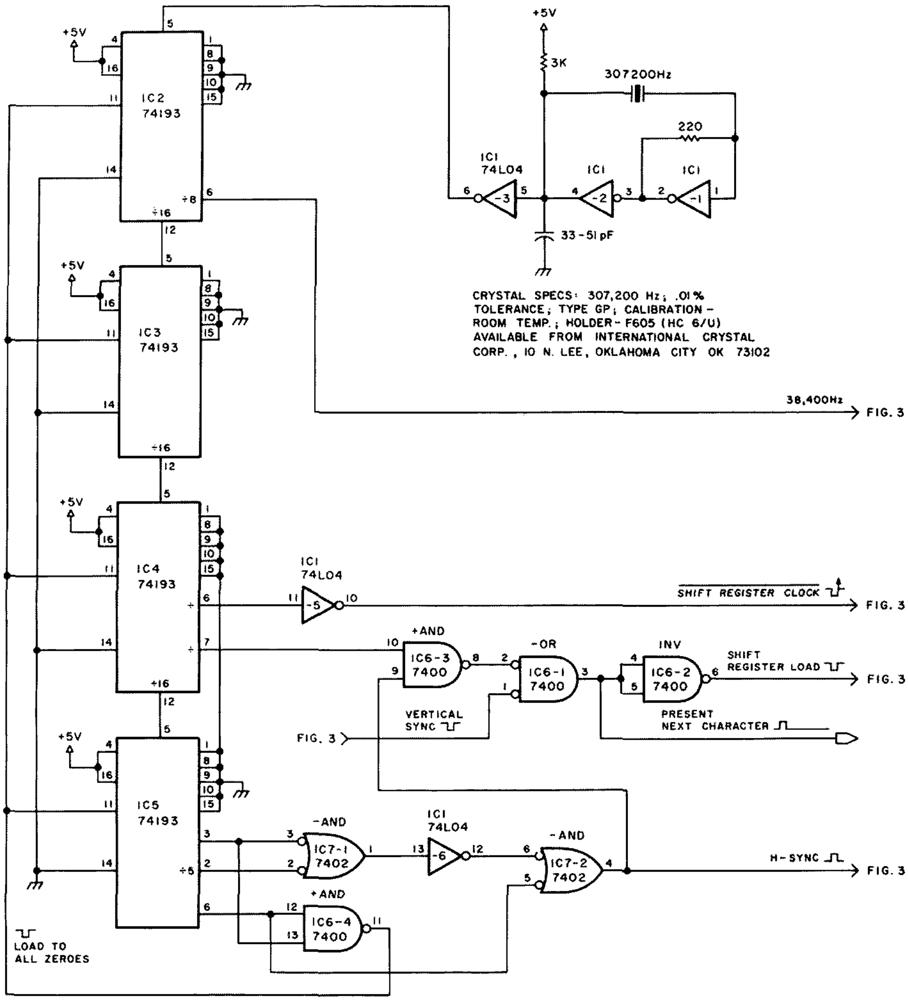


Fig. 2. Transmitter bit-timing chain.

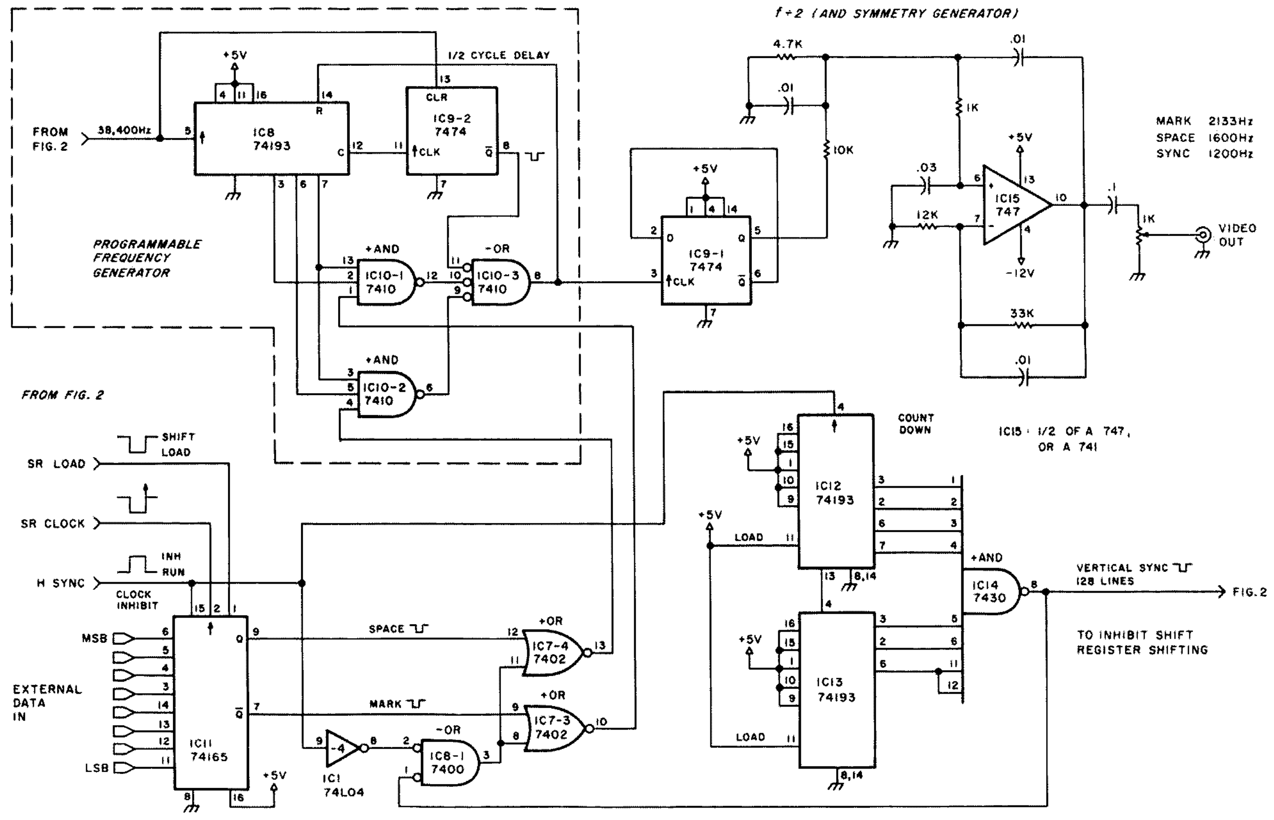


Fig. 3. Transmitter signal and V-sync generator.

other two (13.33 ms) will be used for sync.

Here's How It Was Done

Instead of the usual point-by-point logical description, which is an excellent cure for insomnia, I'm going to describe logical functions. The functional diagram will show notes as to which detailed logic blocks are included in each function.

IC1 (Fig. 2) is a free-running 307,200 Hz crystal oscillator, and is the basic timing source for the transmitter. IC1 drives a complex countdown timing chain consisting of IC2-IC5. An output at 38,400 Hz is used to drive a programmable frequency generator IC8, IC9, and IC10 (Fig. 3). The timing for this function is shown in Fig. 4. The output frequencies of this generator are divided by 2 by IC9 to provide a symmetrical output signal at 2,133 Hz for mark, 1600 Hz for space, and 1200 Hz for sync. IC15 is a bandpass output amplifier/driver with a cutoff of about 3.0 Hz.

Another pair of outputs, described by timing waveform rather than frequency, are obtained from IC4 and IC5 to provide the bit timing logic signals for the parallel-to-serial converter.

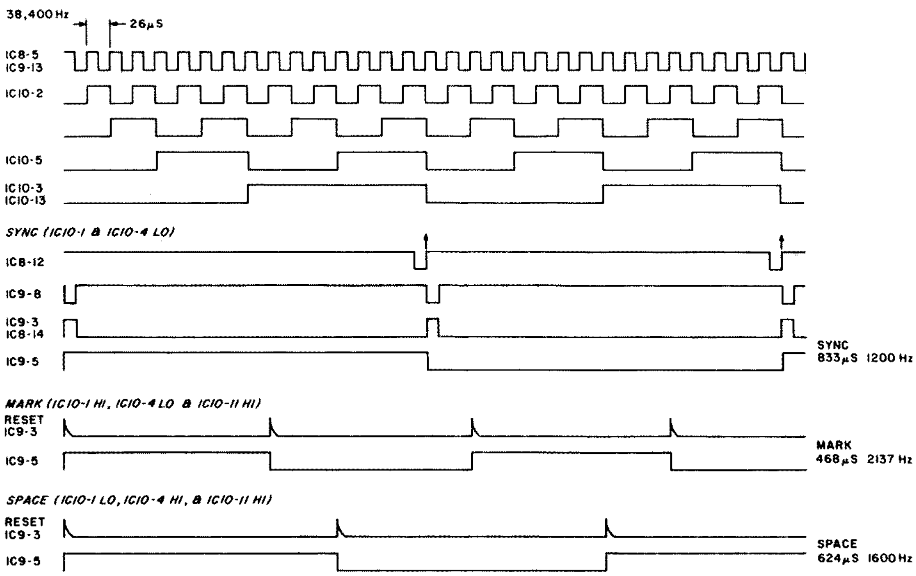


Fig. 4. Programmable frequency generator waveforms.

Signal Conversion and Frame Definition Logic

Control of the timing chain is based upon a 66.67 ms line and an 8 second, 128 line frame. Let us refer to a typical line sequence and its significant timing points (Fig. 5) and line events. The sequence is as follows:

1. Horizontal (H-sync) begins.
2. The parallel-to-serial shift register is loaded, but not shifted out.
3. H-sync ends.

4a. Signals are shifted out of the parallel-to-serial shift register. These serial signals are applied to the variable-count timing gen-

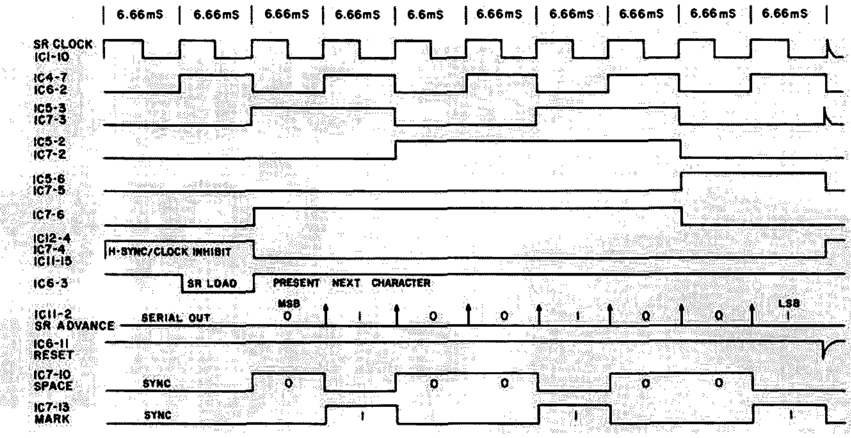


Fig. 5. Significant transmitter timing waveforms.

erator (IC8-10) to generate an FSK FM signal.

4b. While signals are being shifted out, a control line is made active to the external source to present the next character. Vertical sync (V-sync) is generated when IC7 pin 10 (Fig. 3) is held low by IC14 pin 8. This causes a continuous sync frequency of 1200 Hz to be transmitted. Pin 10 is allowed to go low for 67 ms to generate a V-sync pulse. At the beginning of each line, IC12 and IC13 are decremented. When 128 countdowns are reached, IC14 provides a negative pulse to IC7 pin 10 (through IC8) and a vertical-sync pulse is generated. During V-sync time, IC11 is held in a load state. Its bits are not shifted out until the beginning of line 1.

Test Configuration (Fig. 6)

In order to test the system, a binary pattern consisting of ASCII characters @A-O was generated by temporarily connecting the vertical line counter, IC12, to the low-order data input bits of IC11. The high-order bits of IC11 are fixed at 0100. Thus, the repetitive pattern shown in Fig. 7 consists of:

0100	0000
0100	0001
.	.
.	.
.	.
.	.
0100	1110
0100	1111
0100	0000

The FSK output (Fig. 7) was tested by viewing it on a standard SSTV monitor, recording it on an audio cassette, and then playing it back through the same SSTV monitor. This was done in order to ascertain whether the bit time lengths were sufficient to accommodate variations in tape recorder speeds.

Modifying the Original Design

After using Quad-S for a time, it became apparent that certain changes could be made to the hardware that might make it possible to use a UART at a later date. Also, changes to the format of the frame could be made to make it easier for the receiving station, including the FCC, to determine the nature of the data being sent.

By Quad-S line definition, we will always send a fixed line format of 10 bits that will be designated as shown in Fig. 7. In order to make it easier to detect errors when data is received, the data is put together in a manner so as to be self-checking. In other words, one part of the data is used

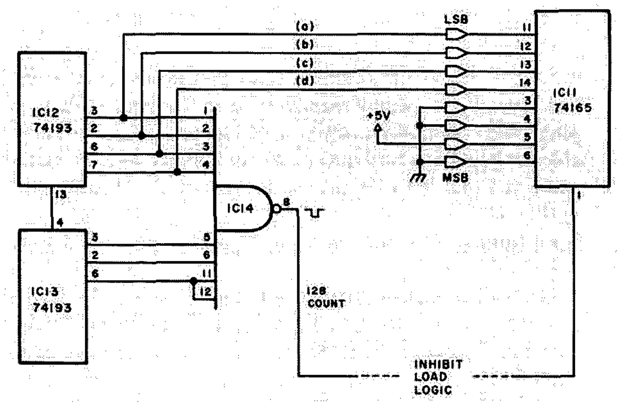


Fig. 6. Test generation hardware configuration.

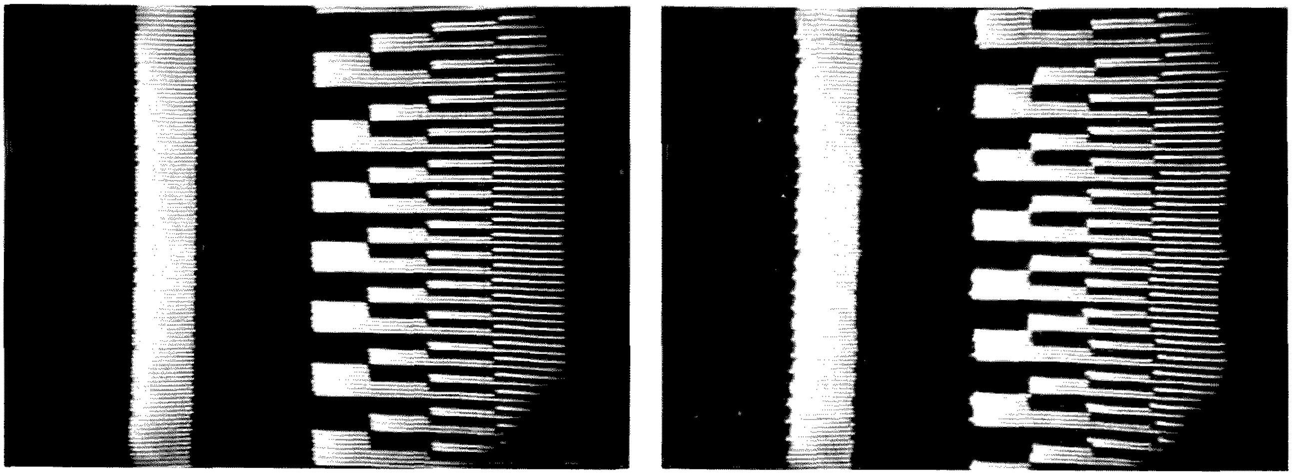


Fig. 7. FSK output as viewed on an SSTV monitor. Photo at left shows Quad-S transmitter output to cassette tape input. Photo at right was produced from cassette tape output. Both photos show SSTV FSK uppercase ASCII @A-O (40-4f hex.).

to check the other part. There are many ways to do this; one easy way is the parity method. Error detection via parity states simply that the sum of all "1" bits (bits at the "1" level) in a word must *always* be either even or odd (see Fig. 9). Even is defined as 0, 2, 4, 6, or 8 bits. Odd is defined as 1, 3, 5, 7, or 9 bits. The choice of even or odd parity may appear to be optional, but odd parity is actually the better choice for the following important reason: If no bits are received, this would be equal to a bit sum of 0—even. Even parity demands that the sum of all "1" bits, including the parity bit, be even. 0 bits *is* even and is also an error condition which would pass the test for good data. Odd parity, on the other hand, demands that the sum of all "1" bits, including the parity bit, be odd; 0 bits is even and therefore is an error condition that would always be detected. How do you make the *sum* of all bits which are sent odd? Refer to Fig. 9. Notice that if the sum of all bits, not including the parity bit, is even, uppercase ASCII letter "A" for example, then the parity bit is turned on to make the sum odd. Conversely, if this sum is already odd, uppercase ASCII letter "J" for example, then the parity bit is left in the off condition to retain an odd sum. Thus the sum of all "1" bits in a word is always odd for odd parity. The sender must generate this parity bit through the use of either hardware (74180 module), or by programming, if a microprocessor is used. The other important hardware specification is that the lsb (*l*east *s*ignificant *b*it) will immediately follow the sync bit on each line. If there are only 7 bits, as in ASCII, then the lsb will follow the sync bit and there will be 1 bit position open (usually forced to zero) just before the parity bit. This line format is shown in Fig. 8.

These changes will, of course, require some method of frame format

GENERAL LINE FORMAT	HOR SYNC (1200Hz)	LSB DATA	LSB +1	LSB +2	LSB +3	MSB -3	MSB -2	MSB -1	MSB DATA	PARITY	
UPPER CASE ASCII A	HOR SYNC (1200Hz)	1	0	0	0	0	0	1	0	1	3 BITS (ODD)
UPPER CASE ASCII J	HOR SYNC (1200Hz)	0	1	0	1	0	0	1	0	0	3 BITS (ODD)
VERTICAL SYNC	VERTICAL SYNC 1200Hz FOR ONE ENTIRE LINE										

Fig. 8. Quad-S line formats.

VERTICAL SYNC ALWAYS PRECEEDS HEADER LINE	VERTICAL SYNC 1200Hz FOR ONE ENTIRE LINE										
FRAME HEADER LINE	HOR SYNC	ACK	LSB COUNT	LSB +1	LSB +2	LSB +3	MSB -2	MSB -1	MSB COUNT	PARITY	
LINE COUNT =19	HOR SYNC	0	1	1	0	0	1	0	0	0	3 BITS (ODD)
LINE COUNT =15	HOR SYNC	0	1	1	1	1	0	0	0	1	5 BITS (ODD)
ACKNOWLEDGE TRANSMISSION ACCEPTED	HOR SYNC	1	0	0	0	0	0	0	0	0	1 BIT (ODD)
ACKNOWLEDGE TRANSMISSION REJECTED	HOR SYNC	0	0	0	0	0	0	0	0	1	1 BIT (ODD)

Fig. 9. Quad-S header formats for both transmission and acknowledgement.

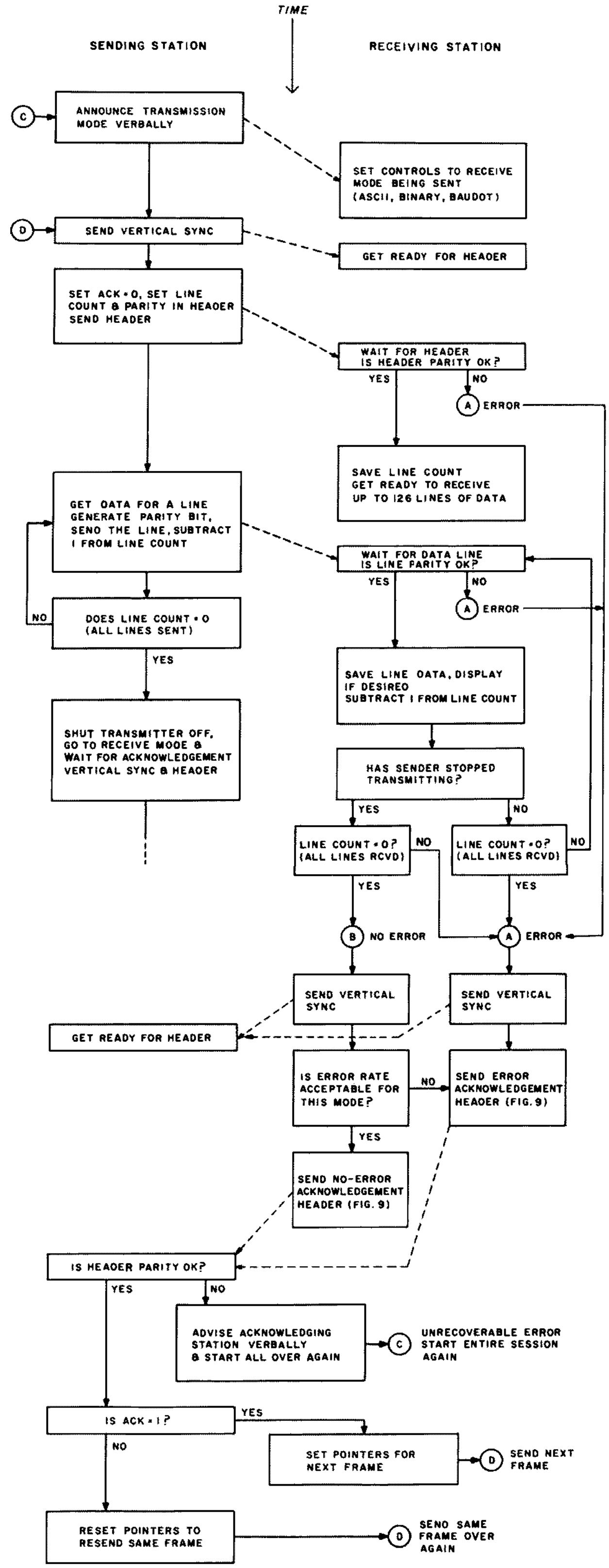


Fig. 10. Suggested Quad-S handshaking sequence for header, data, and acknowledgement.

designation to convey to the receiving station what length code we are sending, and some indication of the number of lines that are to be sent, or when the last line has been sent. This is necessary for the receiving station to properly interpret the data being received. It must know the number of significant bits in each line being received—for example, 5-bit Baudot, 7-bit ASCII, or 8-bit binary. In practice, this information need be conveyed to the receiving station only once before the start of any session, or when the mode is being changed. This information can be sent orally or included in each frame. The receiving station must also know the total number of lines to be sent, or have some indication of the last line, in order to determine, for error-checking purposes, if all of the data has been received. The "end" designator method, unfortunately, does not indicate a line count to the receiver, so missing lines could go undetected. The method that I prefer, due to its simplicity, is a verbal announcement of the mode before starting the session, and including a header line indicating a line count as shown in Fig. 9. This header is easy for the receiver to locate, since it is always sent immediately following a vertical sync pulse frame separator. The line count must be in the range of 1 to 126 (it does not include the vertical sync or header line). This is a count only of the data lines that follow the header line. Notice that in the header, the bit immediately following the horizontal sync bit is called ack (Fig. 9).

Fig. 10 shows a typical data transfer sequence. Note that when the receiving station gets the entire transmission, determined by the header line count, it counts the number of errors (bad lines or missing lines), and if this number is less than the error rate suggested for the particular mode (0% for binary, and up to 20% for Baudot or ASCII), then the receiving station transmits back to the sending station a positive acknowledgement. This is done by sending a vertical sync pulse followed by a header with ack = 1 and line count = 0 (Fig. 9).

This probably should be repeated a few times in case of off-tune conditions. If the error rate is determined to exceed the suggested values, then the header sent back should have ack = 0. When this occurs, the sending (originating) station can retransmit the data. Fig. 10 shows a typical sequence.

I am presenting these "handshaking" conventions primarily because they are simple and easy to implement. I would hope that further improvements could be made as the Quad-S mode of communication becomes more widely used.

Conclusion

I have described what Quad-S is, and detailed how it works. Now, here is why I think that it's better than the regular start/stop code:

1. Quad-S has an unambiguous sync pulse to indicate the start of a character.
2. Quad-S provides crystal-controlled mark and space signals.
3. Quad-S signals can be visibly debugged using a standard SSTV monitor.

It is my hope that the material presented in this article will provide a foundation upon which to build more sophisticated and reliable communications systems. ■

Brew Up a Beam for Two

—double-barreled design

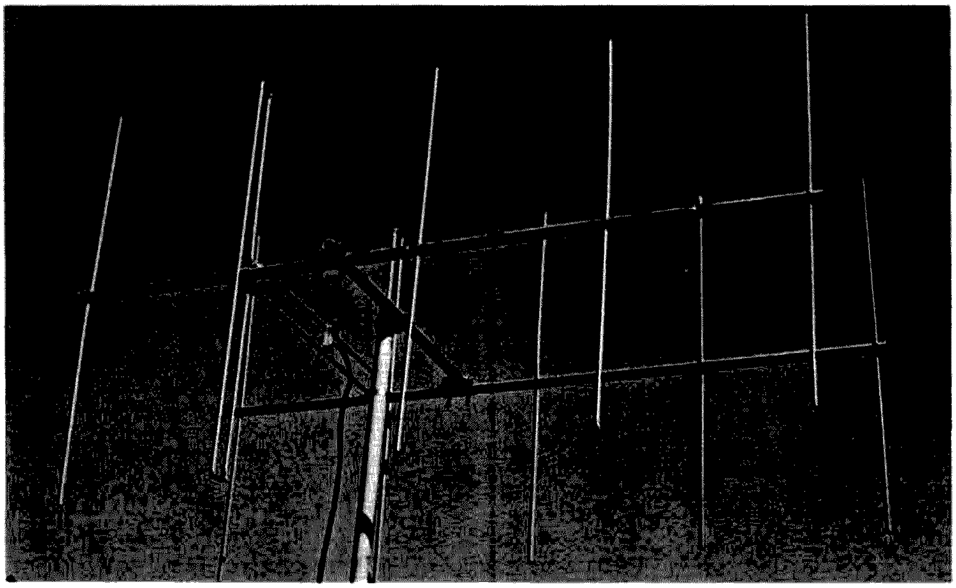
Just what you've been looking for.

Glenn Crowe VE3BSM
RR #5
Wallaceburg, Ontario
Canada N8A 4L2

Here is the 2 meter beam you have been looking for. It has the gain, directivity, and simplicity that put it in a class by itself. No cut and try, no tuning, it has a 300-Ohm feedpoint, or you can use 50-Ohm cable with the balun at feedpoint with the same low swr. The pattern is such that there is one lobe in front with no other side lobes.

It was rugged enough to stand 3 inches of ice with no ill effects during last winter's ice storm. There are many of these in use in this area. I have two pairs of these up at 50 feet, the top pair vertical, and 40 inches below, another pair horizontal. With my IC-22 I have worked a great many DX stations on 2 meters in the last five years. In this area, there are many repeaters and many on the same frequency, so it is important to be able to work the one you want and not bother the others.

Photo by Elmer Hamilton



I recently made checks with the antenna you see in the picture, taken in Sarina, Ontario, 35 miles away at the VE3SM QTH. It is up 38 feet, and the front lobe read 20 over 9; the ends of the elements on me were S1 while the back was S4, so that would make the gain about 30 dB. Stan is using an IC-22S with 10 Watts out.

Ordinary hand tools are all you need to make it up. Use plated bolts and nuts, and aluminum for the brackets. The U-bolts are from Radio Shack, and the booms and elements are from old TV antennas. The cross boom is ¾-inch aluminum conduit. The insulators are ¼-inch clear plastic. I use Belden

feedline UHF no. 9085. It has low loss even when wet, and I put the balun at the transceiver. It is quite broadband with the center at 146.52 and works either lower or higher with very little difference in swr.

I have a similar pair of 4-element beams that I take camping with me, with four sections of masting that go together with thumbscrews. It all goes in the trunk of my car. They, too, give me excellent coverage on the 2 meter band. So spend a few hours and get one together; you'll like it. ■

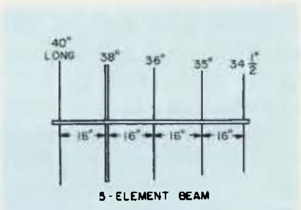


Fig. 1. The 5-element beam (2 required) with about 13 dB gain.

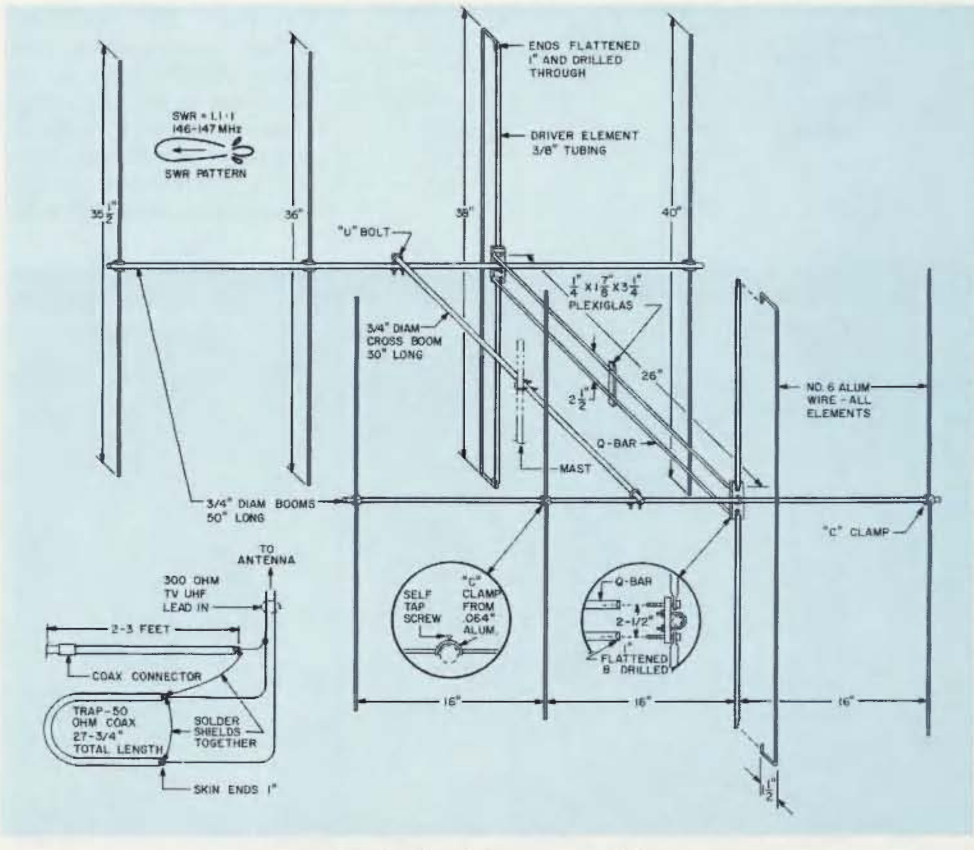


Fig. 2. The 4-element model.

R. J. Bosen
Box 93
Magna UT 84044

Keyboard Serialization

—when parallel isn't enough

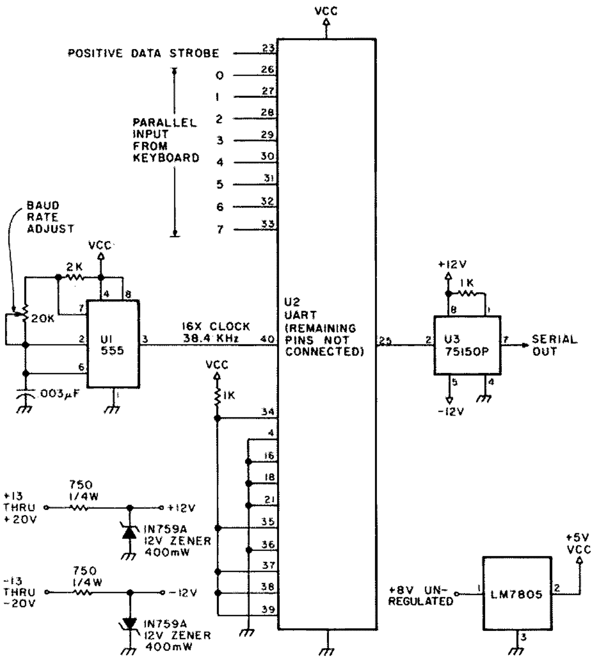


Fig. 1.

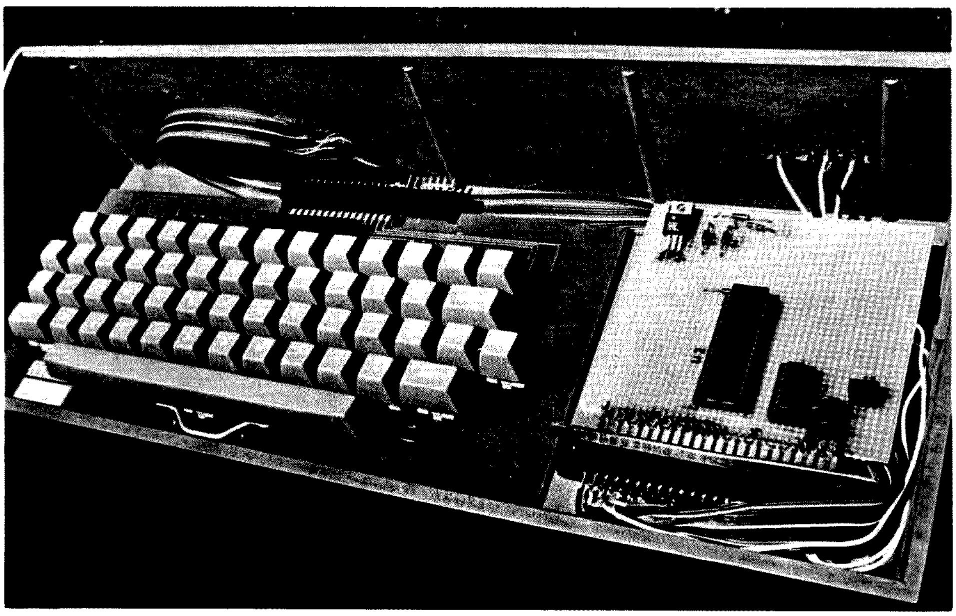
Here's a project that you can throw together with three chips and that you will find useful if you have more serial input ports than parallel ones. It will also solve a few software hassles for you if you've been feeding your VDM or TV typewriter with parallel bytes because programmers always seem to expect you to do it serially.

When I found myself with those two minor problems, I decided to build a simple parallel-to-serial converter to take advantage of an unused serial input port. The resulting project was finished that same evening at a cost of about ten bucks, including connectors, wire, solder, and parts. I think this project is simple and useful enough that a lot of hobbyists may want to use it to break into hardware. I think you'll find it painless.

Take a look at the schematic in Fig. 1. As you see it, this is a minimum implementation which could be complicated quite a bit. For the purposes of this article, I decided to eliminate everything but the bare necessities and leave the fun of designing frills like repeat keys, flashing lights, and spelling corrections up to you. The values on components are pretty flexible, but, as shown, will work at 2400 baud quite nicely. For a detailed understanding of the circuit, it's probably better for you to look up the individual chips in a manufacturer's catalog than for me to take up space for the simple theory here.

When you get the circuit built, you will have to hook it up to a power supply providing +18 to +20 and −18 to −20 volts, and adjust the pot for the desired baud rate. If you don't have a scope, you can do it by the trial and error method, but don't be too disappointed if you don't finish the same day you start out! The RS232 level output is what most serial input ports expect, but verify this step before hooking it up. If you want some other kind of output level, a different chip will have to be chosen for U3.

That about does it! Now . . . let's see what we can do with that spare parallel input port . . . ■



Larry Nickel W3QG
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Ignition Noise and 2m FM

—one ham's cure

Peace and quiet come to the 280Z.

Recent frustrations with radio noise prompted me to write this article. After purchasing my 1976 280Z, I set about installing a 2 meter FM transceiver. Upon completion, it was observed that a great deal of noise was picked up when the engine was running (except when receiving the strongest of local stations). The intensity and frequency of these noise pulses are directly proportional to engine speed. Since resistance-type spark plug wire has been used in the engine compartment, and reception on the Z's AM-FM radio is clean, you'd hardly expect such a problem, especially since FM reception has a natural noise rejection advantage over standard AM. Regardless, the noise persists!

I began by performing some basic cures. Using short lengths of ½-inch tinned copper braid, the engine was grounded to the body, the tailpipe to the body, and the hood to the body. No help! Next, the coil primary and alternator were treated with filter capacitors. Again, no help. Perhaps the noise could still be coming in through the dc supply line from the car's battery. The radio was then powered by a separate battery. This did not help. Evidently, the noise is radiated through the air from ignition to radio rather than conducted by the dc line. Now a small portable AM radio was used as a detector to sweep over suspected areas such as under the dash, front car exterior, rear car exterior, under the hood, etc. As suspected, the predominant noise source is under the hood. When the hood is closed, noise even leaks through the seams where the hood meets the fenders (and also through the grill and out under the engine).

At this point, I chanced upon an article by the spark plug engineers at GM (AC). It compared various techniques such as resistance plugs, resistance wire, inductance wire, complete ignition shielding, etc. I decided to use resistance plugs in addition to the resistance wire already in the 280Z. Installation of AC plugs (R43XLS) reduced noise somewhat. The combination of resistance plugs and wire does reduce spark slightly, and it is important to keep plugs clean and properly gapped and to check the ignition wire periodically. Otherwise, some missing may be experienced at high RPMs.

The final episode: A friend of mine told me about a certain brand of inductance wire stocked at a nearby store. Information from GM (AC) indicated that improvement would be slight. I bought a model 12-72 ignition wire kit made by C. E. Niehoff & Co. (4925 Lawrence Ave., Chicago, Illinois 60630). They don't make a set for the Z but the 12-72, a V-8 set, can be used. Since the coil wire is too short, a leftover long plug wire had to be substituted. I carefully removed the metal clips from the short wire, cut the long wire about 1½ inches longer than necessary, and, with a knife, ¾ of an inch of insulation was stripped from each end. The center conductor was folded back alongside the rubber insulation. The metal clips were crimped on, and the excess center conductor was removed.

With the R43XLS plugs and the inductive wire, noise has been virtually eliminated in the 2m FM rig (perhaps resistance plugs are no longer necessary). An HF rig, which is AM, may still pick up some noise with this modification, but there should still be a substantial improvement. Let me know how you make out. ■

An 8080 Repeater Control System

—part II: hardware

You're on your way.

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Randallstown MD 21133

The control system is built on a 19-inch rack panel. The touchtone™ decoder and power supply are on the rear of the panel. The tape loop, amplifiers, touchtone pad, and main board are on the front of the panel. The main board is a Vector #169P84-062WE 8½- × 17-inch board. The circuitry is assembled using wire-wrap techniques. I recommend the Vector battery-operated Slit-N-Wrap tool. This permits daisy-chaining connections and is invaluable when wiring buses. Discrete components are mounted using Vector T49 pins. The parts are soldered on the top, and the connections are wire-wrapped on the bottom. The board layout is shown in Fig. 1. The circles in the center of the board are LEDs. The relays are on the right side, and LEDs in series with the relay coils are mounted adjacent to the relays. The oblong objects are printed-circuit-board-mount miniature potentiometers. The left half of the board consists of the microprocessor components. Since the board is built with wire-wrap, most sensible layout arrangements will work, but I present my layout to save you from the head-scratching I did in deciding upon an arrangement.

Every connection to the main board is through standard DIP plugs. This permits wire-wrapping to the connectors on the board. Each of the connectors is 16-pin (except the power connector, which is 14-pin). Fig. 3 gives the pinouts. The dummy sockets permit the repeaters to be placed on the air for testing with no control system.

Bypass capacitors (.1 uF) are placed liberally on the power supply lines. At the power supply connector, 100-uF capacitors are placed on each voltage.

Circuit Description

The hardware consists of

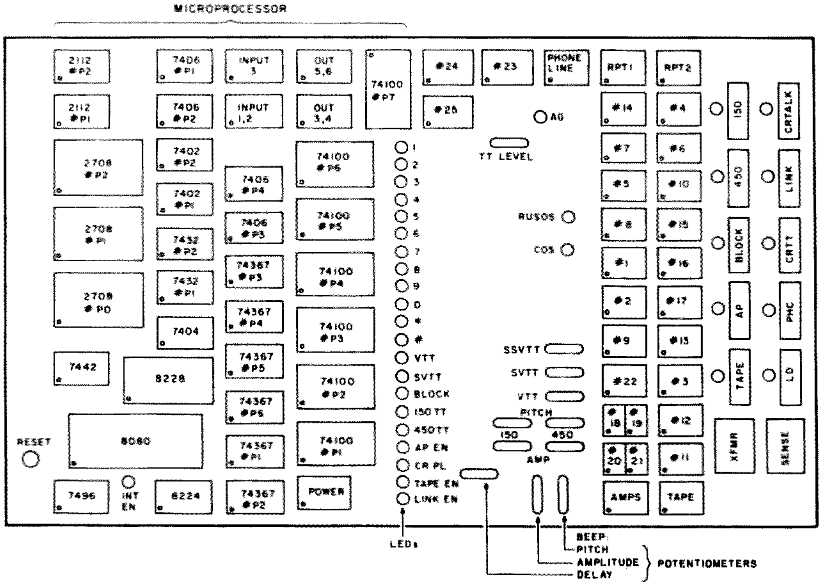
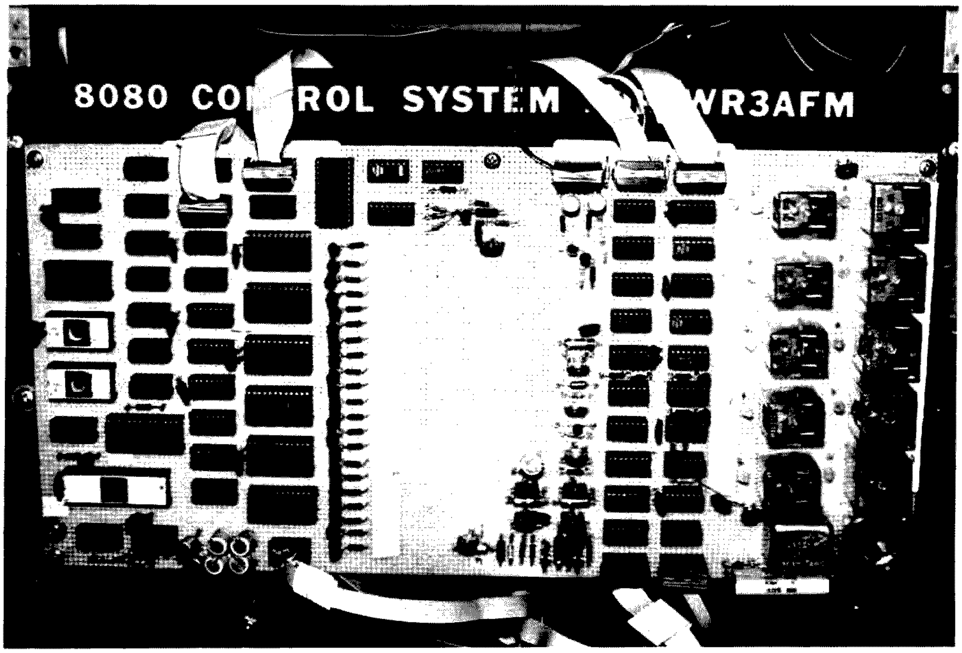


Fig. 1. Board layout.

1—7474
2—7474
3—7420
4—7410
5—7408
6—7427
7—7432
8—7402
9—7400
#10—7400
#11—7493
#12—7473
#13—7404
#14—7404
#15—7407
#16—7407
#17—7406
#18—555
#19—555
#20—555
#21—555
#22—CD4050
#23—7405
#24—7473
#25—MC14410

Fig. 2. IC list.



Close-up of processor board. The empty socket on the left is for a third ROM.

two sections: the processor and related circuitry, and circuitry external to the processor which accomplishes audio and control path switching as well as interfacing to the repeater.

To understand how the system operates, examine the path flow diagram in Fig. 4. All of the switches shown are relays in their relaxed position. There are two types of signals: audio pairs, which are shown as one line only, and dc control lines. Relays are used for switching the audio lines and some control lines. Solid-state replacements could be made, but there is nothing easier to interface than switched contacts. Using relays also prevents many problems due to possible idiosyncrasies of audio balancing, impedances, and levels of different repeaters. (I admit that it does hurt to use the ancient relay.) The feed from each transmitter control shelf passes through the repeater enable relay to the PTT line. The feeds are grounded during IDs. The 150 and 450 relays, when activated, positively isolate the PTT lines and prevent the transmitters from keying. If the LINK relay is closed, the two transmitter feeds are shorted, ensuring that both transmitters are activated simultaneously. The audio pairs are shorted together as well, placing the same audio on both transmitters. When the BLOCK relay is energized, the 150 transmit audio is shorted out. This relay is activated to prevent repeating touchtones.

In normal operation, the CRTALK relay is relaxed. In this condition, the audio and COS lines from the voter are passed to the 150 control shelf. The COS lead goes out to the control circuitry and returns to the control shelf. When the CRTALK relay is activated, the voter is removed from the system and is replaced with the control receiver. When the CRTALK relay follows the control receiver COS, the end result is that the control receiver is given priority over the two meter inputs to the repeater. When voltage is placed on the audio gate line to the control shelf, any audio present on the duplex audio input goes to

Input 1,2 (touchtone decoder):
1—digit 1
2—digit 2
3—digit 3
4—digit 4
5—digit 5
6—digit 6
7—digit 7
8—digit 8
9—digit 9
10—digit 0
11—digit *
12—digit #
13—VTT (valid touchtone)
14—Ground

Power Supply:
1—Ground
3—Ground
5— +5
7— −5
9— +12
11— −12
13— +18
15— −18

Phone Line:
1—Tip
3—Ring

Tape:
1—Start
3—Start
5—Run
7—Run
9—Audio low
11—Audio high

Amplifiers:
1—LDI in
2—LDI in
3—LDI out
4—LDI out
5—LDO in
6—LDO in
7—LDO out
8—LDO out
9—TT in
10—TT in
16—Ground

Out 5,6 (voter):
1—Disable Rx #1
2—Disable Rx #2
3—Disable Rx #3
4—Disable Rx #4
5—Disable Rx #5
6—Disable Rx #6
7—Disable Rx #7
8—Disable Rx #8
9—Select Rx #1
10—Select Rx #2
11—Select Rx #3
12—Select Rx #4
13—Select Rx #5
14—Select Rx #6
15—Select Rx #7
16—Select Rx #8

RPT1 (dc lines):
1—150 feed
2—440 feed
3—150 PTT
4—440 PTT
5—Voter $\overline{COS}$
6—Control rx $\overline{COS}$
7—Control shelf $\overline{COS}$
8—RUSOS
9—AG (audio gate)
10—Control Rx PL enable
11—Link (from 440 rpt)
12—Disable timer
13—Force timer
16—Ground

RPT2 (audio):
1—Voter aud
2—Voter aud
3—Control rx aud
4—Control rx aud
5—Control shelf aud
6—Control shelf aud
7—Duplex aud
8—Duplex aud
9—150 ID aud
10—440 ID aud
11—440 transmit aud
12—440 transmit aud
13—150 transmit aud
14—150 transmit aud
16—Ground

Dummy Socket for RPT1:
1—3
2—4
5—7

Dummy Socket for RPT2:
1—5
2—6

Fig. 3. Connector pinouts.

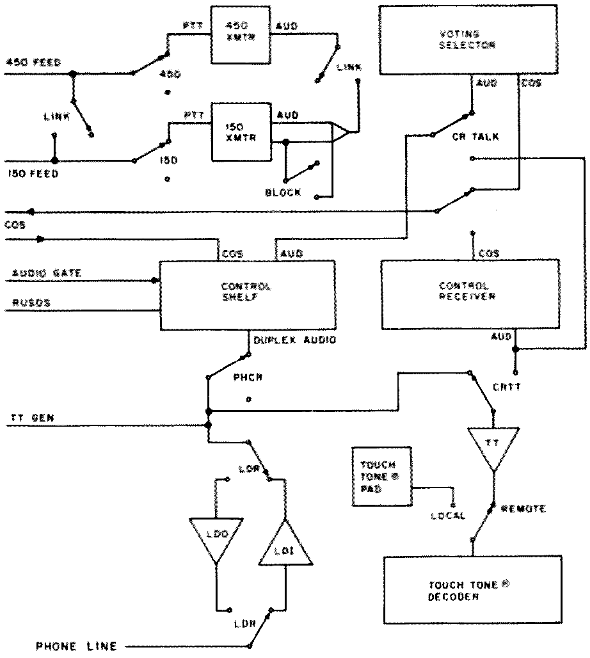


Fig. 4. System flow diagram.

the transmitter. When the RUSOS lead is grounded, the transmitter remains on the air.

Next, consider the path to the telephone line. LDR (line direction relay) determines whether audio is being fed into the line or taken from it. Normally, LDR follows the COS signal. When no received signals are present, LDR is off and audio from the telephone line goes into the system. During autopatches, this places the party on the telephone on the air. When the COS goes low, LDR activates and the audio coming from the duplex audio output goes into the phone line. During autopatches, this permits the party on the telephone to hear the transmitting station. The audio fed into the control shelf on the AUD lines comes out on the duplex audio pair when the audio gate is not enabled.

With the local/remote switch in the local position, the touchtone decoder is driven solely by the on-site pad. When placed in the remote position, the touchtone amplifier drives the decoder. If CRTT (control receiver touchtone) is relaxed, the decoder is fed from the duplex audio pair or the telephone line. The path for two meter users is through the duplex audio pair, and for control operators on the telephone line it comes from that source. If PHCR (phone control relay) is activated, the two meter input is isolated from the decoder. If CRTT is on, the control receiver has absolute command over the decoder. From this arrangement, it can be seen that the hierarchy of control access is the control receiver at the highest priority, the telephone next, and the two meter input last. By controlling the logic driving the relays, any of these modes of access to the decoder may be precluded. The touchtone generator injects audio at a point where it can drive both the telephone line and the repeater. The latter permits hearing the processor dialing users' numbers. It consequently also drives the decoder, which is not of any particular importance except that it allows the locally generated tones to be blocked from repeating. It may seem that placing tones on the repeater while at the same time blocking them is a silly procedure. However, the end result is that you hear short blips of tones, pleasing to the ear.

Due to the arrangement of the switching paths, level adjustments must be made in the following order:

1) The audio from the control receiver and the voter must be equalized. Place a meter at the output of the decoder amplifier. Adjust the audio output of the control receiver so that equal tone deviation on the two meter input and the control input results.

2) Adjust the gain of the touchtone amplifier for the required input for your decoder. For the decoder specified, this is about two volts rms.

3) Adjust the gain of the LDI (LD input) amplifier so that tones arriving from the telephone line are of equal amplitude with the other two inputs at the decoder.

4) Adjust the LINE IN control on the control shelf so that proper deviation results when talking through the repeater from the phone line.

5) Adjust the gain of the LDO (LD output) amplifier to the required level of your telephone line interface when talking on two meters.

6) Adjust the output level of the touchtone generator for the required level at the telephone line.

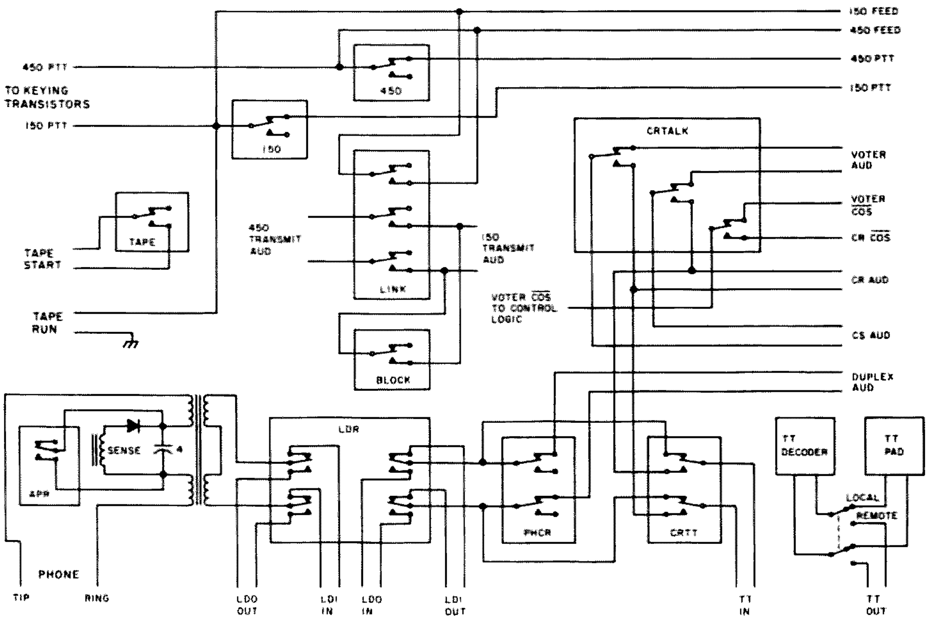


Fig. 5. Relay switching.

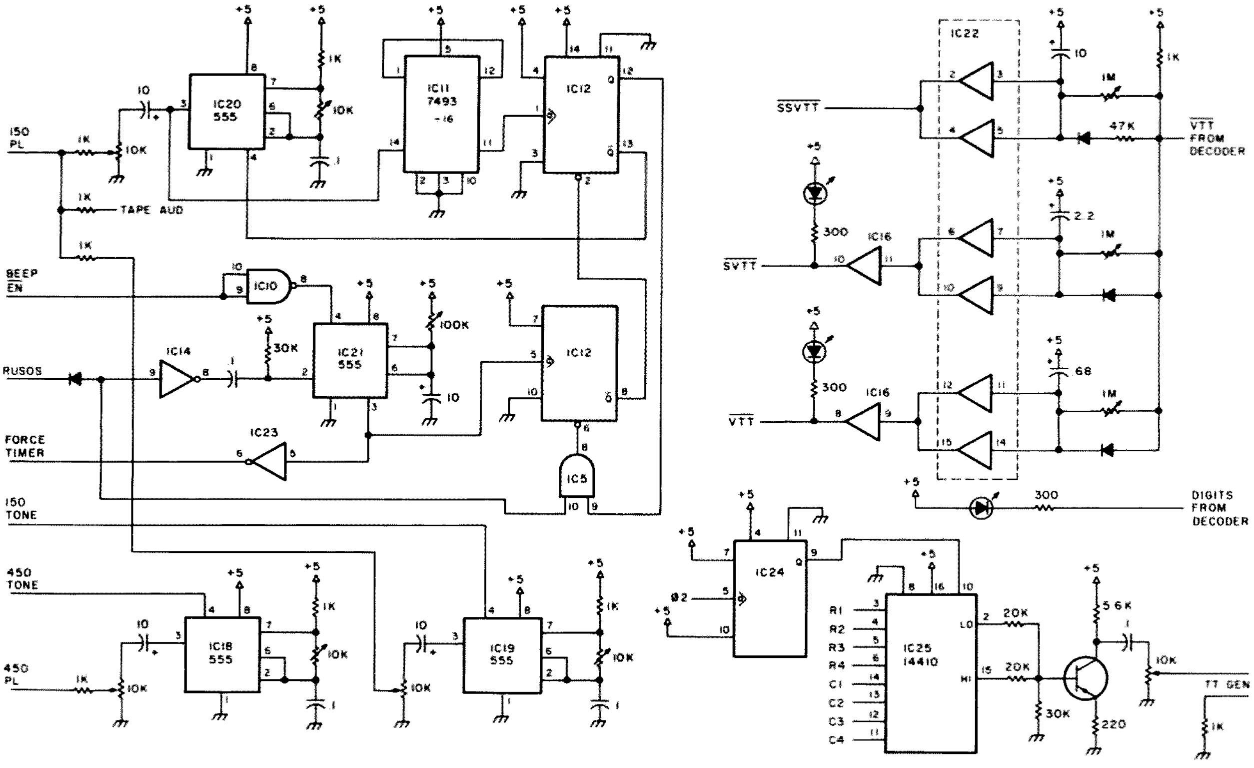


Fig. 6. Audio circuits.

Fig. 5 shows the relay and autopatch connections. Most of the lines go to connectors defined in Fig. 3. The PTT lines from the keying transistors and the voter COS to the control logic are picked up in Fig. 7. The TAPE relay pulses to activate the tape loop. A shorted pair is available from the tape loop while the tape is running and is connected at TAPE RUN. The relay wiring should be self-explanatory.

The autopatch interface circuitry may need to be modified to fit a particular coupler. The line transformer isolates the telephone equipment from the repeater circuitry. A suitable transformer is made for the MASTR line and is available from General Electric (part number 19A116736P1). During an autopatch, APR (autopatch relay) is closed. In our system, the line current is sensed at the other end, and the dial tone is requested. If a coupler is installed at the repeater site, APR may be directly connected to the coupler to request a dial tone. The SENSE relay is a sensitive relay which detects the dc line current. In our system, there is always current present in the line. A quick measurement of line current at the other end ensures the integrity of the line. When an incoming call is made, the line current is reversed. The diode in series with the SENSE relay distinguishes the difference between an idle condition and an incoming call. The SENSE contacts are normally closed and open when an incoming call is made. The contacts remain open until the line is disconnected. This relay is necessary to determine who initiates a call. If a call is initiated from the telephone line, a control access is assumed and PHCR activates. A telephone coupler at the repeater site simplifies some of the circuitry. Any contact pair which opens when the line is in use may be used in place of the SENSE relay, because suitable gating is provided in the control logic to produce the logical equivalent to our system.

The audio circuits are shown in Fig. 6. There are two separate oscillators for the 150 and 440 CW identifier tones. ICs 18 and 19 are simple 555 oscillators. They each have tone and amplitude controls. Pin 4 is the keying input; the 150 tone and 450 tone lines come from the processor output ports. ICs 11, 12, 20, and 21 generate the "beep" tone. Perhaps this is too elaborate an arrangement for such a simple function, but it does provide a distinctive, pleasing sound. It is best described as the "bounce" sound in TV Pong games. It is noticeable, but not objectionable. When the RUSOS lead goes from low to high (carrier release), IC21, a one-shot, fires. The time delay is adjustable and is nominally half of a second. When the pulse falls, IC12 is triggered, placing a low on pin 8. This clears the other half of IC12, putting a high on pin 13, enabling the oscillator, and clearing the first half of IC12. IC20 oscillates and generates the tone. The pitch is variable, and a variety of sounds can be formed by adjustment. The pulses are counted by IC11. At the fall of the sixteenth pulse, the top half of IC12 is set, the oscillator is turned off, and all returns to the rest condition. All of this generates exactly sixteen pulses shortly after the carrier release, providing the "beep" sound. The beep, ID, and tape audio are summed and fed to the transmitter. While IC21 is high, the repeater timeout timer is tricked into believing that the signal is still present. If the user does not wait for the "beep," then the timer is not reset because of the overlapping

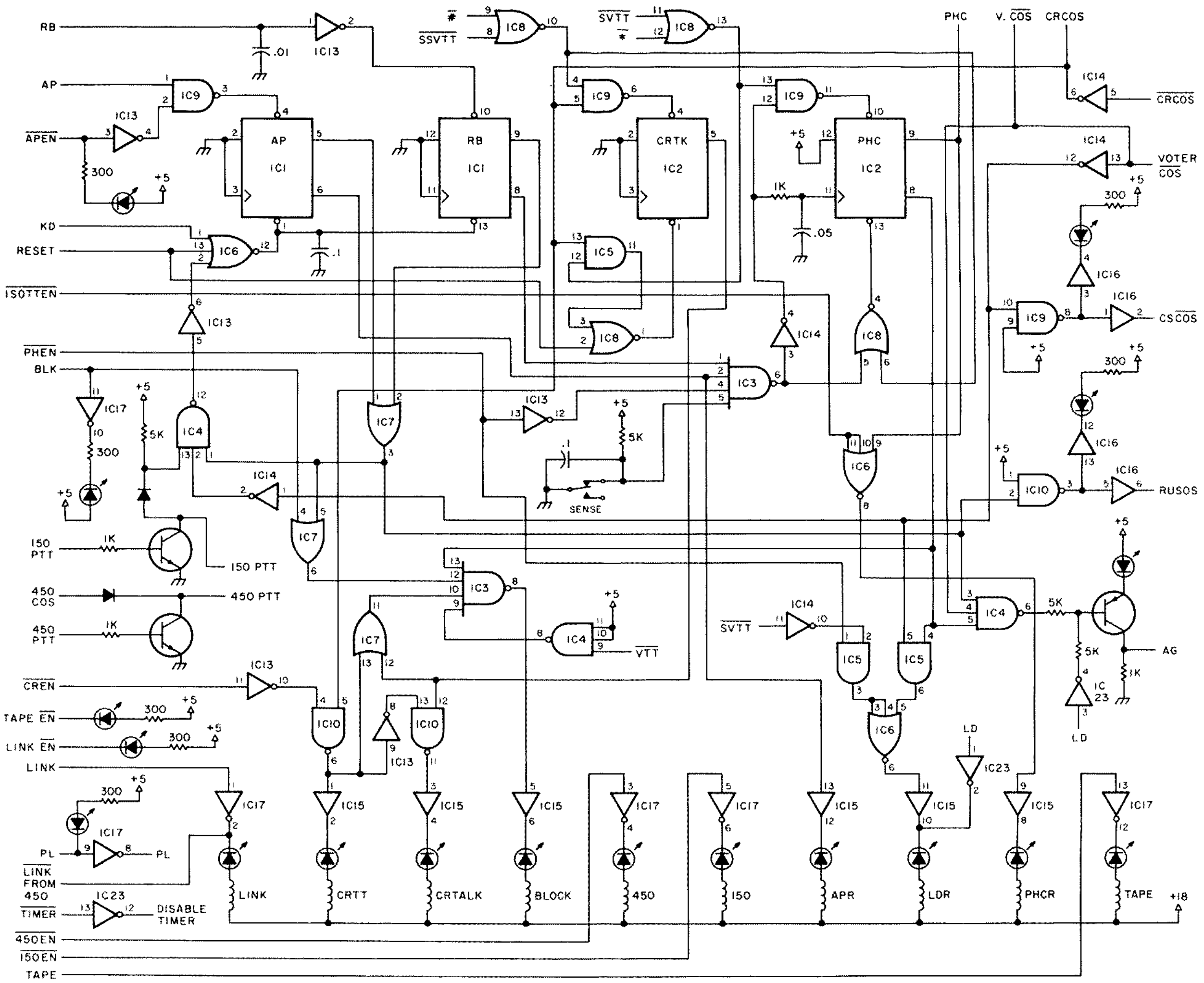
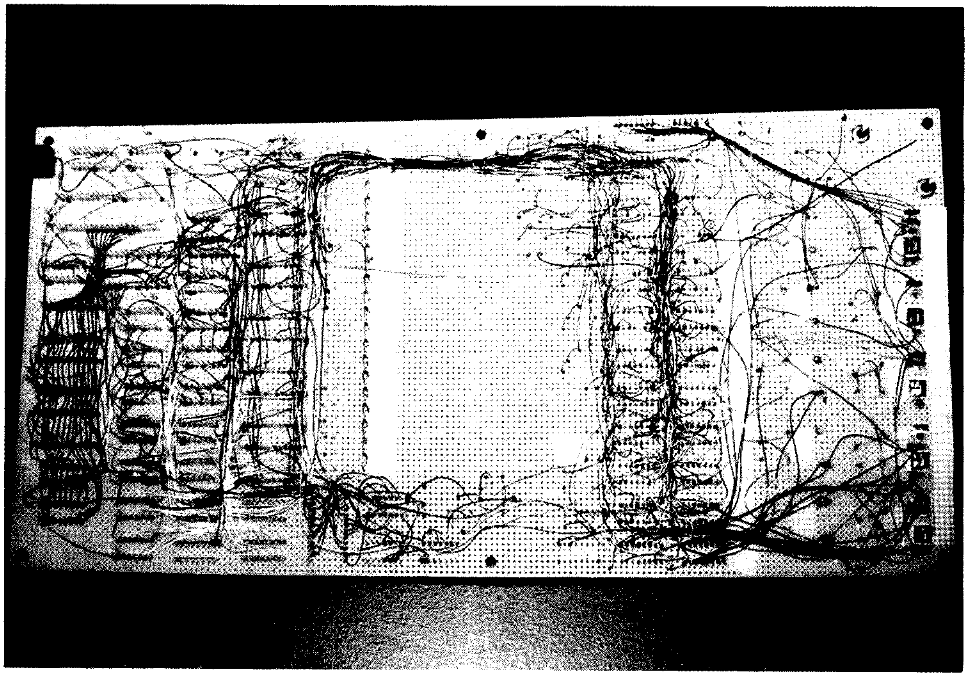


Fig. 7. Control logic.



Bottom of board. Reset switch at upper left. Microprocessor circuitry on left.

of the incoming signal and the one-shot. If a signal is present when IC21 falls, then the "beep" is inhibited via IC5. If the beep is disabled, IC21 is prevented from firing by IC10, and carrier release immediately resets the timer. This seems like a lot of trouble to go through for a silly beeper. The system permits a long (3-second) drop delay on the repeater transmitter. In normal QSOs, the transmitter stays keyed continuously, each participant merely waiting for the beep. This saves a lot of wear and tear on the transmitter and amplifier, both of which otherwise are constantly being turned on and off. This is of particular importance for busy repeaters; WR3AFM

logs about 13 hours of uptime per day. The users *do* learn to wait for the beep, leaving time for breakers; if not, they time out.

IC24 divides the master 2-MHz clock by two, supplying the required 1-MHz clock for IC25, the touchtone generator. The rows and columns are selected by the processor at output port #7. The low and high group tones are summed and sent to a transistor amplifier.

Each of the digit outputs from the touchtone decoder has an LED which serves the dual purpose of giving an indication of what is going on and providing a pull-up for input to the processor input ports. The decoder outputs are normally open and go low when active. The VTT (valid touchtone) signal must be processed. IC22, a CMOS buffer, permits high-impedance timer resistors to be used. Each of three sections requires digits to be held a certain amount of time before they are recognized. The VTT output is just a debounced output set for a delay of about 50 milliseconds. The SVTT (slow VTT) output is adjusted for a delay of one second. This sets the amount of time the first digit of 3-digit codes must be held. The SSVTT (slow slow VTT) output is adjusted for 5 seconds. This sets the amount of time required to enter the telephone listen and control receiver talk modes.

The circuitry which performs the switching functions is shown in Fig. 7. The outputs of this section are the relays and the CS COS, RUSOS, AG, DISABLE TIMER, PL, and PTT lines. There are four state flip-flops. The AP (autopatch) flip-flop goes high during an autopatch, and the RB (remote base) flip-flop is high during a remote base operation (reverse autopatch, limited to control operators). The CRTK (control receiver talk) flip-flop may be left in either state, but by operating convention is normally left low. If it is set, any signals coming from the control receiver will be repeated. The PHC (phone control) flip-flop is normally clear and is set when a call-in is made on the phone line. The gating of these flip-flops will now be described.

The clear inputs of AP and RB are driven from IC6. If any of the three inputs to that gate go high, IC1 is cleared. A KD (knockdown) pulse from the processor will do so. When the knockdown digit is received, the processor pulses the KD output high. The master RESET pulse also clears the flip-flops, setting the initial states correctly after power on. The third input comes from an AND gate made up of ICs 4 and 13. If all three inputs of IC4 go high, then the flip-flops will be reset. This input provides for these functions to be killed should the repeater time out. If either function is up, pin 3 of IC7 is high. Whenever these functions are on, the RUSOS lead is grounded to keep the transmitter on the air. If the RUSOS lead is low, and the 150 PTT is high, sensed by pins 13 and 1 on IC4, then the repeater must be timed out. The last input to the AND gate is the voter COS. This only allows the AP and RB functions to be killed from a timeout if the incoming signal is released. During autopatches, if the repeater times out, the party on the telephone hears the last transmission made even after the repeater drops off the air. At that point, all three inputs to IC4 are high, and the function is killed.

The processor pulses the RB input line, setting the RB flip-flop when a remote base function is requested. When an autopatch is requested, the AP input is pulsed. If the APEN (autopatch enable) input is low, IC9 passes the request and the AP flip-flop is set. Otherwise, the patch is not permitted to start. This autopatch defeat is easily done in software, but this method allows visual indication when at the site that the autopatch function has been disabled.

The CRTK flip-flop is set when both inputs of IC9 are high. Pin 5 goes to the CRCOS (control receiver COS), so this can only be enabled by a signal present in that receiver. Both inputs of IC8, which feeds the other input of IC9,

$150 = \overline{\text{150EN}}$
$450 = \overline{\text{450EN}}$
$\text{TAPE} = \text{TAPE}$
$\text{APR} = \text{AP}$
$\overline{\text{CSCOS}} = \overline{\text{COS}}$
$\text{CRTT} = (\text{CRCOS})\,(\text{CREN})$
$\text{CRTALK} = (\text{CRTK})\,\overline{(\text{CRTT})}$
$\text{PHCR} = \text{PHC} + \overline{\text{150TTEN}}$
$\text{LDR} = (\text{COS})\,\overline{(\text{PHC})} + (\text{SVTT})\,\overline{(\text{PHEN})} + \text{LD}$
$\text{BLOCK} = (\text{VTT})\,(\text{BLK} + \text{AP} + \text{RB})\,(\overline{\text{PHC}})\,(\text{CRTK} + \overline{\text{CRTT}})$
$\text{LINK} = \text{LINK} + \text{LINK FROM 450}$
$\text{AG} = (\text{AP} + \text{RB})\,(\overline{\text{COS}})\,(\overline{\text{PHC}}) + \text{LD}$
$\overline{\text{RUSOS}} = (\text{AP} + \text{RB})$

150: 150 repeater off
450: 450 repeater off
TAPE: Start tape loop
APR: AutoPatch Relay
CSCOS: Control Shelf Carrier Operated Switch input
CRTT: Control Receiver Touchtone access
CRTALK: Control Receiver TALK through 150 with priority
PHCR: Phone Control Relay
LDR: Telephone Line Direction Relay
BLOCK: Audio tone Blocking relay
LINK: Linkup of 150/450 repeaters
AG: Audio Gate—audio to transmitter
RUSOS: Timed transmit input
150EN: 150 repeater enable from processor
450EN: 450 repeater enable from processor
TAPE: Tape activate from processor
AP: AutoPatch flip-flop
COS: Carrier Operated Switch from voter/control receiver
CRCOS: Control Receiver COS
CREN: Control Receiver ENable
CRTK: Control Receiver Talk flip-flop
PHC: Phone Control flip-flop
150TTEN: ENable Touchtone access from 150
VTT: Valid Touchtone
SVTT: Slow Valid Touchtone
SSVTT: Slow Slow Valid Touchtone
PHEN: ENable telePHone control access
LD: Line Direction from processor
BLK: Block signal from processor
RB: Remote Base flip-flop

Fig. 8. Control logic functions.

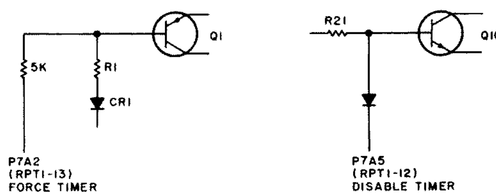


Fig. 9. Modifications to repeater control board 19D416675.

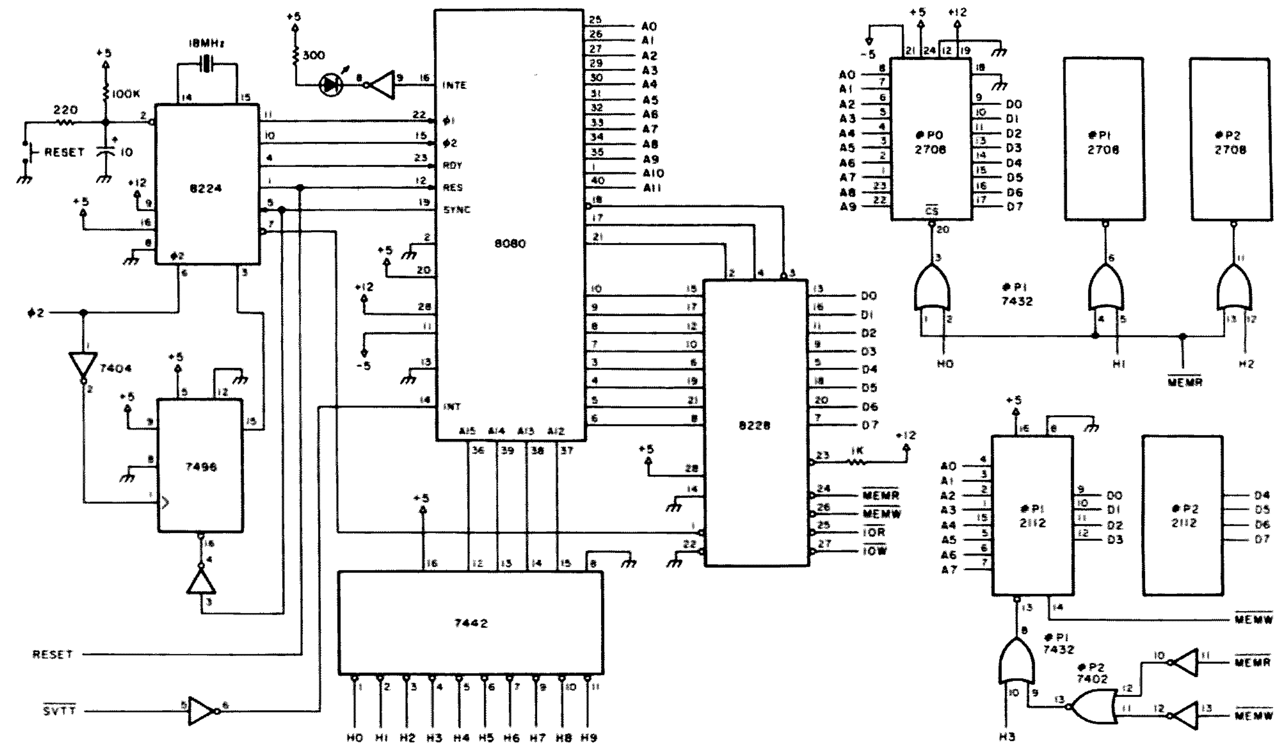


Fig. 10. Processor and memory.

must be low as well. The # digit and the SSVTT signals must be present. Therefore, the # must be held for 5 seconds while transmitting on the control frequency in order to enable the CRTK mode. CRTK is cleared by IC8. The RESET pulse goes to pin 2, clearing CRTK on power-up. Otherwise, the two inputs of IC5 must go high. One input goes to the CRCOS, so it can only be killed on the control frequency. The other input comes from pin 13 of IC8, which goes high when a one second * is received.

The PHC flip-flop is controlled in part by IC3. If any of the four inputs to this gate are low, the output is high, clamping PHC clear through IC8. If telephone loop current is sensed, the PHEN (phone enable) line is low, and neither the RB nor AP flip-flops are set, then pin 6 of IC3 goes low. If the last three conditions are satisfied when a call-in is made on the phone line, the transition clocks PHC high, placing the system into the telephone control access mode. Pin 6 of IC8 is driven from the five-second # gate, so PHC can be cleared in this manner, permitting the repeater input signals to be heard on the phone line. Via pin 13 of IC9, a one-second * sets PHC again.

The rest of the circuitry is combinational. Rather than give a detailed description of how each gate operates, I have shown the Boolean logic functions in Fig. 8, from which the circuitry can be easily understood. The 150, 450, and TAPE outputs are directly driven from the processor outputs. APR is directly driven from AP. The CS COS is a buffered COS output. The CRTT relay is activated if CREN (control receiver enable) is low, and if a signal is received in the control receiver. Normally, this relay follows the control receiver, giving it priority over anything else for access to the touchtone decoder. The CRTALK relay follows the CRTT relay if the CRTK flip-flop is set. PHCR is activated when PHC goes high. If 150TTEN (150 touchtone enable) is high, PHCR is also on. This totally isolates the decoder from two meter inputs.

Normally, LDR follows the COS. If PHC is high, it stops following the COS, giving the control operator total control from the telephone line. Otherwise, whenever an incoming signal is present, the line direction gets turned around, and tones from the telephone never reach the decoder. If PHEN is low, LDR follows the SVTT signal. This is used to remove control access from the telephone line. Every time an attempt is made to send a tone down the line in this mode, the line is turned around, cycling the relays and removing the tone from the system. It is a clumsy but simple way to accomplish the task. The LD output from the processor also activates LDR, to ensure that the locally-generated touchtones produced when redialing a number go down the telephone line.

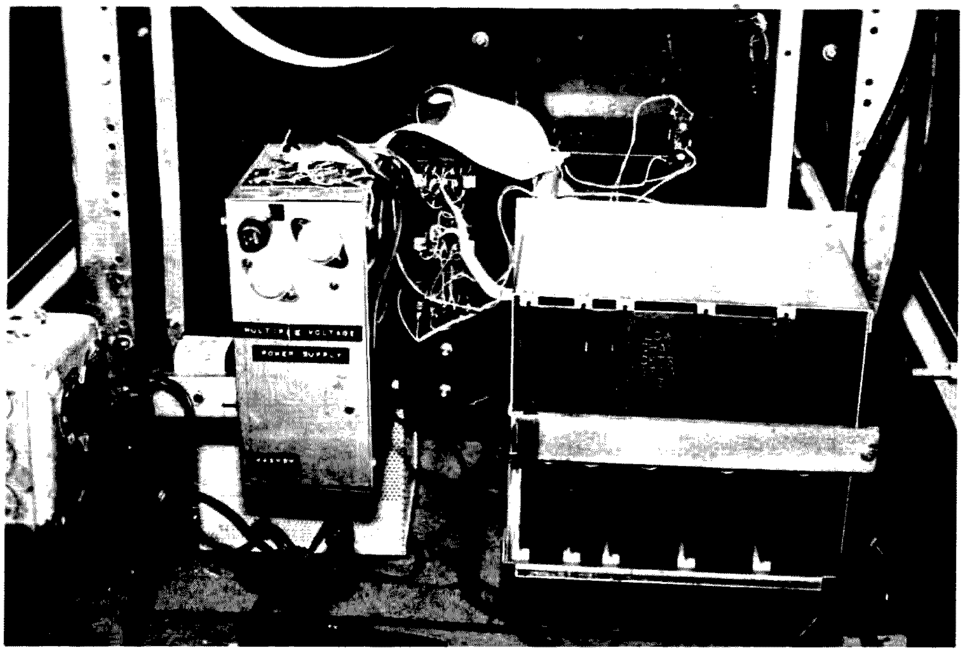
When in the blocking mode, BLOCK follows VTT. To be in the blocking mode, the BLK signal must be present from the processor, or an autopatch or remote base function must be in progress. The blocking mode is left for two special cases: when controlling the repeater on the phone line or the control receiver when it is not repeating. If these exceptions were not made, when a control operator was executing functions, users talking on the repeater would have their voices blotted out every time a tone was sent by the control operator. This would limit control to when the repeater was free. The PHC bar in the BLOCK formula stops the blocking for telephone control, and the CRTK + CRTT bar removes the blocking for silent control on the con-

trol frequency.

LINK normally follows the output from the processor, but a link request from 450 also activates it.

AG is activated during autopatch or remote base functions when the incoming signal is released, placing the telephone audio on the air. The LD output from the processor also activates AG so that the redialing of telephone numbers can be heard on the air. The RUSOS lead is grounded during autopatches and remote base operations.

ICs 15, 16, and 17 are open collector buffers used to drive the relay coils and external inputs. The AG input requires +10 volts. A PNP switching transistor, through an LED which drops a couple of volts, accomplishes this. The PTT outputs from the processor feed NPN driver transistors to keep the transmitters on the air during IDs. The keying transistors should be hefty enough to sink the current of the PTT lines of the particular transmitters used.



Rear of control system rack, showing power supply and touchtone decoder. The amplifier sockets are also visible.

Depending upon the repeater timer control methods used, the FORCE TIMER and DISABLE TIMER inputs may or may not already be present. Fig. 9 shows the necessary

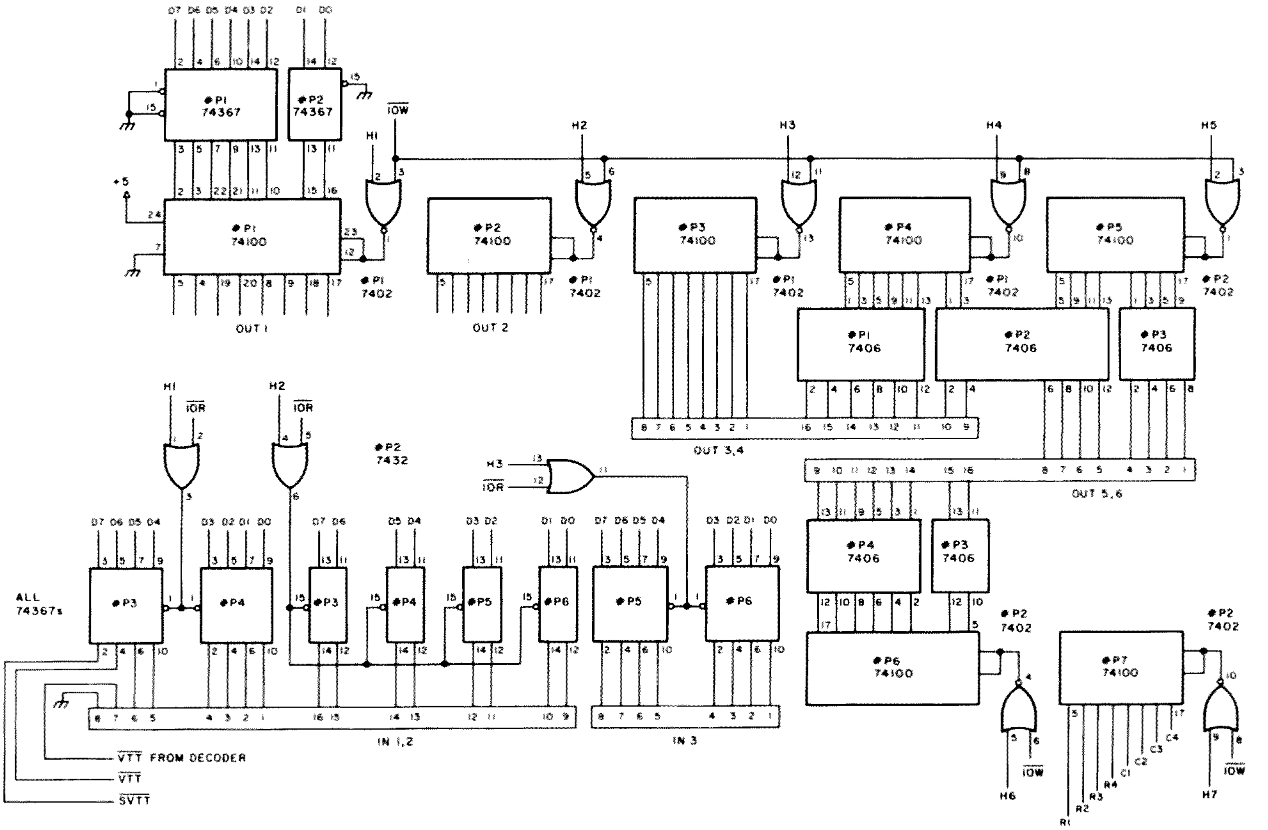


Fig. 11. Processor I/O ports.

modifications if a General Electric MASTR control shelf is used.

The Microprocessor

There are scores of microprocessor chips on the market. Many could be selected as the controlling element in a control system. A single interrupt is required. Barring other considerations, the RCA Cosmac would be a good choice because it is fabricated from CMOS technology, causing it to draw very little current and to have high noise immunity. The major consideration when selecting a microprocessor chip is support. I chose the Intel 8080 family for three reasons: I am extremely familiar with it, I have a supply of spare chips for that family, and I have the needed software support. The software support is most important.

There are a number of memory chips which can be used. I decided to use 2708 ROMs because I have a supply of them and because they are easily programmed. Newly constructed systems would do well by utilizing 2716 ROMs. The 2716 has twice the capacity of the 2708, and in this application, only one is required. The 2716 is even easier to program than the 2708. A minimal amount of RAM is required. Two 2112s, each 256 x 4, are used, providing 256 bytes of RAM.

The microprocessor components are considered separately from the rest of the hardware. The integrated circuits are not numbered, except where more than one of a particular number is used (where the letter "P" is attached to indicate that the IC belongs to the processor). The processor and memory schematic is shown in Fig. 10. The 8224 support chip provides the clock signals to the 8080 using an 18-MHz crystal. It also is the source of the power-up RESET pulse. Pushing the reset switch also generates a RESET pulse. The 7496 shift register introduces one memory wait state. The 8080 has plenty of speed for its required functions, and the 2708 ROMs are cheaper in the 650 ns variety, so a wait state was added so that the slower memory could be used. I suggest that the 18-MHz clock and wait state be retained for duplication, for the simple reason that otherwise the timing loops in the program will have to be readjusted.

The SVTT signal interrupts the processor. There are several reasons for using SVTT rather than VTT. Voices tend to be momentarily detected as touchtone. Using VTT to interrupt the 8080 would result in the processor frequently being interrupted for no purpose. This is bad, because when interrupted it stops counting time and initiates tone blocking, resulting in unintentional blocking of voices. Operationally, SVTT requires the first digit of any code to be held for a second; this gives control operators a chance to respond to unidentified stations attempting to access the system. The INTE (interrupt enable) is monitored by an LED, showing if the interrupt program has been exited, since after exit the interrupt is always re-enabled.

The four high address lines feed a 7442 decoder to provide the memory and I/O port selects. The rest of the address bus goes directly to memory. An 8228 bus controller buffers the data bus and produces the memory and I/O read and write signals. The pull-up resistor on pin 23 lets the 8228 perform the single interrupt instruction.

The program is stored in 2708 1K x 8 ROMs. The addressing is set by the H0, H1, and H2 lines. The ROMs are selected only during a memory read operation. Three sockets are provided for 2708s, and currently only two are needed, leaving room for an expanded program. It is simple to add up to six more 2708s by paralleling all lines and using the H4 through H9 lines. The RAM

INPUT PORTS

Port #10
8—$\overline{\text{SVTT}}$
7—$\overline{\text{VTT}}$
6—150 $\overline{\text{COS}}$
5—450 $\overline{\text{COS}}$
4—digit 1
3—digit 2
2—digit 3
1—digit 4

Port #20
8—digit 5
7—digit 6
6—digit 7
5—digit 8
4—digit 9
3—digit 0
2—digit *
1—digit #

Port #30
8—PHC
7—CRCOS

OUTPUT PORTS

Port #10
8—150 tone
7—150 PTT
6—450 tone
5—450 PTT
4—AP activate
3—RB activate
2—KD (KnockDown)
1—BLK

Port #20
8—$\overline{\text{150EN}}$
7—$\overline{\text{450EN}}$
6—$\overline{\text{APEN}}$
5—$\overline{\text{CRTTEN}}$
4—$\overline{\text{PHEN}}$
3—$\overline{\text{150TTEN}}$
2—CR PL
1—$\overline{\text{Beep}}$

Port #30
8—Tape activate
7—LD
6—Disable timer
5—Link

Port #50: Receiver disable
Port #60: Receiver select
Port #70: Row and column select for touchtone generator

Fig. 12. I/O ports.

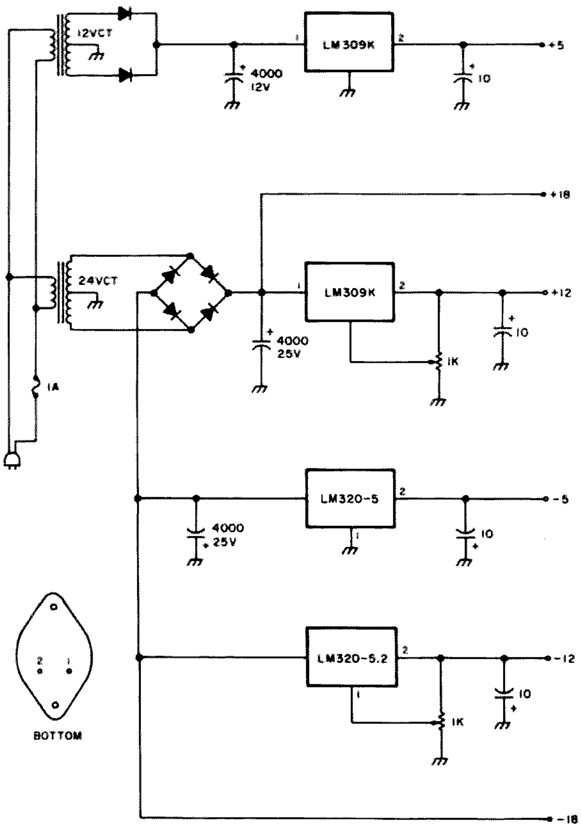


Fig. 13. Power supply.

consists of two 2112 256 x 4 chips. They are selected during memory read or write operations. On the memory chips, all pins not shown are paralleled with the other chips.

The input/output ports are shown in Fig. 11. 74100s are used for output ports because they are inexpensive. 74367s (8097) are used for input ports and buffers. 74367 #P1 and part of #P2 are used to buffer the data bus from the output ports. The H1 through H7 lines are used to select the port addresses, which correspond to 10, 20, ... hexadecimal port numbers. The input lines for 74100s #P2 through #P7 are paralleled with those lines on 74100 #P1. Output ports 1, 2, and 7 go directly to the rest of the hardware. The port and bit designations are shown in Fig. 12. Ports #3 through #6 go to output connectors. The input ports are as shown. Ports #1 and #2 come from the touchtone decoder, the VTT and SVTT conditioned outputs, and the two repeater COS lines. The decoder plugs into IN1,2. The pins which do not connect to the decoder are left open and wired over to the RPT1 connector. Two of the inputs on port #3 are used, and the remaining six may be used for expansion.

The power supply must provide +5, +12, and −5 volts for the circuitry. Other voltages may be required for your choice of amplifiers, decoder, and pad. Up to 2 Amps is required for the +5 supply, and 1 Amp is sufficient for the rest of the voltages. A power supply schematic is shown in Fig. 13. An LM309 regulator is used for +5, and it works—but this is on the close side. ■

DX Fantasy

—a moment in the sun

What you don't know can't help you.

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Canada N4S 5T1

It was official: Effective 0001 GMT, all VEs could use the CJ prefix. I relished what lay before me. After years of chasing DX, for the first time (before the world discovered that CJ = VE, a fact that would hardly impress anyone), I would be the chased. Of course, I wouldn't disguise this detail; I simply wouldn't advertise it.

At the appointed hour, I ran to the rig and aimed the beam east. "CQ DX CQ DX from CJ3FLE."

They were there in an instant; the band exploded with Europeans clamoring to work me.

I imitated the best DXer's style I had heard and started to work them: "G2ZZ from CJ3FLE. Fifty-seven."

Back came the reply: "CJ3FLE from G2ZZ. 59, break."

"Roger; thanks for the report. QSL to VE3FLE. QRZ DX from CJ3FLE?"

"CJ3FLE from DL2XX."

"DL2XX, you're 58, from CJ3FLE."

"QSL. Thanks for the contact. What's the QT—"

"—roger, roger. QSL to VE3FLE. QRZ the G-station?"

And on I went. The stations were characteristically weak—they were no doubt in confusion as to where to point their antennas. But I was concerned with giving everyone the opportunity to work CJ, so I kept the QSOs short.

One French station was pounding in. "F2XX, you're 58 from CJ3FLE."

"QSL, you're five nine plus. Nice signal. What's the QTH?"

"Thanks for the report. QSL to VE3FLE. QRZ DX from CJ3FLE?"

"CJ3FLE. What's the QTH, old man? F2XX."

"Oh, sorry old man. We're in Canada. VE-land," I whispered, and then turned the amplifier back on, "CQ DX from CJ3FLE?"

The band began to shift and Asia came rolling in. I was ecstatic. It seemed as if all of Japan were calling at once. What a feeling!

As I worked the JAs, I could hear the stateside stations trying to break. One particular strong W7 kept calling, with such a strong signal I was having trouble hearing the JAs under him.

"W7XYZ from CJ3FLE. Fifty-eight."

"Thanks, old man." He came back sounding very pleased. "Didn't think I was going to get through. Beautiful signal here, even though I know you're beaming north. You're 5 and 9 plus. Name here is Bud."

"Thanks, Bud. Nice signal yourself. QSL to VE3FLE if you want a card ... 73 for now. QRZ DX from CJ3FLE?"

"By the way," it was the W7 again, "is there an award for working that special Canadian prefix? I've already worked a dozen of you and was wondering if there might be a certificate."

I felt crushed. "Ah, no, I don't think so," I replied.

"Okay; 73 and thanks for the contact."

"73. QRZ DX from CJ3FLE?" I said and glanced at the clock—less than an hour had elapsed.

I continued to call for DX but over the next hour managed only a handful of contacts. Finally I shut off the rig and leaned back and pretended the band had folded. ■

Try a Log Periodic Antenna

—with a computerized design

Bring in the big ones with your frequency-independent LPDA.

Fig. 1. Sample run.

```
RUN
LOG PERIODIC DIPOLE ANTENNA DESIGN PROGRAM
1: INPUT THE LOWEST OPERATING FREQUENCY IN MHZ
? 13
2: INPUT THE HIGHEST OPERATING FREQUENCY IN MHZ
? 30
3: INPUT THE CONSTANT TAU (.8 <= TAU <= .99 )
? .9
4: INPUT THE CONSTANT SIGMA (.05 <= SIGMA <= .1662 )
? .05
5: DO YOU WANT A SPECIFIC NUMBER OF ELEMENTS
? 2
THE LENGTH OF THE BOOM IS 27.05162 FEET
THE NUMBER OF ELEMENTS IS 13
DO YOU WANT A LIST OF ELEMENT LENGTHS AND SPACINGS
? 1
TAU= .9 SIGMA= .05
LENGTH (FEET) SPACING (FEET)
 37.84615      3.784615
 34.06154      3.406154
 30.65538      3.065538
 27.58985      2.758985
 24.83086      2.483086
 22.34778      2.234777
 20.113        2.0113
 18.1017       1.81017
 16.29153      1.629153
 14.66238      1.466238
 13.19614      1.319614
 11.87652      1.187652
 10.68867
DO YOU WANT TO CONTINUE
? 1
HOW MANY VALUES DO YOU WANT TO CHANGE
? 6
1: INPUT THE LOWEST OPERATING FREQUENCY IN MHZ
? 14
2: INPUT THE HIGHEST OPERATING FREQUENCY IN MHZ
? 14.35
3: INPUT THE CONSTANT TAU (.8 <= TAU <= .99 )
? .95
4: INPUT THE CONSTANT SIGMA (.05 <= SIGMA <= .1791 )
? .05
5: DO YOU WANT A SPECIFIC NUMBER OF ELEMENTS
? 1
6: INPUT THE NUMBER OF ELEMENTS
? 8
THE LENGTH OF THE BOOM IS 21.31978 FEET
THE NUMBER OF ELEMENTS IS 8
DO YOU WANT A LIST OF ELEMENT LENGTHS AND SPACINGS
? 1
TAU= .9522999 SIGMA= .05
LENGTH (FEET) SPACING (FEET)
 35.14286      3.514285
 33.46654      3.346653
 31.87018      3.187017
 30.34997      3.034996
 28.90227      2.890226
 27.52363      2.752362
 26.21075      2.621074
 24.96049
DO YOU WANT TO CONTINUE
? 1
HOW MANY VALUES DO YOU WANT TO CHANGE
? 3
INPUT THE NUMBERS
? 1
? 2
? 6
1: INPUT THE LOWEST OPERATING FREQUENCY IN MHZ
? 13.95
2: INPUT THE HIGHEST OPERATING FREQUENCY IN MHZ
? 14.4
6: INPUT THE NUMBER OF ELEMENTS
? 5
THE VALUES YOU HAVE CHOSEN WILL NOT WORK.  INPUT NEW DATA
DO YOU WANT TO CONTINUE
? 1
HOW MANY VALUES DO YOU WANT TO CHANGE
? 1
INPUT THE NUMBERS
? 6
6: INPUT THE NUMBER OF ELEMENTS
? 7
THE VALUES YOU HAVE CHOSEN WILL NOT WORK.  INPUT NEW DATA
DO YOU WANT TO CONTINUE
? 1
HOW MANY VALUES DO YOU WANT TO CHANGE
? 1
INPUT THE NUMBERS
? 6
6: INPUT THE NUMBER OF ELEMENTS
? 6
THE VALUES YOU HAVE CHOSEN WILL NOT WORK.  INPUT NEW DATA
DO YOU WANT TO CONTINUE
? 1
HOW MANY VALUES DO YOU WANT TO CHANGE
? 2
INPUT THE NUMBERS
? 3
? 6
3: INPUT THE CONSTANT TAU (.8 <= TAU <= .99 )
? .92
6: INPUT THE NUMBER OF ELEMENTS
? 7
THE LENGTH OF THE BOOM IS 18.21714 FEET
THE NUMBER OF ELEMENTS IS 7
DO YOU WANT A LIST OF ELEMENT LENGTHS AND SPACINGS
? 1
TAU= .9399989 SIGMA= .05
LENGTH (FEET) SPACING (FEET)
 35.20882      3.520882
 33.15265      3.315265
 31.16345      3.116345
 29.29361      2.929361
 27.53596      2.753596
 25.88377      2.588377
 24.33071
DO YOU WANT TO CONTINUE
? 2
```

Christopher Johnson WA1ZAC
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If you must ask yourself, "What would I want with a log periodic dipole array (LPDA)?" then, obviously, you are unaware of the benefits of this amazing antenna. The main advantage of an LPDA is that it is frequency-independent. The gain, front-to-back ratio, swr, and other electrical characteristics remain fairly constant within the design limits.

Unlike a parasitic beam, whose performance deteriorates as the operating frequency is moved away from the design frequency, the array is not tuned to a single wavelength. The array has elements which are resonant at various points within the passband of the antenna. Very simply stated, at a given frequency, there is a group of elements which are near resonance; these act as driven elements. The nonresonant elements in front of the "driven" elements act as directors, and those behind act as reflectors. Hence, the antenna has many combinations of "driven," "directing," and "reflecting" elements.

When faced with the task of designing an LPDA the old-fashioned way, you can look forward to grinding out the numbers with pencil, paper, and calculator. It can be very boring and time-consuming. If you are not fortunate enough to get the results you require on the first attempt, your only alternative is to repeat the entire tedious process. However, in this age of microcomputers, you have only to type in a few numbers, wait a few seconds, and, miraculously, out pop the element lengths and spacings for your LPDA.

After examining the program, the results should seem a little less miraculous. An antenna can be designed in one of two modes. In both modes, you enter the frequency limits and two constants. In mode one, the computer will calculate the number of elements and their lengths and spacings. In mode two, you may also enter the number of elements. The computer will then design an antenna with these specifications.

This program is tailored to work on almost any computer processing BASIC which is equipped with higher math and radian trig functions. If optimized for your computer, the program can be condensed considerably. It was written on a Digital Equipment PDB 8/e minicomputer. For all inputs, yes is one, and no is two.

To use mode one, you must enter the higher and lower frequency limits (lines 190-220). You must also input the two constants tau and sigma (lines 250-300). Tau must be in the range of .8 to .99, and sigma must be in the range of .05 to sigma optimum (sigma optimum is equal to .258 x tau = .066). If you answer no to line 310, the computer will calculate the values for an LPDA with the characteristics which were entered. If you answer yes to line 310, you may enter a specific number of elements. If possible, the computer will optimize the constant tau for the highest gain and the smallest array with the characteristic input. If no antenna can be designed for the values encoded, you will be blamed for entering unacceptable data (line 590).

After the computer has sweated over the figures, it will print out boom length and number of elements (lines 730-740). You are then able to either accept these and get a printout, or reject them and change the inputs (lines 750-780). Just enter the number of each item to be changed (lines 680-700). The entire process will repeat itself, and you will soon be staring at a new set of data. How easy can designing an antenna be?

All of the computations are performed on lines 360-580. On line 360, the cotangent of alpha is

Fig. 2. Program listing.

```
10 PRI"LOG PERIODIC DIPOLE ANTENNA DESIGN PROGRAM"
20 H=6
30 I=0
40 T1=0
50 U=2.302585
60 FORV=1TOH
70 IFI=0THE90
80 GOT100
90 W(V)=V
100 IFW(V)=1THE190
110 IFW(V)=2THE220
120 IFW(V)=3THE250
130 IFW(V)=4THE280
140 IFW(V)=5THE310
150 IFQ=2THE330
160 PRI"6: INPUT THE NUMBER OF ELEMENTS"
170 INPN
180 GOT330
190 PRI"1: INPUT THE LOWEST OPERATING FREQUENCY IN MHZ"
200 INPF1
210 GOT330
220 PRI"2: INPUT THE HIGHEST OPERATING FREQUENCY IN MHZ"
230 INPF2
240 GOT330
250 PRI"3: INPUT THE CONSTANT TAU (.8 <= TAU <= .99 )"
260 INPT
270 GOT330
280 PRI"4: INPUT THE CONSTANT SIGMA (.05 <= SIGMA <=".258*T-.066")"
290 INPE
300 GOT330
310 PRI"5: DO YOU WANT A SPECIFIC NUMBER OF ELEMENTS"
320 INPQ
330 NEXV
340 F=F2/F1
350 W=984/F1
360 C=4*E/(1-T)
370 R=(((ATN(1/C))/.017452)↑E)/T↑2
380 S=R*F
390 L=(1-(1/S))/4*C*W
400 IFQ/2<>INT(Q/2)THE460
410 N=1+(LOG(S)/U)/(LOG(1/T)/U)
420 IFN-INT(N)>=.5THE450
430 N=INT(N)
440 GOT460
450 N=INT(N)+1
460 D=492/F1
470 P=(D-L*T)/2*L
480 IFQ<>1THE730
490 IFT1>=TTHE500
500 FORT1=TTO.99STE.0001
510 C1=4*E/(1-T1)
520 B=T1↑(3-N)/(((ATN(1/C1))/.017452)↑E)
530 IFINT(1000*B)>INT(1000*F)THE560
540 IFINT(1000*B)<INT(1000*F)THE590
550 T=T1
560 Q=3
570 GOT360
580 NEXTT1
590 PRI"THE VALUES YOU HAVE CHOSEN WILL NOT WORK.  INPUT NEW DATA"
600 PRI"DO YOU WANT TO CONTINUE"
610 INPJ
620 IFJ=1THE640
630 GOT940
640 PRI"HOW MANY VALUES DO YOU WANT TO CHANGE"
650 INPH
660 IFH=6THE20
670 PRI"INPUT THE NUMBERS"
680 FORV=1TOH
690 INPW(V)
700 NEXV
710 I=1
720 GOT40
730 PRI"THE LENGTH OF THE BOOM IS"L"FEET"
740 PRI"THE NUMBER OF ELEMENTS IS"N
750 PRI"DO YOU WANT A LIST OF ELEMENT LENGTHS AND SPACINGS"
760 INPM
770 IFM=1THE790
780 GOT600
790 PRI"TAU="T"SIGMA="E
800 PRI"LENGTH (FEET) SPACING (FEET)"
810 FORA=1TON
820 PRID,
830 IFN<>ATHE850
840 GOT860
850 PRIP
860 D=D*T
870 P=P*T
880 NEXA
890 PRI
900 IFQ=3THE920
910 GOT930
920 Q=1
930 GOT600
940 STOP
950 END
```

E = sigma
T = tau
R = bandwidth active region
L = length of boom
N = number of elements
C = cotangent of alpha
D = length of element
P = spacing of element
B = operating bandwidth (should be approximately equal to F)
F = upper frequency over lower frequency

Table 1. List of variables.

calculated. Line 370 computes the bandwidth of the active region. The length of the boom is calculated on line 380. If the number of elements is predetermined, lines 490-580 will optimize tau for any given sigma. The loop increments tau by .001 at each pass and checks to see if the results are acceptable.

The element lengths and spacings are listed with lines 810-880. After listing these items, you are allowed the choice of continuing or packing up the inch-thick pile of printouts you already have and going off to begin work on your antenna. Now that you have enough data to design a thousand antennas, you can choose the one best suited to your needs.

The log periodic dipole array is a truly versatile and useful antenna. And, since one is so utterly simple to design, you have no excuse not to type in this program, punch in a few figures, and prepare for the construction of your personal, computer-designed LPDA.■

New Coax Cable Designations

—watch for them

Upgraded standards since 1977.

Carl C. Drumeller W5JJ
5824 NW 58 Street
Warr Acres OK 73122

For years, ever since the Hitler War, radio amateurs have placed their trust in coaxial cables bearing RG- designations. For good cause, too, as they were manufactured to strict military standards. As of 15 March 1977, a new set of standards was introduced and made mandatory. This new standard closes some loopholes in the former specifications.

Most manufacturers of coaxial cable turned out products of which they could be justifiably proud. Some scrimped. Even the best products were made to specifications that unwittingly omitted important factors. Now, though, all such cable made to current requirements, as spelled out in MIL-C-17E, will have certain additional desirable characteristics.

For instance, cable approved under MIL-C-17E will have tightly controlled adhesion between inner conductor and dielectric. If you've ever had, in cold weather, the inner conductor contract enough to pull back the male prod on a type N connector, you'll appreciate this requirement!

In another pair of specifications, the outer jacket must have dimensional stability. It must not shrink back from a connector, nor may it crack and pull away from the shield when stressed.

How do you spot the new and desirable cables? Look for the stamped-on identification. For what used to be RG-58C/U, for instance, look for M17/028-RG58. Note carefully that there is no hyphen between RG and 58.

Incidentally, I did not find a new version of the old stand-by, RG-8/U. It must have been replaced by one of the new three-numeral series.

Cable marked with the old designations still will be manufactured. Be thoroughly aware, though, that it very probably will not be of the high quality that characterized such cable when it was made to military standards. In fact, already some quite inferior cable is being sold. It looks like the "real" thing; it's the same size and of the same exterior appearance. When rf is piped into it, it's quite another matter. It may leak rf like a sieve; it may have high attenuation per unit length; it may have "suck-out" points. "Suck-out" points are narrow frequency bands at which the cable displays very high attenuation although passing other frequencies with only nominal attenuation.

So, if you want the best, look for (and pay dearly for) the newer MIL-C-17E series of coaxial cables. Keep in mind that a penny saved on coax cost may be a dollar lost in precious rf dissipation. ■

The Micro Magic Pi Designer

—figure networks with a minimum of fuss

A bulletproof program.

Gil Boelke
505 Main St.
West Seneca NY 14224

Here's a BASIC program to design pi-networks, used for impedance matching and filtering. A feature of the program is that it makes a smooth transition to the degenerative case of minimum Q—the L-network.

When the primary function is to transform impedance with minimum loss and not to provide filtering action, the L-network is the way to go. For a given impedance ratio, it provides the broadest bandpass of any resonant network, and the lowest loss.

If filtering action is required, such as for harmonic rejection, or if the impedance ratio is to be made variable through the use of variable capacitors, a pi-network may be better. Q may be chosen as desired and a range of impedance ratios can be accommodated without changing the inductor value. A pi-network is nothing more than back-to-back L-networks. Since an L-network always steps impedance either up or down, a pi-network can be used to provide filtering action with equal impedances at both source and load, as well as transformations up or down. If the two L-networks have equal ratios, the first steps impedance down and the second one steps it back up to the

Program listing.

```
100 REM PI-NETWORK DESIGN PROGRAM
110 REM Copyright GLB ELECTRONICS 1977
120 REM G. BOELKE  7-26-77
130 REM
140 REM CHR$(12) IS TO CLEAR SCREEN AND HOME UP CURSOR
150 PRINTCHR$(12):PRINT"PI NETWORK DESIGN"
160 INPUT"FREQUENCY (MHZ)";F:IFF<=0THEN160ELSEF=F*1E6
170 PRINT:INPUT"INPUT Z";R1
180 INPUT"LOAD Z";R2
190 Y1=0:IFR2>R1THENSWAPR1,R2:Y1=1
200 Q0=SQR(R1/R2-1)
210 Q0=INT(Q0*1E5+.5)/1E5
220 PRINT"Q VALUE (MIN "Q0")";:INPUTQ$
230 Q=VAL(Q$)
240 PI=3.1415926
250 IFQ$="MIN"ORQ=Q0THENQ=Q0:GOTO640
260 IFQ<Q0THEN220
270 REM CALCULATIONS
280 IFQ=0THENX1=1E38:GOTO260
290 X1=R1/Q
300 X2=Q*Q+1-R1/R2
310 IFX2<=0THENPRINT"UNREASONABLE PROBLEM":GOTO170
320 X2=SQR(R1*R2/X2)
330 X3=Q*R1+(R1*R2/X2)
340 X3=X3/(Q*Q+1)
350 C1=1/2/PI/X1/F
360 C2=1/2/PI/X2/F
370 L=X3/2/PI/F
380 REM SCHEMATIC
390 PRINT
400 PRINT"O------UUUUU------O"
410 PRINT"  |       L"TAB(16)"|"
420 PRINT"  |               |
430 PRINT" ---             ---"
440 PRINT" --- C1";TAB(15)"--- C2"
450 PRINT"  |               |"
460 PRINT"  |               |"
470 PRINT"O-----------------O"
480 IFY1>0THENPRINTR2;TAB(16)R1:GOTO500
490 PRINTR1;TAB(16)R2
500 IFL>=1E-6THENPRINT"L="INT(L*1E9+.5)/1E3"UH":GOTO520
510 PRINT"L="INT(L*1E9+.5)"NH"
520 PRINT"C1="INT(C1*1E12+.5)"PF"
530 PRINT"C2="INT(C2*1E12+.5)"PF"
540 PRINT
550 INPUT"ANOTHER Q VALUE";A$
560 IFASC(A$)=89THEN190
570 INPUT"IMPEDANCE CHANGE";A$
580 IFASC(A$)=89THEN170
590 INPUT"ANOTHER FREQ";A$
600 IFASC(A$)=89THENINPUT"F";F:IFF<=0THEN600ELSEF=F*1E6:GOTO200
610 INPUT"MORE";A$:IFASC(A$)=89THEN160
620 END
630 REM MIN Q YIELDS AN L NETWORK
640 IFQ=0THENPRINT"USE A DIRECT CONNECTION!":GOTO220
650 X3=Q*R2
660 X1=R1/Q:C1=0:C2=0:X2=X1
670 IFY1=1THEN360
680 C1=1/2/PI/F/X1
690 GOTO370
700 END
```

Sample run.

```
READY
RUN

PI NETWORK DESIGN
FREQUENCY (MHZ)? 150

INPUT Z? 50
LOAD Z? 300
Q VALUE (MIN  2.23607 )? 12

O------UUUUU------O
  |       L       |
  |               |
 ---             ---
 --- C1          --- C2
  |               |
  |               |
O-----------------O
 50              300
L= 37 NH
C1= 42 PF
C2= 102 PF

ANOTHER Q VALUE? YES
Q VALUE (MIN  2.23607 )? MIN

O------UUUUU------O
  |       L       |
  |               |
 ---             ---
 --- C1          --- C2
  |               |
  |               |
O-----------------O
 300             50
L= 119 NH
C1= 8 PF
C2= 0 PF

ANOTHER Q VALUE? NO
IMPEDANCE CHANGE? YES

INPUT Z? 25
LOAD Z? 1000
Q VALUE (MIN  6.245 )? 10

O------UUUUU------O
  |       L       |
  |               |
 ---             ---
 --- C1          --- C2
  |               |
  |               |
O-----------------O
 25              1000
L= 118 NH
C1= 11 PF
C2= 52 PF

ANOTHER Q VALUE? NO
IMPEDANCE CHANGE? NO
ANOTHER FREQ? NO
MORE? NO

READY
```

same value.

In each L-network, the transformation ratio increases with higher Q values. For a Q of zero, the component values diminish to zero; thus the program specifies a piece of wire as the answer to this problem!

When you give it a problem, it always calculates the minimum Q required to do the job. (Remember: The lowest Q is the lowest loss and the least critical in parts values.) If you need a higher Q for filtering action, you simply enter it. On the other hand, if an L-network is desired, just enter "MIN" and the computer will use the value it already has, saving you the trouble of re-entering it.

It then prints out the circuit and gives parts values. Afterwards, you have a chance to change the frequency or the impedance ratio, or to enter a new problem before leaving the program.

An effort was made to "bulletproof" the program by filtering out negative values and divide-by-zeros and by providing for the accommodation of impedance values without regard to whether the first is greater or less than the second. The schematic always labels the impedances of each port so you don't get them mixed up.

The program was written for MITS extended BASIC with multiple statements per line, plus some functions such as "PRINT USING" and "SWAP," but these are easily purged for running it on other BASICs.

Finally, my apologies to those who have much memory in their system. The statements are not separated by spaces for those who do not! ■

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A Better Micoder™

—no more battery woes

Good-bye to mushy audio.

If you are one of the many who own a Heath HW-2036 synthesized 2 meter rig with the Micoder™, here is a way to eliminate that 9-volt battery for good. Not only is the modification simple, but you end up with a much lighter microphone along with an end to those embarrassing moments when you hear, "Your audio sounds real low and kinda mushy." Here's how to do it:

1. Open up the microphone case and remove the case from your HW-2036. Locate both ends of the black wire in the mike cable (one end goes to terminal 1 on the terminal strip inside the mike and the other end goes to terminal 2 on the three-terminal strip inside the rig) and clip them free.

2. Clip out the battery connector inside the microphone and remove it. The red wire should be removed from pin 5 of SW101 and the black wire comes off terminal 1 of the two-terminal strip.

3. Solder the free black wire inside the mike to pin 5 of SW101.

4. Solder a 270-Ohm resistor to the wire (WHT-ORG) going to C515 on the vco assembly. The resistor should be soldered to the WHT-ORG wire near the ferrite bead.

5. Cover the resistor and leads with spaghetti or some other insulating cover and connect the free end of the resistor to the free black wire inside the rig. After carefully checking that all leads are properly insulated, put everything back together and get back on the air. ■

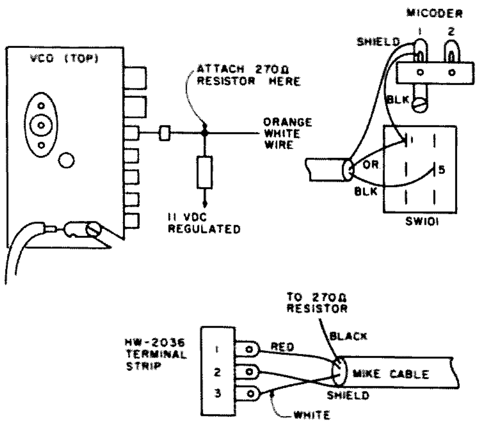

Fig. 1. After modification. It doesn't matter whether the shield goes to pin 1 of SW101 or to the terminal strip, as long as both pin 1s are tied together.

Winning the QSO Name Game

—sure beats 3 x 5 cards

Put your info on the tip of your tongue.

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Would you like to have a fantastic memory with everyone's name on the tip of your tongue (keyboard)? Whether you are running for office, trying to borrow equipment, or just want to appear to be on the ball, this program will fill that need.

The number of newcomers appearing on the repeater scene increases every day. It is extremely difficult to remember everyone's name. Using my program, all you have to do is type in the call of the operator. The computer supplies you with his call and his name. A small piece of information can be included if you so desire.

I wrote this program using SWTPC 8K BASIC to run on my 6800-based machine. Southwest BASIC reserves 32 bytes for a string variable. This would allow 6 bytes for the call and 1 byte for a space. This leaves 25 spaces (bytes) available for the operator's name and a key word of information pertaining to that particular operator. If your memory is small, you might consider limiting the length of the string variables by adding DIM statements.

String variables in Southwest BASIC may be named any single alphabetic character or a subscripted letter. The subscripts permitted are 0 through 9 only.

```
10 REM ** 3 X 5 CARD UPDATE **
20 REM ** AMATEUR RADIO NAME DIRECTORY **
30 PRINT "ENTER THE AMATEUR CALL ";
40 INPUT C$
100 LET A$(1) = "WA3AOQ  BILL"
101 IF C$ = LEFT$(A$(1),6)  PRINT A$(1)
200 LET B$(1) = "K3BD  MIKE"
201 IF C$ = LEFT$(B$(1),4)  PRINT B$(1)
300 LET C$(1) = "K3CHD  DON"
301 IF C$ = LEFT$(C$(1),5)  PRINT C$(1)
400 LET D$(1) = "WB3DHB  PHIL"
401 IF C$ = LEFT$(D$(1),6)  PRINT D$(1)
500 LET E$(1) = "WA3ENU  RICH"
501 IF C$ = LEFT$(E$(1),6) PRINT E$(1)
  • • •
  • • •
900 LET I$(1) = "K3IXB  JOHN"
901 IF C$ = LEFT$(I$(1),5)  PRINT I$(1)
  • • •
  • • •
2500 LET Z$(1) = "W3ZCO  KEN"
2501 IF C$ = LEFT$(Z$(1),5)  PRINT Z$(1)
9000 FOR D = 1 TO 50
9010 NEXT D
9020 PRINT
9030 PRINT
9040 PRINT
9050 GOTO 30
```

Program listing.

When adapting my program for your own use, be sure to keep some type of line number organization to avoid confusion when adding new calls to memory. Assuming you are using the program for local 2 meter operation data, the call area will probably be the same for the majority of the entries. Therefore, concentrate on the last three letters of the operator's call. In my program, I assigned the line numbers as follows: 100-190 to the calls whose last three (or two as the case may be) letters begin with the letter A, 200-290 to those whose last three letters begin with the letter B, and so on through the rest of the alphabet. Those amateur calls contained in statement lines 100-190 would be assigned the string variables A$(0) through A$(9). Those in lines 200-290 (beginning with B) would be assigned B$(0) through B$(9) and so on. Line 9000 is inserted as a slight delay loop.

```
READY
#RUN

ENTER THE AMATEUR CALL ? K3IXB

K3IXB  JOHN


ENTER THE AMATEUR CALL ?
```

Sample run. User input is underlined.

"WA3MWM, WA3MWM—this is K3IXB calling."

Now, let's see, what is that guy's name? I know that I have worked him before! ■

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A New Approach To Nicad Care

—*charges up to ten at a time*

Is this going to be cheap? How about $1.75 for the two components required, besides the usual transformer, rectifier, and filter capacitor needed for any charger? Is it perfect? Connect any reasonable number of nicad cells (0-10) between the charging terminals, and the current will vary only a small fraction of a milliampere. The design is so simple that I think my brother-in-law could handle it.

Fig. 1 shows the schematic. The circuit and design data are given in the National Semiconductor *Voltage Regulator Handbook*, available at Radio Shack stores. Don't rush out and buy the book for this information, though. Herewith I will save you $2.25 on the cost of building your charger. Besides, using the data in the book requires a lot more time and measuring than using the cut and try system, if you have some idea of just what you are doing.

Your dc supply will have to furnish the following: the maximum voltage of the bank of cells you will want to charge and the rated voltage of the voltage regulator you will use plus its dropout voltage. Figure on approximately 30 volts for use with 10 nicads, but don't forget that the maximum you can use with the voltage regulator is probably 35 volts. Also, when using a voltage regulator, you must watch $I(V_{in} - V_{out})$, the power dissipated in the regulator. With a nominal 1 Amp regulator and the current you will draw, there will be no problem here.

I use a small power transformer rated 25.2 volts at .3 Amps, a silicon diode rectifier, and a 220 uF filter capacitor. Under the load you will use, the voltage is 31 volts. With R1 at 300 Ohms, the charging current is 45 mils exactly, when charging anything from one to ten cells. The transformer gets pretty warm, but not too warm. Everything else gets just barely warm. If you intend to charge at 100 mils, use a larger power transformer — everything else can be the same. I suppose you could incorporate a pot and a meter to make an adjustable-rate charger, but be sure to use a limiting resistor if you do use a pot in place of R1. I use a 220-Ohm shunt across the 300-Ohm R1 for a couple of batteries that can use a 100 mils charge. The transformer has to be "heat sinked," too. ■

Parts List

T1	25.2 V at 0.3 Amp (Radio Shack 273-1386)
D1	1 Amp silicon rectifier
C1	220 uF, 50 V (Radio Shack 272-1045)
VR	12 V at 1 Amp (Radio Shack 276-1771)
R1	selected to adjust charge rate (in the 300 Ω range for 0.05 A)
M1	suitable for charging rate desired (optional)

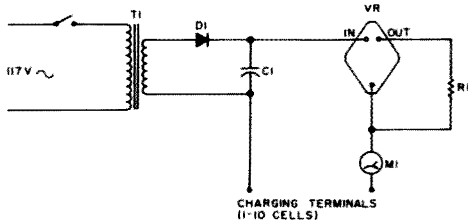

Fig. 1.

On the Razor's Edge

—it could happen

Hams, home-brewing, and hamburgers.

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On a country hillside outside Oklahoma City, George in one tree and Jerry in another tugged a dipole antenna up between them. Besides the two young men in the trees, other signs that this was a weekend could be seen in the distance where, although it was 8:30 in the morning, light traffic moved along the interstate highway—a few cars and a short caravan of army-green trucks. The day seemed to portend nothing headier than a satisfying hilltop QRP contact. The sun would not be too warm, and the breeze not too cool.

The boys were classmates. George was WD5XZF, and Jerry was an unlicensed CBer. George wanted to convert to real radio. From the center of the antenna, a length of coax dangled to the ground near their bicycles. In the basket of George's bike, wrapped in a cloth for protection, nestled an HW-8 transceiver which he was going to demonstrate to Jerry, and a pair of lantern batteries to power it.

The boys were so engrossed in centering the antenna between the trees so no leaves would touch the wires that they did not notice a black limousine leaving the road down at the edge of the field and starting up the grassy hill trailing a wake of flattened grass sweeping across the field towards them. They did notice when the car stopped by their bicycles. The driver got out and opened a rear door. A big man in a dark suit emerged from the rear and stood by the door.

"Jerry?" the big man called. "Gerald William Williams?" He spoke in exaggeratedly polite tones. Jerry climbed down from his tree. "Yes?" he asked.

"Your father has been hurt," the big man said. "He wants you to come right away." George had tied his guy rope and hurried down from his tree. He was standing by Jerry's side. "Excuse me," George said, "but who are you?"

"Come on, kid. We don't have all day." The hissing voice came from another man inside the car.

"George!" Jerry shouted. "It's my father. He's been hurt. Don't stand around asking questions. Let's go." He was already scrambling into the back seat of the huge automobile.

"You don't know these men," George started to say; then he felt himself held firmly and pushed toward the car. He began to resist, but then he saw that inside the car the small man held a pistol aimed roughly at Jerry's right eye. George let himself be shoved into the car. The big man threw himself into the seat next to George and slammed the massive door. The small man sat on a jump seat facing Jerry. The car started to move.

The windows had heavy curtains across them. A thick sheet of glass separated the rear seat area from the front. The small man reached out and flicked another curtain closed behind the driver.

"Like a snake striking," George thought. The small man was thin and dressed in a tight plaid suit that reminded George of snakeskin. The rear seat area was now a dark, closed compartment. The boys could not see out.

George considered diving for the door to get away. He looked at the door, then looked again. He looked at the other door. The big man saw his glance and smiled. The door handles and window handles had been removed. The doors could not be opened from the inside.

The men took off their neckties, then George and Jerry felt their arms pulled behind their backs and their wrists tied with the neckties. The big man lit a cigar, then spoke.

"You might as well relax," he said, puffing on his cigar and settling back into his seat. "We're going a long way. You're going so far from anywhere there won't be any point in trying to escape. Har-har," he laughed and puffed on his cigar. "Karaff-hack," he coughed, sputtering smoke.

They drove and drove. The ride was so smooth the boys could not tell if they were going slow or fast. The minutes flowed into an hour or two. George wanted to see outside.

Making believe the long ride had made him sleepy, he slumped over, leaning against the bear of a man, who obligingly moved over. Soon George was almost lying down on the wide seat. He had enough room. He lashed out his leg and pushed the curtain open with his foot. Quickly

he sat up and looked out.

He saw open fields, fence wire, and a telephone pole slipping backward. He saw these briefly, as if he were inside a large camera and the shutter has clicked open and shut once. A big hand threw the curtain shut.

"Don't try anything like that again," the big man growled. "You'll be sorry. I mean it."

George believed him. He was already sorry he had not learned more from his glimpse outside.

Finally the car's smooth motion stopped. The door swung open. The bright sun dazzled the boys' eyes.

The three men had a brief conversation next to the car. "The little one is more trouble than he's worth," the slender man hissed. "Williams is the one we want. Why don't I just blow the other one away?"

The driver took time to consider this suggestion. He looked into the car at George, then said, "No. Keep them both as long as they don't make any trouble. His old man may be worth something, too."

George felt they were just acting out this little skit to scare him into a cooperative mood. But, of course, he was not sure.

"Put them in the barn," the snake hissed to the bear.

Locked inside the barn, the boys struggled back to back and finally succeeded in untying each other's hands. Then Jerry sat down on a bale of hay and hit it with his fist. The bale was firmer than he had expected. He rubbed his hand and looked around to see what George was doing.

George walked around the barn, looking at everything in the dim light which sifted through the pigeonholes high up in all the walls. There was a hay door high above the loft. Slowly, George climbed an old ladder, testing each rung gingerly with more and more weight before finally trusting his balance to it. He reached the high door. "It's nailed shut," he called down just loud enough for Jerry to hear but not loud enough to be heard outside. "There are about a hundred ten-penny nails driven through to a couple of two-by-twelves I can see through the cracks. We'd never get through that."

Jerry's head sank lower and lower in his hands. George kept on searching. The pigeonholes and the locked main door were the only ways out. Jerry, feeling the minutes drag by, hit the hay bale again and again. George came back and reported on his explorations.

"No way out," he said, "but I found an old door buzzer installed in the back by the dairy stalls. The wires run all the way up to the rafters and then out the main door, but they're not connected to anything any more. The ends just dangle by the door."

"Wonderful," Jerry said sadly.

"But that's not all," George said with a smile. "I also found these." He held up an almost-empty paper towel roll and an almost-empty aluminum foil dispenser, left over, perhaps, from some picnic which had been forced by rain into the barn. "And I found a damp book of matches and put them in the sunshine by the crack of the door to dry."

"Wonderful," Jerry repeated. "I may cry."

"And there's some interesting junk in that barrel over there," George went on, pointing.

Jerry looked up through darker and darker eyes. He did not lift his chin from his hand. He did not answer.

"But best of all," George concluded happily, "this!" He stepped back and carefully picked up, from an old stone sink, one more prize: a rusty old razor blade.

Jerry looked from the razor blade in George's hand to George's eyes. Jerry's expression was so woebegone that George had to smile. "Here we've been kidnapped," Jerry began slowly, "we're locked in this barn without a hope of getting out, and even if we got out, we'd be a hundred miles from anywhere . . ."

"If you believe them," George interrupted, with a jerk of his thumb down toward the house.

"If you believe them," Jerry agreed. "But right now I do believe them. We're stuck out here without a hope, and our parents are probably worried sick right now because some strange hood is calling them demanding ransom for us, and you're gathering junk. If you're wondering why your enthusiasm depresses me, it's because I don't believe you're playing with a full deck."

"Wait," George said. "This may not be just ordinary junk. This may be . . . well, I have heard you can use these old blue steel razor blades for a detector in a crystal set instead of a crystal. It requires delicate adjustment of the cat's whisker, but they say it can be done, and I believe it. After all, any imperfect connection may rectify rf. That's why some people can hear local broadcast stations in their rain gutters or in their bedsprings."

"So?" Jerry asked.

"So," George said, pointing proudly to his little collection, "this junk might turn out to be radio junk."

Jerry groaned. "George, you have lost your mind," he stated judiciously. "Ham radio is all you can think about." He sagged forward and cradled his chin in his palms.

"Easy, buddy," George said. "This radio junk might give us an idea of where we are."

"You have a plan?" Jerry asked. He tried to sound sarcastic, but he couldn't help letting a little optimism creep into his voice.

"Yes, a plan—sort of," George went on. "If we know where we are, we might know what direction to go in if we get a chance. And besides, we don't have anything else to do right now."

"So what do we do?" Jerry no longer looked depressed.

"Well, we see if we can make a DF set, and . . ."

"DF?" Jerry asked.

"Direction-finding," George answered. "A direction-finding set is a radio receiver with a directional antenna. If we can hear stations in known locations, we might be able to locate ourselves in reference to them. We can try to make a crystal set out of the stuff we have; then we might be able to use it as a DF set by making a loop antenna out of the wire from the buzzer."

"Wow," Jerry said. Then he shook his head and hit the hay bale again. "And we do all this," he said, "with a piece of aluminum foil, a few paper towels, and an old razor blade?"

"Yes," said George. "And the bell wire from the door buzzer, this old jar lid, and a few more parts. We'll build it on the counter of this sink."

"Oh, no," Jerry groaned. "I remember what we needed when we made the crystal set at home: a variable capacitor and a coil, earphones, not to mention a crystal and holder, and an antenna and a ground system."

"You're right," George said. "But if we can use this razor blade as a detector, making the earphone will probably be the trickiest part. The rest shouldn't be too difficult. We'll make

the coil variable instead of the capacitor. We can use the wire that runs through the rafters to the old buzzer for our antenna, and this cold water pipe will be our ground."

"Okay," Jerry agreed. "We might as well try it."

"Good. Do you have any tools with you? I left all mine back with our bikes."

"I just have my pocketknife," Jerry said.

"Good. That should let us get to work."

"What should I do?"

"Well, to start the earphone, we'll need to find a couple of nails. And we'll need something to hold the razor blade steady."

"Good. What size nails?"

"Two-penny finishing would probably be good," George said. "I'm just guessing. We'll be happy with anything you can find that isn't too big or too rusty."

"Great," Jerry said happily, because he didn't know a two-penny finishing from a two-bit starting, whatever that might be. While Jerry searched, George stripped bell wire off the door buzzer magnets and wound it around the cardboard tube from the aluminum foil package. Using the pocketknife, he made slits in the tube to hold the wire. Then he stripped insulation from a path down the coil where the slider would contact the windings.

"How do we know how long to make the coil?" Jerry asked.

"We don't. We'll just have to make it as long as we can, and we'll make as much capacitor as we have foil and towel. Then we'll just hope for the best," George confided.

"Oh, I see," Jerry said. He was beginning to sound discouraged again. "Here's a couple of shiny nails," he went on. "And I found this." It was an old coffee can with a plastic cap.

"What's inside it?"

"It seems to be white flour, and the cap seems to have kept it fresh and dry. Should we throw out the flour and keep the can in case it might come in handy?"

"You seem to be getting into the spirit of scrounging," George said. "Yeah, you can if you want, but I don't really think we'll have any use for it."

Jerry began to tip the can to pour the flour into the barrel, then he stopped. "We can use this," he said smiling, almost beaming for the first time since he had clambered into the limousine. "I'll tell you about it later. What's next for the radio?" He soon found a large antique, and now rusty, C-clamp to hold the razor blade, then asked, "What next?"

"Let's see. You make the capacitor," George said. "Tear the aluminum foil in two and make a double sandwich with three paper towels. Put the sandwich flat on the sink counter and weigh it down with that big board over there. Scrape some insulation from the ends of some lengths of bell wire and make a lead from each plate. Scrape back six inches or more and we'll hope the pressure of the sandwich is enough to make contact. I'll try to make an earphone by pounding these nails a little way into a piece of wood and winding lots of bell wire around them. Later, we'll place the jar lid over the nails and hope there's enough energy in the coils to make the lid vibrate sound waves we can hear."

While they worked, Jerry said, "Did you know flour can be explosive? If it's dispersed in air, there's so much surface area that it can explode. My science teacher demonstrated that last year. He put some flour in the end of a rubber tube and a lighted candle under an inverted coffee can. Then he blew into the other end of the tube, blowing the flour around in the can. There was a loud boom, and the can flew in the air."

"Huh," George answered.

"And there's a stub of a candle in the trash can and a garden hose in the loft."

"Hmm," George said. They made their plans.

Later, the boys were ready to test what was perhaps the largest, roughest-looking crystal-less crystal set in the world. The homemade capacitor lay under its board. Wires ran from it to either end of the coil on the cardboard tube. Antenna wire dropped from the rafters and connected to one end of the tuner, the other end of which was connected to the cold water pipe. From the antenna end, another wire ran to the antique C-clamp Jerry had found, which held the razor blade upright. All electrical connections consisted of about a foot of scraped bell wire wound around and around the desired point. The cat's whisker touching the blade was a piece of bell wire anchored under a rock for stability. From there a wire disappeared under the jar lid, the diaphragm of the earphone. Another wire crept from under the lid to the cold water pipe.

"Well," George said. "That's our amazing crystal set."

"The amazing thing will be if it works," Jerry responded. He leaned over so his ear was over the jar lid. George moved the slider up and down the coil and looked questioningly at Jerry.

"Nothing," Jerry said.

George moved the cat's whisker to another part of the blade, then moved the slider again.

"Nothing," Jerry repeated. "Oh, why did we waste time with this thing anyway? Just look at it," he said in disgust. He reached out and, before George could stop him, slammed his fist down on the capacitor sandwich. Both boys heard a tiny tinny clink in the earphone.

Jerry bent over the earphone again and moved the slider along the coil. "There's something here," he said, "but I can't hear it well enough to understand."

"I was afraid of that," George said. He began to pace; the orbit of his pacing widened. Then his eye fell on an old oatmeal box in the trash barrel. "Hold this over the lid," he told Jerry.

Jerry then lowered his ear to the open mouth of the box. "That's it," he said happily, careful to keep his voice low. "It's a radio. It works. There's music."

"Great. Let me listen," George said. "Super!" he announced in his most judicious tones. "It's stronger than I dared to hope—which means you can just about hear it." While holding the oatmeal box earphone, he moved the slider. "There's another station," he said. He moved the slider up and down the coil slowly. "That's it," he said, "two stations, both fairly strong.

The boys shook hands triumphantly. Then Jerry leaned back over the oatmeal box. He listened in silence a while, then said, "Here, this is it. They're going to identify." He leaned close to the mouth of the box and held his breath so as not to miss the announcement. "Hey, it's KTOK!" he reported.

"KTOK?" George echoed. "That's Oklahoma City. That's home!"

Jerry started to shout, but then caught himself so quickly it would have sounded like little more

than a sneeze to anyone outside. He tuned down to the other station and listened. He started humming with the music. "Wait," he said. "It's over now. The DJ's talking. Wait. It's . . . yes. This is KNOR."

"KNOR — Norman!" George said. "That's a good sign. We can't be far from home. KNOR is at 1240, and KTOK is about one megahertz. I guess our radio only tunes the high end of the broadcast band. Let's make our DF loop."

They pulled all the stiff wire down from the rafters and wound it in a big loop, tying the loop to a board they could use for a handle. "Now let's see if we can hear anything at all," George said. He stood with the loop in front of him. "Do you hear anything now?"

Jerry, bent over the earphone, answered, "Nothing. Nothing at all."

George turned slowly, holding the loop in front of him. "Nothing, nothing," Jerry said.

"Tune it again," George suggested. "The different antenna could make a difference in the tuning."

Jerry moved the slider all the way down the coil,then slowly all the way back up. He tried the whole range of the coil again. "Nothing," he said. The boys looked at each other for a long minute while neither thought of anything to try or say. Then Jerry, perking up somewhat, said he would try one more time. He held his breath, and slowly slid the slider down the coil. "Nothing," he said. "No. Wait! There is . . . something . . . here, you'd better listen to this."

Jerry took the antenna from George, who put his ear to the oatmeal box. He heard a rhythmic hissing. He realized why Jerry had wanted him to listen. When his ear adjusted to the strange hiss, he could copy CW strong and clear: "OLZ OLZ OLZ DE W5RB QNI K."

"Well, I'll be," he said. "We can tune the 80 meter band. That's Gil calling the Oklahoma Traffic Net."

Jerry took a step toward George. The signal George was again copying became weaker. "No," George said. "Turn the other way. That's it. More. More. No, now it's getting weaker again. That's right, back this way a little. Right. Right there, I guess. He's due west of us."

"Wow," Jerry said. "Do you know this guy Gil?"

"I've contacted him on the net. I know he has a farm somewhere south of the city. His signal is really strong. We can't be very far from him."

"Okay," Jerry said, his voice quavering with eagerness and apprehension. "Let's get on with the plan. Step two."

"HEY! SNAKE! BEAR! DRIVER! COME QUICK! HEY, YOU THUGS, ON THE DOUBLE!" The boys yelled at the tops of their lungs, then they subsided and hid behind a wall of hay bales.

Soon they heard the crossbar moving on the main door, then the door opened a little — just a little. Nothing else happened. The boys watched the door. Jerry held one end of a water hose. The hose lay across the floor under the hay and ran under a dividing wall and into the stalls at the rear of the barn.

Into the strip of light at the door, first Snake's head appeared, then, over his, Bear's. They looked around, did not see the boys, and then looked at each other. George nudged Jerry to indicate "Now." Jerry blew into the hose.

BOOM!

From the back of the barn, a small explosion roared. The men at the door looked at each other, then ran past the boys, around the partition. George and Jerry burst from behind the hay and sprinted for the door. Outside, they pushed the door shut and locked it with the four-by-four crossbar.

"The driver," Jerry said. "Should we do step three?"

George hesitated a moment before answering. "Guess we'd better," he said. They ran to the limousine and opened both rear doors and the driver's window. George reached in and started blowing the horn while Jerry hid behind the car. He blew it again and again. The driver came out of the house and saw George.

"Hey, what are you doing out here?" the driver shouted and started to sprint to George. As he ran, he looked up at the barn and back at George, who turned deliberately and sat in the rear seat of the car. The driver reached the car and dived in after George. In another moment he would have grabbed George, but Jerry came out from behind the car and hurried around behind the man.

"Hey, you!" Jerry shouted. The driver hesitated for just the necessary moment. George got away.

The driver looked back at Jerry. "Hi there," Jerry said and slammed the door. The driver's face seemed to show in this moment that he understood what was happening but knew he couldn't react quickly enough to stop it from happening. George slammed the other door. The driver was trapped in the rear of the car with no inside door handles.

The boys started running west up a long slope as hard as they could go. Behind them they heard pistol shots from the barn. "They may be able to shoot their way out," George said. "Let's give it all we've got." Jerry, not wasting his energy talking, was passing George.

Cresting the hill, looking into a valley under the setting sun, the boys saw a tall tower with a large beam antenna on top. The house below the tower was strung with various wire antennas. The two boys ran about 200 yards from the crest of the hill to the door of the house. They knocked on the door, then banged on it.

The door opened. A thin man with grey hair and friendly eyes stood in the doorway.

"You're Gil W5RB, right?" George gasped, between gulping air. "I'm George WD5XZF. We were kidnapped and we escaped. Please let us in."

Gil stepped out of the way. Breathless, the boys ran in, and, while Gil closed and locked the door, relaxed for a moment in the luxuriance of repeated deep breaths.

"It's good to meet you," Gil said, and shook George's hand. George introduced Jerry while Gil picked up the telephone, and Jerry also felt the firm handshake.

"Uh-oh," Gil said, looking at the telephone receiver in his hand. He jiggled the cradle up and down, listened again, then lowered the receiver to its cradle.

"The phone just went dead, boys," he said, his face serious. "That means your friends are out there."

"And they have guns," Jerry said.

"Pistols," George said.

"So I guess we're just sitting ducks," Jerry said sadly. "They can push their way in here and . . . "

"I doubt if they'll rush us right away," Gil said. "They probably expect a farmer to be armed. They'll feel the situation out for a while. And we have another card to play." He turned toward the rear of the house.

The boys followed into a

back room full of radio equipment: cabinets and racks of meters, dials, knobs, and switches. "Uh-oh," Jerry said. "Your clock has stopped."

"They found the main power switch in the barn," Gil said. "But I wasn't going to use the big rig anyway." He picked up a small handie-talkie, pressed the button, and talked into the grill.

"K5VJO, this is W5RB."

After a minute's pause, the answer came loud from the grill on the little instrument. "W5RB from K5VJO. It took me a while to get back to the jeep, Gil. What's up?"

"Jeep?" Jerry asked.

"Jeep," Gil affirmed with a smile, then pushed the mike button. "Al, this is a Mayday. Repeat, Mayday. Two young men were kidnapped this morning and taken to the abandoned farm next to me. They escaped to my house. The kidnappers are outside right now, armed with pistols."

"Okay, Gil," the voice from the radio said. "We'll take care of it. Hang loose, now."

"Thanks, Al," Gil said. He turned to the boys. "I heard Al on the air earlier today. He's on weekend drill with the National Guard around Edmond."

"I'd feel a lot better if . . ." Jerry began.

"Let's try not to worry," Gil said. "I think we've done all we can for now. Would you boys like something to eat?" He carried his handie-talkie into the kitchen, and of course the boys followed.

"You talked to Edmond with that little thing?" Jerry asked.

"That's right," Gil said. "Our club has a repeater up on the channel 9 tower. We're just one of hundreds of repeater clubs around the country. The repeater picks up our handie-talkie and automobile-mobile transmissions and retransmits them from its high, central location, covering the whole metropolitan area. I heard Al say he was going to monitor the repeater during his Guard drill. He's Emergency Coordinator with the Air Cavalry unit."

Gil put a big frying pan on the stove and took some hamburger patties from the refrigerator. Soon the patties were sizzling in the pan and the boys were spreading catsup, mayonnaise, and mustard carefully to the edges of their sliced hamburger buns. They were pouring three glasses of milk when the house began to shake in a violent flapping thunder. They ran to the window, cautiously parted the drapes, and looked outside. Five giant army-green helicopters circled and swooped toward the house from five different directions. As the boys watched, the kidnappers ran out of the barn toward the limousine. One chopper landed in a terrible cloud of dust next to the car. Four Guardsmen, dressed in fatigue uniforms and combat boots and armed with M-14 rifles, jumped to the ground and faced the kidnappers, who stopped, looked astounded, shook their heads in disbelief, and then threw their pistols to the ground and raised their hands.

The ground fell away dizzyingly. The boys felt their insides pressing down. The earth below tipped and rotated. It was their first ride in a chopper. In all the excitement they had forgotten their hamburgers. They were eager to get back to their hillside, back to their bicycles, and then to get home to supper. ■

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73 Magazine *Staff*

Tips for VOM Users

— current topics

Put some meaning into your measurements.

Most amateurs, when they learn about test instruments, particularly multimeters, understand that such instruments must not be used in such a manner that they "load" the circuit being tested. Otherwise, readings will be obtained which do not truly indicate the parameter one is trying to measure. In the case of multimeters when measuring voltage, the Ohms/volt rating of the multimeter can be used to determine the loading effect the multimeter will have on a circuit when the meter is used on any given voltage range.

However, a point that is often neglected when using multimeters is to evaluate what effect the meter is having on a circuit when measuring current. This point was not stressed when many old-timers learned radio, but today, with the widespread use of low-voltage, high-current circuits, due to the use of solid-state devices, it can take on considerable significance.

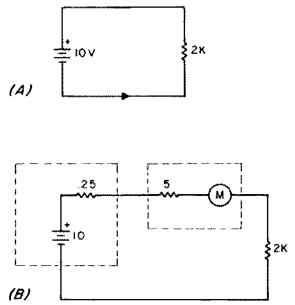

Fig. 1.(a) Simple resistor circuit and (b) representation of other circuit resistances that should be considered when measuring current flow.

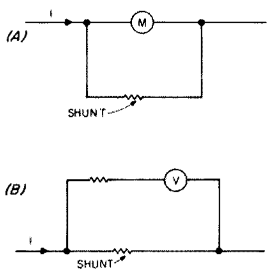

Fig. 2. Two methods of using shunt resistors for measuring current.

There are two points to watch in making current measurements. One is the relationship of the resistance of the meter being used to measure current in comparison to the other resistances in a given circuit as far as it affects the current reading. For instance, in Fig. 1, we have a circuit represented by the 2,000-Ohm resistance powered by a 10-volt battery, and want to measure the current flow.

If we insert a milliampere meter in the circuit, as shown in Fig. 1(b), two other resistances actually have to be taken into account. One is the internal resistance of the battery, and the other is the internal resistance of the meter. These are represented by the 0.25-Ohm and 5-Ohm resistors, respectively. If we had just the elements of Fig. 1(a), a 5.0-milliampere current would flow. With the added resistances of Fig. 1(b), one can easily enough calculate, using Ohm's Law, that 4.99 milliamperes flows in the circuit.

Since this certainly checks out closely enough, let's consider the other point to be careful of in making current measurements—how the the relationship of the resistance of the meter being used to measure current flow in comparison to the other resistances in the circuit changes the operating voltage across the circuit. Remember that the circuit was represented by a 2,000-Ohm resistor. In reality, of course, many cir-

cuits are not linear in their loading characteristics across a supply voltage. That is, the apparent resistance will change according to the supply voltage used. So, if a meaningful current measurement is to be made, the process of taking it must not significantly change the voltage across a circuit. For the case of Fig. 1(b), it does not take too much exercise of Ohm's Law to calculate that the actual voltage across the 2,000-Ohm resistor is practically unaffected at 9.97 volts.

One may ask why the foregoing should be worried about when taking current measurements if the meter's effect on the circuit is so insignificant. The example cited does represent realistic values. That is, 5 Ohms resistance for a 5- or 10-milliampere instrument would represent the coil resistance of a good quality d'Arsonval-type meter movement. However, in reality, one usually doesn't use a basic milliampere meter, but, rather, the current ranges on a multimeter. The usage of the latter brings about a new set of conditions.

Classic ammeter circuits are usually formed by using a basic meter movement and then placing shunts across it as shown in Fig. 2(a). However, in most of the imported multimeters which abound in ham shacks, the meter in the multimeter is actually used as a voltmeter when current measurements are being made, as shown in Fig. 2(b). The meter has a resistance in series, and then the voltage is measured across a current shunt. The reason for doing this is that many multimeters use quite sensitive meter movements (as low as 10 microampere movements) in order to achieve good sensitivity on voltage measurements, or, said in another way, to achieve a high Ohms/volt characteristic so loading effects when taking voltage measurements are minimized. To use these meters directly in the current measuring scheme of Fig. 2(a) would require extremely close tolerance and, hence, expensive shunts. This is particularly true for the higher current ranges, since the percentage of the total current that can flow through the meter becomes very small.

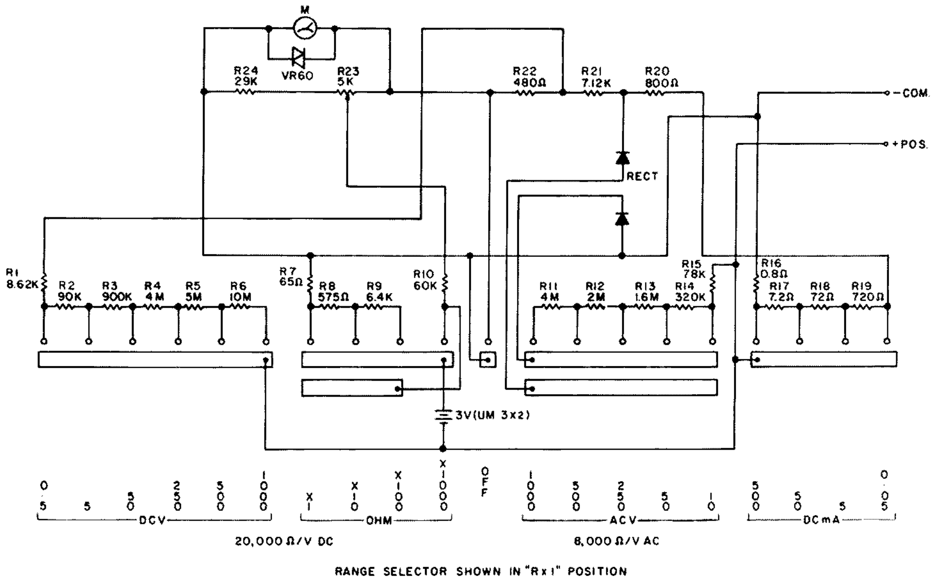

Fig. 3. Typical schematic of moderately-priced ($15-35) multimeter. Note the arrangement of the resistors for the current ranges on the right side.

Fig. 3 shows the diagram of a typical medium-quality multimeter. Note that, for the current ranges, the meter is set up to measure the voltage across current-shunt resistors of approximately 80, 8, or 1 Ohm. The voltage drops that were measured across the terminals of the multimeter when it was used for different current measurements are shown in Table 1.

If one looks at the voltage drops across the meter terminals for full-scale deflection on any of the milliampere ranges, the message should be getting clearer. Up to ½ volt lost across the meter terminals can be very significant when trying to measure the current drawn by some low-voltage battery-operated circuit or some high-current IC circuit. The ½ volt represents 17% of the supply voltage for a 3-volt circuit and 11% for a 4.5-volt circuit. But one cannot relate these percentages directly to the error in the current being measured. As was mentioned before, circuit loading is often not linear. So a small increase in the actual voltage across a circuit may increase the current drawn from a supply by a significant amount. Therefore, the real error in current measurement might be several times greater than the basic percentage error might indicate. This can have significant effects when trying to troubleshoot equipment, evaluate what sort of batteries to use for a circuit, check the power dissipation of a low-voltage circuit, etc.

The foregoing tabulation also indicates how one can overcome the situation. Namely, by measuring current on a range which produces minimum meter deflection so as to reduce the voltage drop in the multimeter. Of course, one sacrifices accuracy of measurement in this manner, but that is the compromise required with moderately-priced multimeters. It would be a good idea to check the actual voltage drops on the current ranges on a multimeter using another instrument and affix a small label to the multimeter giving the values. Who knows? Maybe someday even the manufacturers will do this along with the Ohms/volt figures they seem more eager to advertise. ■

Range	Current	V. Drop	Current	V. Drop
50 A	10 A	.025	50 A	.075
5 mA	1 mA	.075	5 mA	.4
50 mA	10 mA	.08	50 mA	.4
500 mA	100 mA	.16	500 mA	.5

Table 1.

Social Events

CIRCLEVILLE OH
MAR 4

The King of the Pumpkin Ham Fiesta, sponsored by the Teays Amateur Radio Club, will be held from 9:00 am to 5:00 pm on Sunday, March 4, 1979, at the fairgrounds coliseum, Circleville, Ohio. There will be an indoor flea market, new and used equipment, door prizes, refreshments, and free parking. Table spaces are available at $3.00 each. Advance admission is $1.00; $2.00 at the door. For advanced reservations and information, contact Dan Grant W8UCF, 22150 Smith Hulse Road, Circleville OH 43113; (614)-474-6305.

STERLING IL
MAR 4

Sterling Rock Falls Amateur Radio Society will hold its annual hamfest on March 4, 1979, at the Sterling High School Fieldhouse, 1608 4th Avenue, Sterling, Illinois. Tickets are $1.50 in advance; $2.00 at the door. A large indoor flea market is restricted to radio and electronic items only. There is plenty of free parking available, including an area to accommodate campers and mobile trailers. There will be no advance sale of tables. We will take reservations for commercial enterprises only. There will be bargains, miscellaneous prizes, and food. Talk-in on 146.94. For tickets, write Don VanSant WA9PBS, 1104 5th Avenue, Rock Falls IL 61071. Make checks payable to Sterling Rock Falls Amateur Radio Society. Please include an SASE.

DEMAREST NJ
MAR 10

The Chestnut Ridge Radio Club will hold its flea market on March 10, 1979, at the Demarest Methodist Church, 109 Hardenburg Road, Demarest, New Jersey. Tables are $5.00, and tailgating is $3.00. There is no admission fee for buyers. There will be hot dogs, soda, and door prizes. For more information, contact Jack Meagher W2EHD at (201)-768-8360, or Andy Woerner K2ETN at (201)-261-1047.

FLEMINGTON NJ
MAR 17

The Cherryville Repeater Association will hold its annual hamfest on March 17, 1979, from 10:00 am to 5:00 pm, at the Field House of Hunterdon Central High School, just north of Flemington, New Jersey, on Route 31. Admission is $2.50 per person. There is plenty of space, with over 200 sellers' tables, and displays from major manufacturers. There will be seminars and door prizes.

VERO BEACH FL
MAR 17-18

The Treasure Coast Hamfest will be held on March 17-18, 1979, at the Vero Beach Community Center, Vero Beach, Florida. Activities will include prizes, drawings, and a QCWA luncheon. Admission is $3.00 per family. Talk-in on 146.13/.73, 146.52/.52, and 222.34/223.94. For information, write PO Box 3088, Vero Beach FL 32960.

MIDLAND TX
MAR 18

The Midland Amateur Radio Club is having its annual swapfest on Sunday, March 18, 1979, at the Midland County Exhibit Building, Midland, Texas. There will be door prizes. Preregistration is $4.50; $5.00 at the door. Talk-in on 146.16/146.76. For information, write Midland Amateur Radio Club, Box 4401, Midland TX 79701.

JEFFERSON WI
MAR 18

The Tri County ARC Hamfest will be held on March 18, 1979, at the Jefferson County Fair Grounds, Jefferson, Wisconsin. Advance tickets are $1.50. Reserved 6-foot tables are $2.00 in advance, while 6-foot space is $1.00. For information, send an SASE to Glenn Eisenbrandt WA9VYL, 711 East Street, Fort Atkinson WI 53538.

LAWTON OK
MAR 23-25

The Lawton-Fort Sill Amateur Radio Club, Inc., will hold its 33rd annual hamfest at the Montego Bay Motel Complex at Lawton, Oklahoma, the weekend of March 23-25, 1979. There will be the usual large flea market, ARRL officials, technical programs, QCWA breakfast, and activities for the ladies.

EAST RUTHERFORD NJ
MAR 24

The Knight Raiders VHF Club, Inc., will hold its world-famous flea market at St. Joseph's Church, East Rutherford, New Jersey, on Saturday, March 24, 1979. Doors open at 10:00 am. There will be free admission and free parking. Refreshments will be available. Flea market tables are available for: $5.00/full table or $3.00/half table, in advance; $6.00/full table or $3.50/half table, at the door. Talk-in on 146.52 and 144.65/145.25. For further information, call Bob Kovaleski at (201)-473-7113 or Jack Mandelberger at (201)-857-0016 (evenings only). Send reservations to: R. Wetzel, 419 Union Ave., Rutherford NJ 07070, and make checks payable to: Knight Raiders VHF Club, Inc.

FT. WALTON BEACH FL
MAR 24-25

The Playground Amateur Radio Club will hold its ninth annual North Florida Swapfest on Saturday and Sunday, March 24-25, 1979, at the Ft. Walton Beach City Fairgrounds, Ft. Walton Beach, Florida. Advance registration is $1.00; $1.50 at the door. Swap tables and meetings are all under cover. There will be QCWA, MARS, and ARES seminars. Talk-in on 52 and 19/79. For more information, write PARC, Box 873, Ft. Walton Beach FL 32548.

WAUKEGAN IL
MAR 25

The Libertyville and Mundelein Amateur Radio Society will hold its second annual Lamarsfest on Sunday, March 25, 1979, at the J. M. Club, 708 Greenwood Ave., Waukegan, Illinois. Doors will open at 7:00 am.

There will be plenty of free parking, door prizes, and a large indoor flea market for radio and electronic items. Tables will be available at $4.00 each. Advance tickets are $1.50; $2.00 at the gate, with children under 10 free. Hot lunch will be available and there will be plenty of commercial exhibits and demonstrations. Talk-in on 146.94. For further information, write LAMARS (include SASE, please) at 1226 Deer Trail Lane, Libertyville IL 60048, or call (312)-367-1599.

MAUMEE OH
MAR 25

The Toledo Mobile Radio Association will hold its 24th annual auction and hamfest on March 25, 1979, at the Lucas County Recreation Center, Maumee, Ohio. Tickets are $2.00 in advance, $2.50 at the door. Parking is free. Prizes include a Kenwood TS-520, a Yaesu CPU-2500R/K, a Wilson Mark IV, and a Bearcat 210 Scanner. Talk-in on 146.52/.52 and area repeaters on 146.01/.61, .19/.79, .34/.94, .87/.27, and .975/.375.

MUSKEGON MI
MAR 30-31

The Muskegon Area Amateur Radio Council is sponsoring the ARRL Great Lakes Division Convention and Hamfest at the Muskegon Community College in Muskegon, Michigan, on March 30-31, 1979. This event will feature manufacturers' exhibits, technical forums, and a large swap shop. Ample parking and dining facilities are available. Friday evening at the Muskegon Ramada Inn, there will be a "Ham Hospitality" with libation courtesy of the MAARC and a Wouf Hong initiation. For additional information, contact MAARC, PO Box 691, Muskegon MI 49443, or H. Riekels WA8GVK, (616)-722-1378/9.

ST. LOUIS MO
MAR 31

Mayor Conway of St. Louis has proclaimed March 31st as Amateur Radio Day, and, in conjunction with this, the Gateway Amateur Radio Association is sponsoring a hamfest which promises to be a good one. Hamfest hours are 8:00 am to 6:00 pm at the H. J. Cervantes Convention Center. Scheduled events include: Wayne Green on microcomputers, an antenna forum by Hy-Gain, an FM and repeater forum by Motorola and VHF Engineering, FCC Q & A, a station-design forum by Drake, a low-cost transceiving forum by Atlas, a linear amplifier forum by ETO, a DX forum featuring the Navassa group and N9MM, a revolutionary method of learning Morse code, and an

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OSCAR forum. There will be special meetings for teenage hams, Ten-Ten members, Breakfast Clubbers, SWOT members, YLRL members, and others. Activities for YLs include a fashion show, a cosmetic display, and a tour of St. Louis. Talk-in on .34/.94, .37/.97, and .52. Admission is $3.00. For further information, please contact Bob Heil K9EID, PO Box 68, Marissa IL 62257, or phone (618)-295-3000.

WORCESTER MA
MAR 31

The WPI Wireless Association will sponsor its first annual Spring Flea Market on Saturday, March 31, 1979, from 9:00 am to 4:00 pm, at the WPI campus in Worcester, Massachusetts. For more information, write WPI Wireless Association, Box 2393, Worcester Polytechnic Institute, Worcester MA 01609.

COLUMBUS GA
MAR 31-APR 1

The Columbus Amateur Radio Club will hold its first annual hamfest from March 31-April 1, 1979, at the Columbus Municipal Auditorium, US 27 & 280, Columbus, Georgia. Donation is $1.00 at the door. There will be plenty of free parking and overnight free RV space. Exhibitors and flea market will be inside, with a free flea market outside. Talk-in on 28/88. For advance registration and details, write Bob Glasgow N4BGN, 1503 Layard Drive, Columbus GA 31907; (404)-561-7746.

NATCHEZ MS
APR 1

The Old Natchez ARC Hamfest will be held on Sun-

day, April 1, 1979, at the Natchez Convention Center, Natchez, Mississippi. The event will be indoors and air-conditioned. There will be free admission and swap tables. Talk-in on 146.31/.91 and 146.52. For information, write ONARC, 1226 Magnolia Avenue, Natchez MS 39120.

PAINESVILLE OH
APR 1

The Lake County A. R. A. will hold its 1st annual Lake County Hamfest on April 1, 1979, from 8:00 am to 4:00 pm, at the Lake County Armory, located next to the N. E. corner of the Painesville Fairgrounds, Rt. 20, Painesville, Ohio. There will be indoor space for exhibitors, a flea market, and an auction. Reserved tables are $2.00 for a full table and $1.00 for a half table. Admission is $2.00 with children under 12 free. Talk-in on 52/52 and 147.81/147.21. For information, write L'CARA, PO Box 868, Painesville OH 44077, or call (216)-257-4486.

PHILADELPHIA PA
APR 1

The Penn Wireless Association will hold its Tradefest '79 from 8:00 am to 4:00 pm at the National Guard Armory, Southampton Road at Roosevelt Blvd. (Rt. 1), ½ mile south of turnpike exit 28. General admission is $2.00. Setup is at 7:00 am. Sellers may rent a 6' x 8' space for $3.00; you must bring your own table. Some tables are available for $1.00, and a minimum number of power connections are available for $2.00. There will be refreshments, displays, and a rest area. Talk-in on 146.37/.97 and 146.52. For more information, contact Chuck Miller AD3X, (215)-943-3973.

TOWSON MD
APR 1

The Greater Baltimore Hamboree will be held on Sunday, April 1, 1979, beginning at 8:00 am, at Calvert Hall College, Goucher Blvd. and LaSalle Road, Towson, Maryland. The college is located south of Exit 28, Beltway (Interstate 695). There will be food, prizes, and a giant flea market. Admission is $3.00. There will be tables available inside the gym and the cafeteria. For information and table reservations, contact Bro. Gerald Malseed W3WVC at Calvert Hall College, 8102 La Salle Road, Towson MD 21204, or call (301)-825-4266.

ROCHESTER MN
APR 7

The Rochester Amateur Radio Club and the Rochester Repeater Society will hold their Rochester Area Hamfest on Saturday, April 7, 1979, at St. John's School Gymnasium, 490 W. Center St., Rochester, Minnesota. Doors will open at 8:30 am. There will be a large indoor flea market for radio and electronic items, prize raffles, refreshments, and plenty of free parking. Talk-in on 146.22/.82. For further information, contact RARC, c/o KØTS, 2514 N.W. 4th Ave., Rochester MN 55901.

MADISON WI
APR 8

The Madison Area Repeater Association, Inc., will hold its seventh annual Madison Swapfest on Sunday, April 8, 1979, at the Dane County Exposition Center Forum Building in Madison, Wisconsin. Doors will open at 7:00 am for sellers and exhibitors and at 8:00 am for the public. The Forum Building has over 20,000 feet of space for exhibitors and the flea market. There will be plenty of space for parking, with overnight camping available. Hotel accommodations are also available within walking distance of the Swapfest. There will be door prizes, an all-you-can-eat pancake breakfast, and a Bar-B-Q lunch, as well as free movies throughout the day. Admission is $1.50 in advance and $2.00 at the door. Tables are $3.00 in advance and $3.50 at the door. Children twelve and under are admitted free. Talk-in on WR9ABT, 146.16/.76. For reservations or information, write M.A.R.A., PO Box 3404, Madison WI 53704.

KANSAS CITY MO
APR 21-22

The P.H.D. Amateur Radio Association, Inc., of Liberty, Missouri, will sponsor the tenth annual Northwest Missouri Hamfest on Saturday and Sunday, April 21-22, 1979, from 11:00 am to 5:30 pm on Saturday, and from 10:00 am to 5:00 pm on Sunday, at the Kansas City Trade Mart. The Trade Mart is located at the Kansas City Downtown Airport, with easy access to all area interstate highways, with unlimited parking adjacent to the 45,000 sq. feet of exhibition space. Display booth spaces are available at a minimal cost of $15 for a single and $25 for a double. For further information, contact L. Charles Miller WAØKUH, 7000 Northeast 120th Street, Kansas City MO 64166, (816)-781-7313.

TRENTON NJ
APR 22

The Delaware Valley Radio Association and the Lawrenceville Amateur Repeater Group will hold their annual flea market on Sunday, April 22, 1979, from 8:00 am to 4:00 pm, at the New Jersey National Guard 112th Field Artillery Armory on Eggerts Crossing Road off Route 206 in Lawrence Township, Trenton, New Jersey. Advance registration is $2.00; $2.50 at the gate with tailgating $4.00 additional—bring your own table. The selling area is indoors and protected from the weather. There will be ample parking, refreshments, and restroom facilities. Talk-in on 146.52, 146.07/.67, and 147.84/.24. For further information and reservations, write D.V.R.A., PO Box 7024, West Trenton NJ 08628.

DIXON IL
APR 22

The Rock River Radio Club will hold its 13th annual hamfest on Sunday, April 22, 1979, at the Lee County 4-H Center, 1 mile east of the junction of Rts. 52 & 30, south of Dixon, Illinois. Advance tickets are $1.50; $2.00 at the gate. There will be indoor facilities, a camping area, free coffee and donuts from 7:30 am to 8:30 am, prizes, and breakfast and dinner available. Talk-in on 146.52 and 146.37/.97. For advance tickets, mail to RRRC Hamfest, Chuck Randall W9LDU, 1414 Ann Ave., Dixon IL 61021.

WORCESTER MA
APR 27

The Central Massachusetts Amateur Radio Association, Inc., will hold its auction and ham flea market on April 27, 1979, at the Main South American Legion Post 341, Main Street at Webster Square, next to Atamian Motors, Worcester, Massachusetts. The doors open at 6:00 pm, with the auction beginning at 7:30 pm. At the auction, 15% of the profits will go to CMARA. The flea market tables are $5.00 (items $5 and less only). Dealers are welcome. There will be door prizes, raffles, and refreshments available. Talk-in on 146.37-146.97 and .52. For more information, contact Rene Brodeur WA1LEA, (617)-753-7480, or Dave Penttila K1COW, (617)-885-4995.

WILLIAMSPORT PA
APR 29

The West Branch Amateur Radio Association will hold its 15th annual Penn Central Hamfest on Sunday, April 29, 1979, from 11:00 am to 5:00 pm at the Woodward Township Fire Hall, Rt. 220 south from Williamsport. For more information, write Richard Sheasley K3QDA, RD 1, Box 454, Linden PA 17744, or call Tony at (717)-322-6017.

SHREVEPORT LA
MAY 4-5

The Shreveport Amateur Radio Association will hold its annual hamfest on May 4-5, 1979, at the Louisiana State Fairgrounds. Pre-registration is $3.00; $4.00 at the door. This is an ARRL sanctioned hamfest.

NEENAH WI
MAY 5

The 3-F Amateur Radio Club will hold its annual swapfest on Saturday, May 5, 1979, from 8:00 am to 3:00 pm, at the Neenah Labor Temple, 157 S. Green Bay Road, Neenah, Wisconsin, just off Highway 41 at the Highway 114 or 150 exit. Facilities include a large parking area and a large indoor swap area with a free auction at the end of the day. Food and beverage will be available. Advance admission for tickets

Ham Help

I would like to contact any hams who practice transcendental meditation and would like to form a TM net—international, if possible.

Lee Ryan KB6IJ
1229 Park Row
La Jolla CA 92037

I am looking for information on the Level II BASIC kit for the TRS-80. I use the TRS-80 on RTTY and CW. I need the schematic points for the four-wire ribbon on the CPU board, the dip-shunt position after installation, and also for use of the enclosed resistor. I have the technical manual. I will gladly pay any postage or reproduction costs.

Jon J. Kilcoyne N8ACD
12824 Clyde Road
Fenton MI 48430

I am a high school teacher at the Stoneleigh-Burnham School in Greenfield MA, an independent boarding school for girls in grades 9-12. Many students here have expressed great interest in communications and are quite anxious to establish a ham radio club of their own. Many of the girls are avid shortwave listeners and are ready now to move up and get their Novice licenses.

If there is any individual or organization with extra or unused ham gear who would be able to make a tax-deductible donation to the school to start such a club, we would appreciate it if they would please write. We would like to pay all shipping and packing costs. Many thanks.

Jerry Nevins
Stoneleigh-Burnham School
Greenfield MA 01301

and tables is $1.50; $2.00 at the door. Talk-in on 52/52. For reservations, write to Mark Michel W9OP, 339 Naymut Street, Menasha WI 54952.

DEKALB IL
MAY 6

The Kishwaukee Radio Club and the DeKalb County Amateur Repeater Club will hold their 21st annual indoor/outdoor hamfest on Sunday, May 6, 1979, from 8:00 am to 3:00 pm at the Notre Dame School, 3 miles south of DeKalb between highway 23 and South 1st St. on Gurler Rd., DeKalb, Illinois. Tickets are $1.50 in advance; $2.00 at the door. Indoor tables are available or you may bring your own. The outdoor setup is free. Talk-in on 146.13/.73 and 94. For tickets and directions, send an SASE to Howard Newquist WA9TXW, PO Box 349, Sycamore IL 60178.

WARMINSTER PA
MAY 6

The Warminster Amateur Radio Club will hold its fifth annual "Ham-Mart" flea market and auction on Sunday, May 6, 1979, from 9:00 am until 4:00 pm, at the William Tennent Intermediate High School, Street Road (Route 132), two miles east of York Road (Route 263), Warminster, Bucks County, Pennsylvania. A registration fee of $1.00 per car includes one ticket for door prizes. Tailgating is $2.00 additional. Indoor tables are available for $3.00 each. Talk-in on 146.16/76 and 146.52. For further information, please write Horace Carter K3KT, 38 Hickory Lane, Doylestown PA 18901, or phone (215)-345-6816.

FRESNO CA
MAY 11-13

The 37th annual Fresno Hamfest will be held on May 11-13, 1979, at the Sheraton Inn, Clinton and Highway 99, Fresno, California. The program includes technical talks, swap tables and flea market, transmitter hunt on 2 meters (146.52), QLF contest, ARRL CD appointees meeting, ARRL-FCC forum, commercial exhibits, prizes, eyeball QSOs, prime rib banquet, and more. For full registration and eligibility for pre-registration prize, send in $17 before April 27, 1979; it's $19 and no pre-registration prize after that date. Talk-in on 146.34 /146.94. For more information, contact the Fresno Amateur Radio Club, Inc., PO Box 783, Dept. HF, Fresno CA 93712.

DEERFIELD NH
MAY 12

The Hosstraders Net will hold its 6th annual tailgate swapfest on Saturday, May 12, 1979, at the Deerfield Fairgrounds, Deerfield, New Hampshire. There will be covered buildings, in case of rain. Admission is $1.00, with no commission or percentage. Commercial dealers are welcome at the same rate. Excess revenues will benefit the Boston Burns Unit of the Shriners' Hospital for Crippled Children. Last year we donated over $1100.00. Talk-in on .52 and 146.40-147.00. For more information, send an SASE to Joe DeMaso K1RQG, Star Route, Box 56, Bucksport ME 04416, or Norm Blake WA1IVB, PO Box 32, Cornish ME 04020, or check the Hosstraders Net on Sundays at 4:00 pm on 3940 kHz.

SALINE MI
MAY 13

The ARROW Repeater Association will hold its annual Swap and Shop on Sunday, May 13, 1979, at the Saline, Michigan, fairgrounds. Admission, including parking on the fairgrounds, is $1.50 in advance and $2.00 at the door. There will be food, prizes, and a covered area for trunk sales, as well as indoor tables. Because of Mother's Day, wives will be given free admission. Talk-in on 146.37/97, 223.18/224.78, and 448.5/443.5 MHz. For additional details, write ARROW, PO Box 1572, Ann Arbor MI 48106, or call George Raub AD8X at (313)-485-3562.

CADILLAC MI
MAY 19

The Wexaukee ARA will hold its 19th annual swap and shop on Saturday, May 19, 1979, from 9:00 am until 4:00 pm at the National Guard Armory, 415 Haynes Street, Cadillac, Michigan. Tickets are $2.00. There will be free parking and lunches available. Talk-in on 146.37/.97. For more information, contact Robert Bednarick WD8RZL, Publicity Director, Wexaukee ARA, Cadillac MI 49601.

BIRMINGHAM AL
MAY 19-20

The Birmingham Amateur Radio Club will hold Birminghamfest '79 and the Alabama State Convention on May 19-20, 1979, at the Birmingham-Jefferson Civic Center Exhibition Hall, Birmingham, Alabama. There will be many of last year's exhibitors, including most major manufacturers and distributors. There will also be a huge indoor flea market, lots of exhibit space, meetings, forums, activities, and plenty of free parking. Plans are being made to again offer on-site FCC exams on Saturday morning. Prizes will feature at least three complete HF stations, several VHF rigs, and a home video tape recorder system. The Saturday night banquet will feature the nationally known comedian and Grand Ole Opry member Jerry Clower. Banquet tickets will be available in advance, by mail, while they last. For more information, write Birminghamfest '79, PO Box 603, Birmingham AL 35201.

DURHAM NC
MAY 19-20

The Durham F.M. Association will hold its annual Durhamfest on Saturday and Sunday, May 19-20, 1979, at the South Square Mall, Durham, North Carolina. Plenty of prizes, exhibits, and programs will be offered, and the XYLs can enjoy shopping. Ladies' bingo will be held on Sunday. Free tailgating spaces, under a covered, drive-in-and-sell flea market, come with a one-time $3.00 general registration ticket, with vendors and dealers included. Electrical power will be available. Harmonics and unlicensed XYLs are admitted free. Talk-in on 147.825-.225, 146.34-.94, 222.34-3.94. For more information, write DFMA, Box 8651, Durham NC 27707.

BURLINGTON KY
MAY 20

The Kentucky Ham-O-Rama will be held on May 20, 1979, at the Boone County Fairgrounds, Burlington, Kentucky, For easy access, take the Burlington exit off I-75 south. There will be a chance for prizes included with the $3.00 gate ticket. There will also be hourly drawings, exhibits, a flea market, and refreshments. Talk-in on 146.19/79 and 52/52. For more information, contact NKARC, Box 31, Ft. Mitchell KY 41017.

UPPER HUTT NZ
JUNE 1-4

The 1979 Annual Conference of the New Zealand Association of Radio Transmitters will be held on June 1-4, 1979, at Upper Hutt, New Zealand. Visitors are welcome to attend this conference. For registration forms, contact the Secretary, 1979 Conference Committee, PO Box 40-212, Upper Hutt NZ.

WEST HUNTINGTON WV
JUN 3

The Tri-State ARA will hold its 17th annual hamfest and family picnic on June 3, 1979, starting at 10:00 am, at the Camden Amusement Park, West Huntington, West Virginia. There will be a planned program for the XYL and kids, or you can enjoy the amusement park if you prefer. There is a possibility the FCC will administer amateur exams. There will be major prizes, a large flea market, exhibitors, and displays. Dealers are always welcome to space in the covered pavilion. Talk-in on 34/94 or 16/76. For more information, write TARA, PO Box 1295, Huntington WV 25715.

MANASSAS VA
JUN 3

The Ole Virginia Hams A.R.C., Inc., will hold the Manassas Hamfest on Sunday, June 3, 1979, at the Prince William County Fairgrounds, ½ mile south of Manassas, Virginia, on Route 234. There will be indoor and outdoor exhibit areas, dealers and manufacturers, and tailgaters. Also, included will be plenty of parking, prizes, an FM clinic, breakfast and lunch, a YL program, and children's entertainment.

SENATOBIA MS
JUN 9-10

The fourth annual Tri-State Hamfest will be held on June 9-10, 1979, in the coliseum of Northwest Junior College, Senatobia, Mississippi. Indoor air-conditioned space will be available for manufacturers, dealers, and distributors. For information, contact Joel P. Walker, 1979 Hamfest Chairman, PO Box 276, Hernando MS 38632; (601)-368-5277.

BELLEFONTAINE OH
JUL 1

The Champaign Logan Amateur Radio Club, Inc., will hold its annual hamfest on Sunday, July 1, 1979, at the Logan County Fairgrounds, South Main Street and Lake Avenue, Bellefontaine, Ohio. There will be free admission and door prizes. Trunk and table sales are $1.00, and there will also be a bid table. Talk-in on 146.52. For more information, contact John L. Wentz W8HFK, Box 102, West Liberty OH 43357, or Frank Knull W8JS, 402 Lafayette Ave., Urbana OH 43078.

Corrections

In addition to the corrections on page 171 of this month's issue, it is felt that a further clarification is in order. Also in "Light Up Your Life" (December, 1978, page 137, column 2, lines 36-38), the pin connections might have been better explained this way: Connect *readout* pins 3 and 14 and *IC* pins 16 to 5 volts. Pin 8 of the ICs should go to ground.

Gene Smarte WB6TOV
News Editor

Chamber of Horrors

—a true story

"We'll never see him again."

Stanley O. Coutant WB6WFI/LB
248 San Gabriel Ct.
Sierra Madre CA 91024

This was the summer I was going for the amateur Extra. It had been put off far too long. Besides, the new comprehensive code test would make it easy. Wait—that can't be me talking. Or have I finally cracked under the strain? That must be it—to even think the Extra could be easy.

After two weeks of daily study, the situation looks a bit more promising. Maybe I will try after all. At least I'll see what it's like, in preparation for the second attempt.

Okay, this is it. Do or die. Now or never. The cliches don't provide any comfort. The car seems colder than usual. The sky gloomier. My pulse rate is definitely increasing. The car's clock shows 6:05; the sun barely clears the mountains to the east as I back out of the driveway.

I arrive at 7, and already three or four others are either sitting in their cars or pacing out in front of the building. At 7:30 the street-level doors are unlocked, and a brief elevator ride brings us to the fateful floor where we set up camp to await the arrival of 8:00 am.

At 7:55, a lady sticks her head out of a certain doorway we have been studying and says, "All right, I want all the 20-word-per-minute people. . . those going for Extra Class only." I look around at the growing group of about 15. No one moves. I am the only one!

I steady myself against the wall, telling my rubber knees they'll have to do better, and follow her into the reception area amidst comments of "Been nice knowing you," and "We'll never see him again."

The lady and I stand in the still-dark reception lobby. She re-locks the door. I swallow hard. She walks around the desk, turning on the lights in the process. After opening the log at the appropriate page, she asks me to sign in. I am number one. The page is clean, except for the date at the top and the figures down the left margin. I can barely write. I am thankful I had typewritten my Form 610 application the night before.

After the paperwork is complete, the receptionist presses a button and a nasty 60-Hz buzz fills the room. I expect the floor to open beneath my feet, and I try to recall what I know about crocodiles. When the floor remains solid, I decide it is only the locking device on the door to the inner sanctum. I enter. There at the first desk is another lady, sharpening her fingernails. At the second desk is . . . a stranger! The fellow who administered my General and Advanced Class exams is nowhere to be seen! This ferocious-looking fellow is limbering up his "FAILED" rubber stamp with one hand and sorting through a box of cassette tapes labeled "Fast," "Faster," and "Ridiculous" with the other.

I take a seat in the still-empty glass chamber—the first seat, nearest the door.

The buzzer sounds again, and the other applicants begin filing in. And filing in. And still more, until the room is filled— 61 of us in all! Amidst all this humanity are two other Extra Class applicants who have turned up—one a General, the other a Novice of three months!

The examiner appears, grinning diabolically, with three sets of wireless headphones in his hands. "Who are the Extra Class applicants?" he asks. We foolishly raise our hands. He distributes the aforementioned instruments of torture.

"All right, you will hear one minute of practice code which you may copy if you wish but it won't count on the exam followed by five minutes which is the test after which you will hear the procedure signal AR at which time I will hand out questionnaire booklets with five multiple-choice answers per question from which you will select the correct answer and indicate your choice on the answer sheet in the proper box corresponding to the question number. Make no marks in the questionnaire booklets, only on the answer sheets. Are there any questions?"

The receiving test

begins. VVV VVV Got it. Solid copy so far. Hmmm. Sounds like a QSO I had the other night on 80 meters. Nice fist. Not bad at all. What? AR already? I don't believe it. The test is over? There must be some mistake. The examiner must have hooked us up to a receiver on 40 meters instead of the tape machine.

Here he comes, questionnaire booklets in hand, ready to be distributed. The 58 other applicants look on; expressions of sympathy and compassion are evident.

I read the first question. Easy. I've heard of these "buffer question" techniques. The answer is right there. The second question is equally simple. Two buffer questions out of 10? What is the Commission coming to? The third . . . the fourth . . . so obvious! I must be going to wake up soon, at home in my own bed.

The questions have all been answered. A double-check turns up no problems. Oh, well, I probably put the wrong letters in the boxes on the answer sheet.

Here comes the examiner again. Our papers vanish. So does he. The three of us look at each other, not daring to speak. I want to say, "Howdja do?", but nothing happens.

The examiner reappears. "Would the three people who took the code test meet me at the back table, please." It is not a question. We cower on our way to the back of the room, as 116 eyes follow our feeble progress.

The examiner leans close. He whispers: "All three of you aced the receiving test. Under the circumstances, I think we can skip the sending test." Three jaws drop. The examiner smiles. "Congratulations." He shakes our hands.

We float back to our seats. Our smiles must be obvious, as the remainder of the group breathes a collective sigh of relief on our behalf.

But why am I smiling? The theory test . . . the examiner was only playing with us—toying with our emotions! His smile must have been due to what he remembered was yet to come, that which I had momentarily forgotten.

The written exams are distributed. The ordeal begins anew. Only 49 questions after this one. 48 . . . 47 . . . Wait a minute—this is familiar—a lot like what I studied the past two weeks. Not too shabby!

I'm finished—one way or the other. I submit my materials. "Wait in the lobby, please, until your name is called."

The lobby is filled with people! The receptionist is telling a recent arrival, "There are over a hundred applicants so far this morning. Please take a seat and wait to be called."

One hour and 20 minutes later, a clerk appears. She's the one who was sharpening her fingernails earlier. She is carrying a handful of exams and application forms. "Anderson, you passed the Technician. Fill this paper out. Baker, you passed the Advanced. Fill this out, please. Coutant . . . let's see, yours was an Extra Class . . . hmmm . . . oh, here it is—you passed."

As she hands me my interim permit, I can't help but notice her smooth, nicely rounded manicure. She continues through the stack of papers, and we learn my fellow aspirants have both passed as well.

Outside, the sun, now high in the sky, has returned to its usual warm, bright self. It's a spectacular day! ■

✓ Reader Service—see page 211

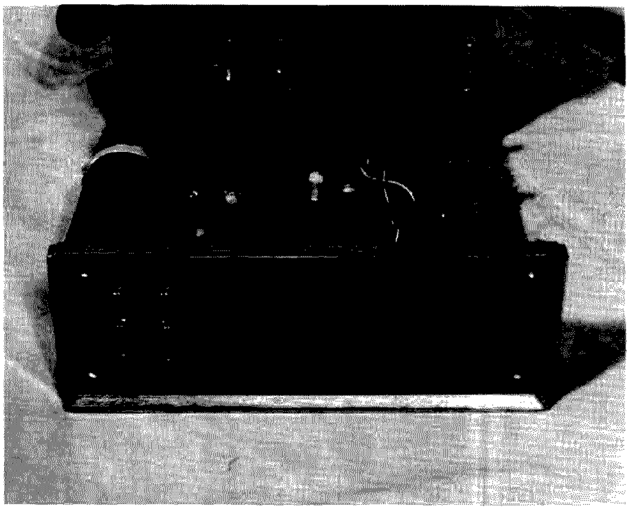
An Intelligent Scanner for the HW-2036

—it's programmable

Unique versatility.

Lawrence D. Schuldt WA9TAH
415 Wayne Rd., Rt. 1
Rochelle IL 61068

This article describes a programmable scanner designed to interface with the Heath HW-2036 transceiver, but capable of being modified to function with other transceivers using binary-coded-decimal synthesizer frequency control. This scanner also has a small instruction set to increase its versatility, a feature which I believe is unique.



View from front of scanner showing front panel layout with all indicators illuminated.

Overview

Frequency and channel number, along with other information, are presented to the user on an LED display. When the scanner's memory has control of transceiver frequency, the memory contents are displayed. When the thumbwheels control frequency, the LED display follows the thumbwheels. This has been found to be a

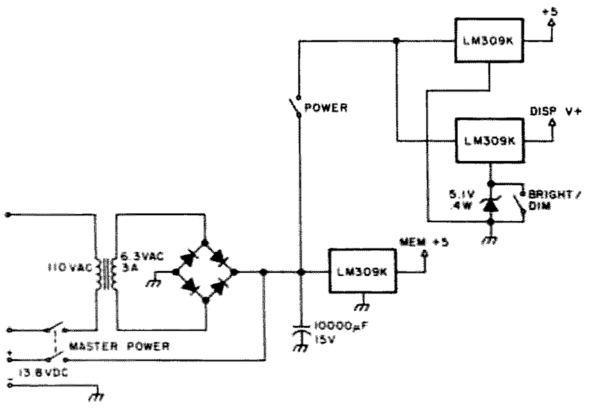


Fig. 1. Power supply.

Note on logic diagrams:

Total IC package count is 27. The numbering scheme is as follows. Components with numbers 100 and above are mounted on the display panel. Components numbered E1-E4 are in the first row on the board, E11-E14 in the second row, E21-24 in the third row, etc.

Not shown on logic diagrams are decoupling capacitors.

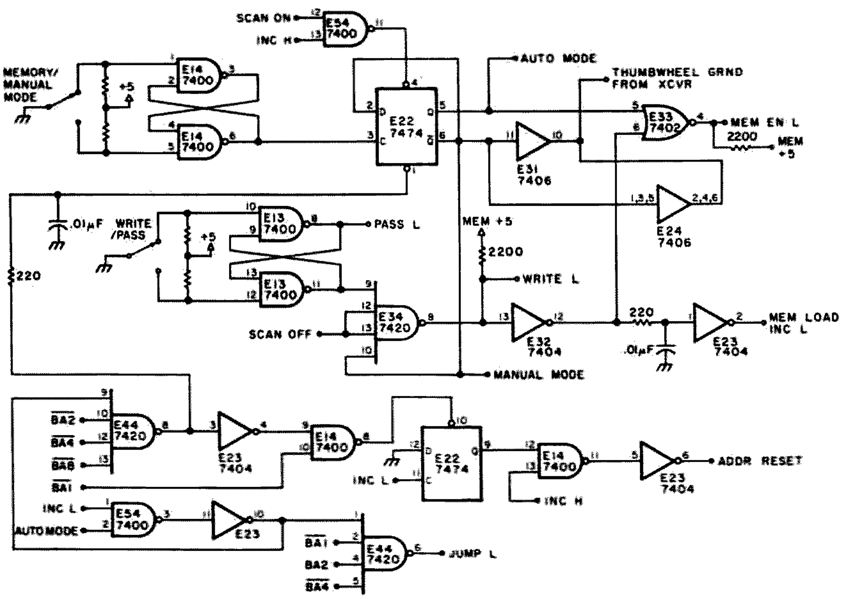


Fig. 2. Memory control and instruction logic. Resistors at E14-1, 5 and E13-10, 12 = 2200 Ohms.

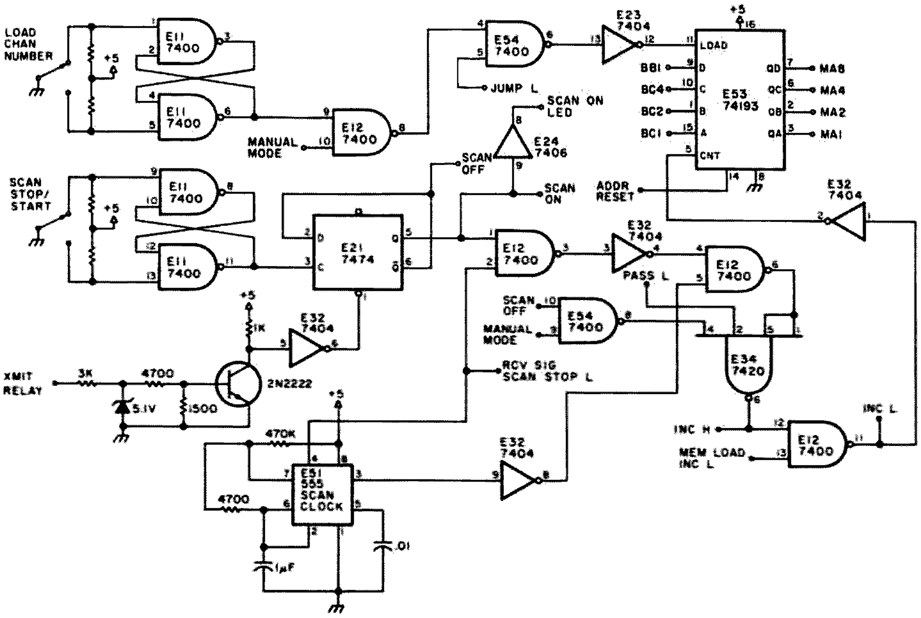


Fig. 3. Scan control logic. Resistors on E11 are 2.2k Ohms.

great convenience when driving at night, since the thumbwheels on the transceiver are not illuminated, which makes it difficult to read the frequency or to QSY without turning on the dome light. Other information displayed in the LED display is whether the scanner memory or the thumbwheels have control of transceiver frequency, whether scanning is turned on, and whether the fast or slow squelch delay is selected.

The scanner's memory is capable of storing 16 words. This memory data can be interpreted as either frequencies or instructions to be executed.

The instruction set consists of three instructions. Since all frequencies entered into the scanner will have either a 4, 5, 6, or 7 in the megahertz position, it was decided to use some of the unused digits as instructions. Therefore, the numbers 0, 1, and 2 are decoded and executed as instructions by the scanner.

The instruction set is as follows:

A zero in the megahertz position will cause the scanner to reference the thumbwheels for its frequency to be scanned, after which it will reset the channel counter to zero and begin scanning again from channel zero.

A one in the megahertz position will cause the scanner to read the thumbwheels for the frequency, but have no effect on the channel counter.

In this and in the previous instruction, the numbers in the 100 kHz and 10 kHz positions are irrelevant.

A two in the megahertz position will cause the scanner to execute a jump to the channel number specified in the 100 kHz and 10 kHz positions. If the memory contents were 204, the scanner would jump to channel 4. This instruction is used for storing more than one set of frequencies in memory. By simply starting the scanner in the appropriate set of frequencies, you have a choice of frequencies that can be scanned without reprogramming.

The instructions that reference the thumbwheels have been found to be very useful, since this gives you one channel that can be changed without reprogramming.

Examples of how the in-

struction set is used will be given later in the section entitled "Operation." It's not as complicated as it sounds.

The scanner can operate either from the 13.8 V dc mobile power or from its own internal ac supply. The Heathkit supply for the HW-2036 is not capable of supplying the current requirements for both the transceiver and the scanner, so a separate supply is required for the scanner.

The scanner was built to provide a reasonably close match to the Heath transceiver, but, of course, the builder can change packaging to suit himself. The cabinet and bezel are ordered from Heath and the chassis is the chassis from the HW-2036-3 power supply. The front panel is fabricated from a piece of scrap aluminum.

There are five push-buttons on the front panel which function as follows:

The SCAN push-button turns scanning on and off. Status is indicated by an LED on the front panel.

The MEM push-button gives you the option of memory-controlled frequency when not scanning Memory is automatically activated when scanning is started, so it is not necessary to press MEM at the start of scanning. Status of memory or manual frequency control is also indicated by an LED on the front panel.

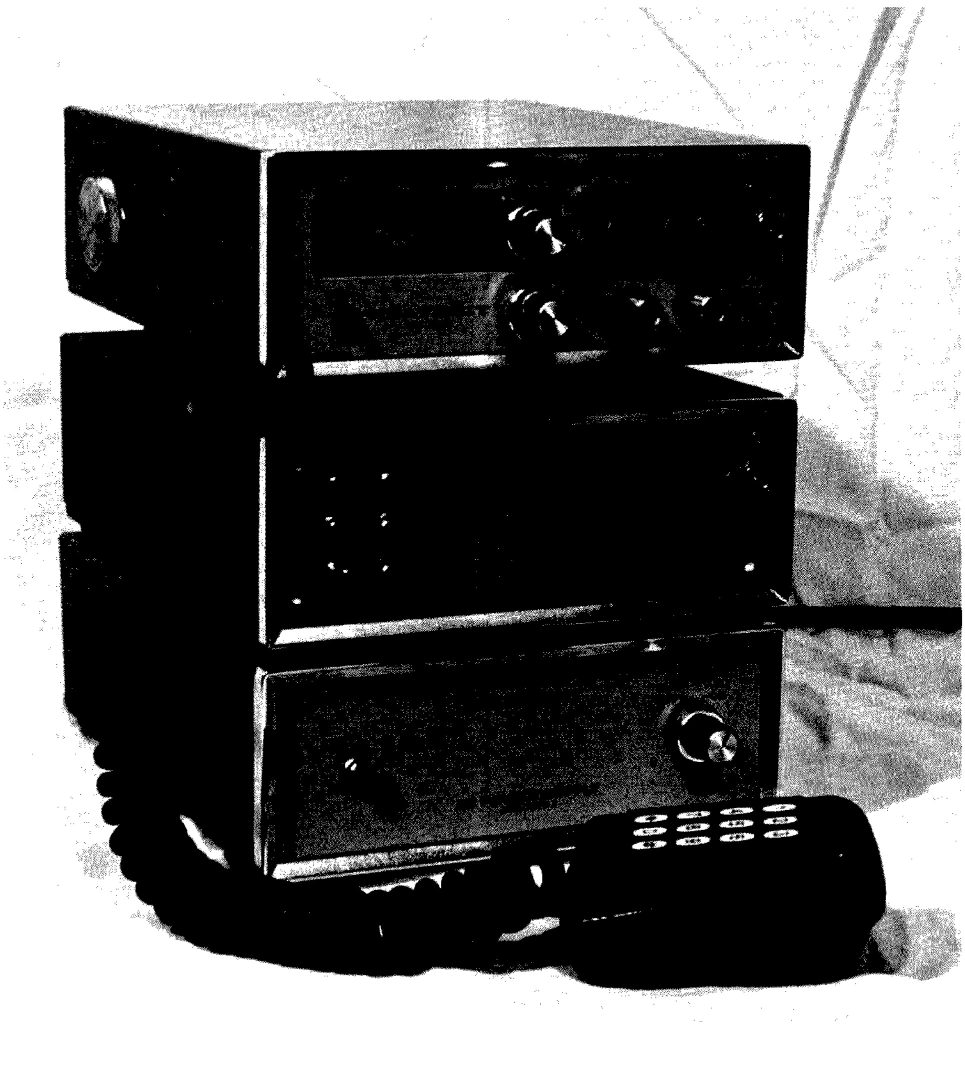
The LOAD CHAN button causes the value placed into the two right-hand digits of the thumbwheels to be transferred to the channel counter. This lets you address any location in memory for modification or for starting a scanning sequence. As has been previously mentioned, more than one scanning sequence can be stored in memory. The correct sequence is activated simply by starting the scanner at the first address (channel number) of the desired sequence. The channels are numbered octally (base 8) from zero to seventeen. The number sequence is, therefore, 0, 1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14, 15, 16, 17. This is done because binary-to-octal and octal-to-binary conversions are much easier to do than binary-to-decimal and decimal-to-binary conversions.

The SQUELCH push-button selects one of two delays, after which scanning resumes when a carrier drops out of the receiver. The two delays are approximately 13 seconds and about .2 seconds. The 13-second delay is sufficiently long to prevent the scanner from resuming scanning before a reply is received. However, if you wish to resume scanning between exchanges of a QSO you are monitoring, switching to the .2-second delay lets you do so. The .2-second delay is long enough, however, that the scanner will not resume scanning if the signal drops momentarily because of mobile flutter.

The WRITE/PASS button serves, as the name implies, a dual function. When the memory and scanning are off, pressing this button will cause the contents of the thumbwheels to be written into memory. When the button is released, the channel counter will increment, ready for the next write.

When scanning, the WRITE/PASS button is used to cause the scanner to bypass a signal. In other words, when the receiver is locked on a signal and you wish to resume scanning, pressing this button will increment the channel counter and cause scanning to resume.

In addition to the five buttons, there are three switches associated with operation. The BRIGHT-DIM switch varies the intensity of the LED display from a low intensity suitable for



Overall view of the author's 2 meter FM setup with Heath power supply, WA9TAH scanner, and HW-2036 transceiver.

indoor use or mobile use at night or a not particularly bright day, to a high intensity that the sun at noon is hard put to wash out when operating mobile.

The power switch on the front panel removes power from the displays and all logic except for the memories. This way, as long as power is available, the RAMs retain their data.

The master power switch is located on the back of the scanner and removes all power within the unit.

Since momentary contact switches are used, some indicator system is required to display the key information on scanner status. For this purpose, the decimal points of the two digits in the channel indicator are used, plus one additional LED. The decimal point labeled MEM is used to indicate that the memory has control of the frequency. When this LED is lit, it is impossible to do a write into memory, since the thumbwheels are disabled.

The other decimal point in the channel indicator display is labeled FAST SQ. When this indicator is on, the squelch delay is set for the .2-second time.

An additional LED is located between the channel counter and the frequency display and is illuminated when scanning is turned on. The write function is disabled when this LED is lit also, so, in order to write into memory, both the SCAN and the MEM LEDs must be off.

One additional feature is built into the scanner; its function is to prevent the transceiver from scanning if you decide to QSO. The first time the push-to-talk button on the microphone is pressed, scanning is turned off. This is reflected on the display panel; when PTT is pressed, the SCAN LED goes out. Scanning can be restarted after the QSO by pressing the SCAN button.

Channel	Contents	Comments
0	6.94	scan 146.94
1	6.52	scan 146.52
2	6.73	scan 146.73
3	6.61	scan 146.61
4	6.79	scan 146.79
5	7.12	scan 147.12
6	7.24	scan 147.24
7	6.22	scan 146.22
10	6.85	scan 146.85
11	1.XX	scan the frequency dialed into the thumbwheels. XX indicates irrelevant digits.
12	6.11	scan 146.11
13	6.22	scan 146.22
14	6.33	scan 146.33
15	6.44	scan 146.44
16	6.55	scan 146.55
17	6.66	scan 146.66

Table 1. All 16 channels used as frequencies. With this sequence programmed in, the scanner will cycle through all memory locations repeatedly, starting again at channel 0 at the end of a sequence.

Operation

The following are some examples of how the scanner may typically be used.

The startup sequence is as follows:

With power on, the LED displays should light. The SCAN, FAST SQ, and MEM LEDs may be on.

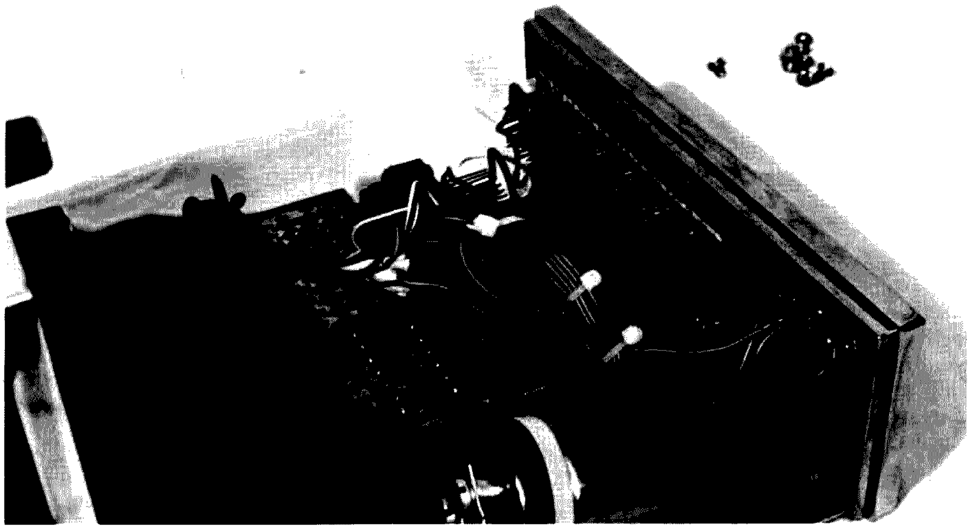
If the SCAN LED is on, press the SCAN button to turn it off.

If the MEM LED is lit, press the MEM button to turn it off.

Dial up the number of the first channel you wish to program in the two right-hand digits of the thumbwheels. Press LOAD CHAN, and the channel counter display should now read this value.

At this time, the scanner is ready for programming. To program, simply dial in the desired digits in the thumbwheels, and press the WRITE/PASS button. Each time the button is released, the channel counter should increment, awaiting the next write cycle.

When all frequencies and instructions are loaded into memory, dial the desired starting channel number into the two right-hand digits and press LOAD CHAN. The channel counter LEDs should display the number in the thumbwheels. Press SCAN and the scanner will begin scanning, changing frequencies, and executing instructions as it reads the memory information. If the programming included an instruction to read the thumbwheels, dial up a frequency in the thumbwheels. As you watch the LED frequency display, you will see the frequency in the thumbwheels being scanned, and the MEM LED will blink out, indicating that, at that time, frequency is being controlled by the thumbwheels.



Close-up view showing construction of front panel and some of the switch wiring.

Tables 1 through 3 are some typical programming examples, with explanations of what the scanner will do.

Logic

An attempt has been made to divide the logic diagrams into easily digestible (and drawable) units. These will be covered individually here.

The frequency display logic diagram consists of the LEDs for the MHz, 100 kHz, and 10 kHz digits, their 7447 decoder-drivers, and the 7404 inverter-buffers. The double inversion on each bit is not a mistake; it is there to reduce loading on the lines between the thumbwheels and the synthesizer board.

Fig. 7 shows the channel display logic for the two digits of the channel display, the SCAN LED, the FAST SQ LED, the MEM LED, and the two most significant digits of the frequency display, which are hard-wired to display a 1 and a 4.

The 7406 IC is a hex inverter-driver with open collector outputs. Four sections of E31 are used here to turn on segments in the left-hand channel display digits.

The heart of the scan control logic (Fig. 3) is the 74193 programmable up-down counter. In this case, only the count up input is used. The counter can be preset to any desired value by applying data to pins 1, 9, 10, and 15 and pulsing pin 11 low. This is how the jump instruction and the load channel functions are performed.

The count pulses for the 74193 are generated by E51, a 555-type timer IC wired in the astable configuration. This produces a string of clock pulses with a period of about 350 milliseconds.

Application of pulses from the scan clock to the counter is enabled by the scan enable flip-flop, E21-6, and the signal RCV SIG SCAN STOP L, which stops the scanner in the presence of a signal. E21 can be set or cleared by pressing the SCAN push-button, and E21 can be cleared by voltage at the transmit relay going to zero, as it does when PTT is pressed.

Two other signal sources for incrementing the channel counter are included. They are PASS L, which is asserted when the WRITE/PASS button is pressed and memory or scanning are turned on, and MEM LOAD INC L, which is asserted when the WRITE/PASS button is pressed and memory and scanning are turned off. This causes the channel counter to increment after the write is performed.

Fig. 2 shows the memory control and instruction decoding logic. The main element in the memory control logic is flip-flop E22-5, 6. This is the memory/manual mode control. When the flip-flop is set, a ground for the thumbwheels is broken, removing them from control of the synthesizer, and the signal MEM EN L is generated to the memory, turning it on and giving the memory control of the synthesizer input lines. This flip-flop can be set and cleared by the MEM push-button on the front panel. It is also set by the signal INC H, which is derived from the scan clock when scanning is turned on. It can be cleared by either a 0 or a 1 instruction, which tells the scanner to scan the frequency in the thumbwheels.

Another part of the memory control logic is the WRITE/PASS logic. PASS L is generated whenever the WRITE/PASS button is pressed, but is inhibited from doing anything unless scanning is on or memory is on. This in-

Channel	Contents	Comments
0	6.94	scan 146.94
1	6.73	scan 146.73
2	6.52	scan 146.52
3	0.XX	read thumbwheels for the frequency, then start scanning again from channel 0

Table 2. Only a few channels are used.

Channel	Contents	Comments
0	6.94	scan 146.94
1	6.52	scan 146.52
2	6.73	scan 146.73
3	0.XX	scan the frequency in the thumbwheels, then set channel counter to zero
4	7.12	scan 147.12
5	7.24	scan 147.24
6	6.79	scan 146.79
7	6.85	scan 146.85
10	2.04	jump to channel 4. The 2 in the megahertz position specifies the jump instruction; other digits specify channel number.
11	6.94	scan 146.94
12	1.xx	read thumbwheels
13	6.79	scan 146.79
14	6.73	scan 146.73
15	6.61	scan 146.61
16	6.52	scan 146.52
17	2.11	jump to channel 11

Table 3. Multiple sets of frequencies, each of which can be individually selected. This sequence contains three separate groups of frequencies and instructions. Starting the scanner at channel 0, 1, 2, or 3 activates the scanner in the first loop. Similarly, starting the scanner at channel 4, 5, 6, 7, or 10 activates the second loop. If the scanner is started at channel 11, 12, 13, 14, 15, 16, or 17, the third loop is entered.

When a signal is encountered, the scanner will stop scanning. When the signal drops, the scanner will resume scanning after either the 13-second or the .2-second delay. If you wish to engage a station heard in a QSO, simply make sure that the offset switch on the transceiver is set to the appropriate offset, pick up the mike, and go. Transmit frequency also follows the scanner.

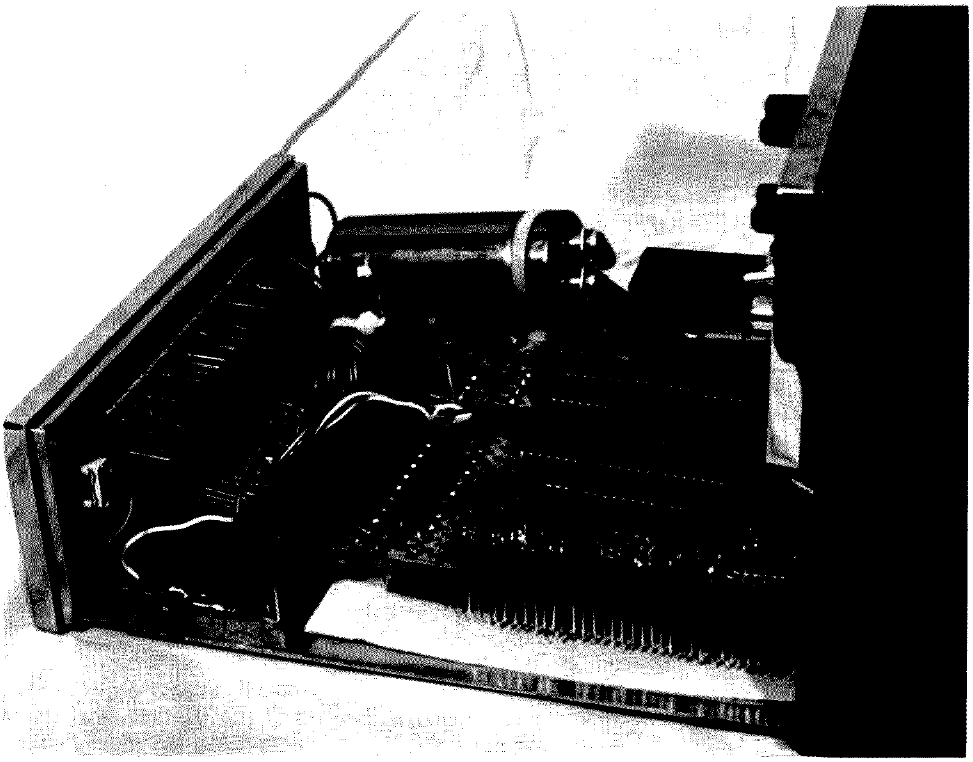
There is one limitation on the instruction set. Do not follow a jump instruction with another instruction, only a frequency. For example, if a memory location contains 2.04, channel four should not have a 1.XX, a 0.XX, or another jump instruction in it. If this is attempted, the instruction following the jump may not decode reliably. Putting a frequency, which requires no decoding, after the jump instruction is perfectly legal, however.

hibit gating is on the channel counter logic diagram, E54-8. When scanning is off and the thumbwheels are in control of the synthesizer lines (also used as the memory input/output bus), it is possible to do a write into memory. In this condition, E54-8 inhibits the PASS L signal from incrementing the channel counter. E34-8 is enabled when the WRITE/PASS button is pressed and the signal WRITE L is generated. This signal is also used to generate MEM EN L, which turns on the memory without giving it control of the synthesizer lines. In this manner, the thumbwheels retain control of the synthesizer lines, and what is dialed into the thumbwheels is written into memory.

Shortly after WRITE L returns to a high condition, MEM LOAD INC L goes low, causing the channel counter to increment for the next write cycle.

The only portion of the logic in this diagram not discussed so far is the instruction decoding logic. Instruction decoding is enabled at E54-3, requiring that we must be in auto mode, that is, the memory must have synthesizer control in order to decode an instruction. This prevents any attempts by the scanner to execute instructions when merely dialing a 0, 1, or 2 into the thumbwheels. The instruction must be read from memory to execute. Instructions are also inhibited from executing until the signal INC L returns to a high state. Since data is brought out from memory on the negative-going edge of INC L, this ensures adequate setup time for proper decoding.

Decoding for the jump instruction is the simplest. E44-6 examines the data from the most significant digit of memory, and, if it is 2, generates JMP L. Note



Close-up view of scanner interior from the left. Discrete components are shown mounted on 16-pin DIP plugs.

that this instruction executes immediately upon INC L going high. This means that after the jump instruction is executed, there will not be another INC L pulse. Thus, if another instruction is present, there is no setup time available, and an instruction will execute as soon as it is marginally decoded. This can lead to very erratic performance, and I have found it best simply not to follow a jump with another instruction.

E44-8 examines the most significant digit in memory and asserts a low if a 1 or a 0 is detected. Since both of these instructions are used to cause the scanner to read the frequency in the thumbwheels, this signal is used to clear the memory/manual mode flip-flop. This places the thumbwheels in control of the frequency until the next INC H pulse.

Additionally, if the instruction decoded is a 0, this will be detected by E14-8. This will set flip-flop E22-9, which serves as a memory for this instruction during the time that the thumbwheels have control of the synthesizer. When INC H goes high, the output of the flip-flop is enabled through E14-11 to become the signal ADDR RESET, which clears the channel counter. At the same time, INC L goes low. When INC L returns to the

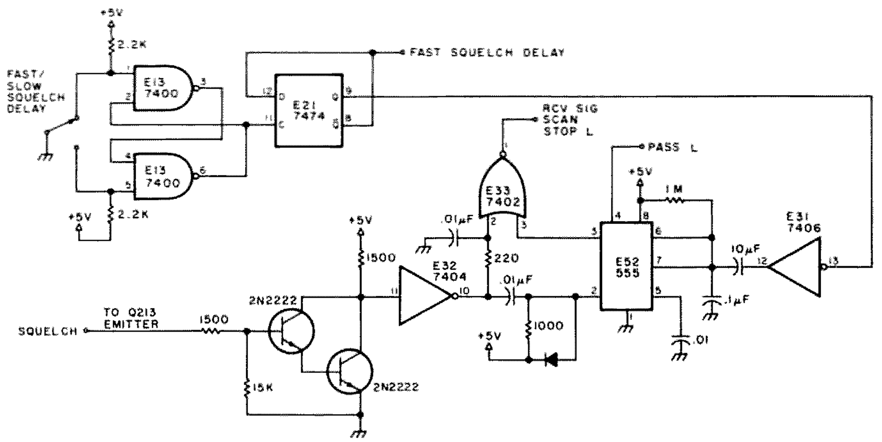


Fig. 4. Fast/slow squelch.

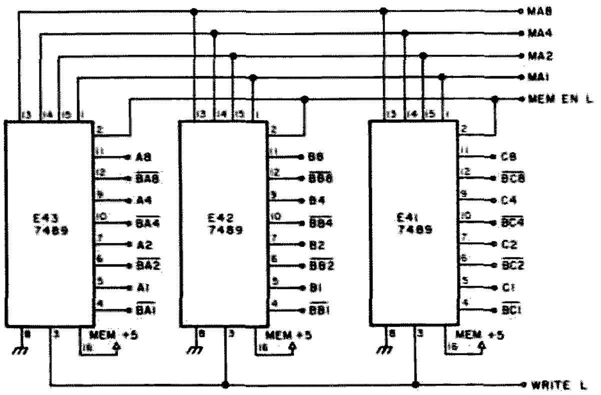


Fig. 5. Memory.

high state, it clocks and clears the flip-flop, restoring it to its original clear condition.

The squelch control logic is relatively simple. The squelch voltage is converted to a TTL logic level* and is used to generate the signal RCV SIG SCAN STOP L. When the squelch voltage returns to the squelch state, this triggers the 555, E52, wired as a monostable. This holds RCV SIG SCAN STOP L asserted for an additional time interval. The selection of the 13-second or the .2-second time delay is performed simply by using E31-12 to switch in additional capacitance for the longer time period.

After the amount of logic required to support it, the memory itself is anticlimactic. There are three memory ICs, each storing 16 words 4 bits long. Certain signals are bussed in common to all three chips. They are MEM EN L, which turns on the memory for a read or write, MA1, MA2, MA4, and MA8, which control memory addressing and are generated by the channel counter, and WRITE L, which, when asserted, causes the data on the input lines to be written into memory.

As can be seen in Fig. 1, there is nothing fancy about the power supply, and it shouldn't cause anyone any problems.

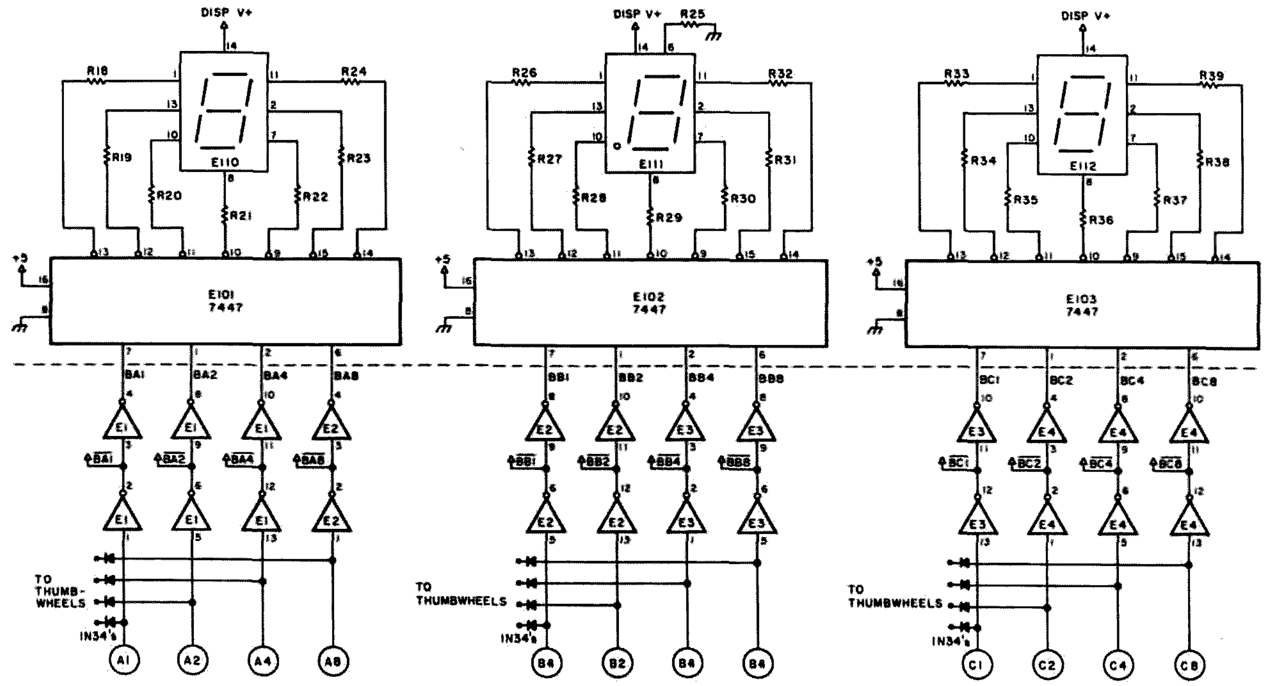
Transceiver Modifications

In order to interface this scanner with the transceiver, a few minor modifications are necessary. They are quite simple and should pose no problem. First the thumbwheel contacts must be isolated from each other. To do this, a diode is placed in series with each wire from the thumbwheels to the synthesizer board. The cathode ends of the diodes are connected to the thumbwheels and the anode ends are connected to the synthesizer board. This isolates the switch sections so that, when the memory has control of the bus, data bits are not shorted together by the switches. I recommend germanium diodes for this purpose because of their lower forward voltage drop. For the Heathkit transceiver, this will require 12 diodes.

The ground wire from the thumbwheels must also be lifted and extended into the scanner. This becomes the signal THUMBWHEEL GND on the logic diagrams. When this is grounded, the thumbwheel data is asserted onto the bus. When this is broken, all data inputs to the synthesizer go to a high state and the memory can then assert control.

Two other wires are required. One goes to the cold side of the transmit/receive relay coil. In the receive position, this is at

*Eugene R. Zobel, "The Synthascanner," *QST*, Vol. LX, No. 11, November, 1976.



	+5	GND
E1, E2, E3, E4 = 7404 IC	14	7
E101, E102, E103 = 7447 IC	16	8
E110, E112, E111 = MAN-1	14	N/A

Fig. 6. Frequency display. All resistors are 330 Ohms, ¼ Watt.

13.8 volts. When transmitting, it is grounded. The other wire is a pickoff for squelch voltage and, in the Heath transceiver, goes to the emitter of Q213. For other transceivers, it may be necessary to vary component values, add a zener diode in the squelch line, or eliminate the inverter at E32-10. This will vary from one make and model to another, so no specifics for other rigs are offered here.

There are a total of 15 conductors between the scanner and the transceiver, not including ground, which is made through the cases.

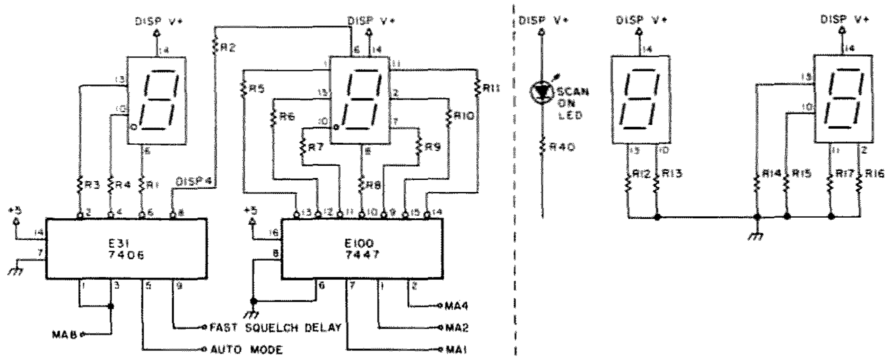


Fig. 7. Channel display.

Construction

The logic is built with wire-wrap techniques on a scrounged wire-wrap board. The display panel is built on a piece of perfboard with the 40 current-limiting resistors for the LEDs epoxied to it. Discrete components are mounted on DIP plugs which then plug into sockets on the wire-wrap board. I will be happy to answer any questions anyone may have that are accompanied by an SASE.

Possible Modifications

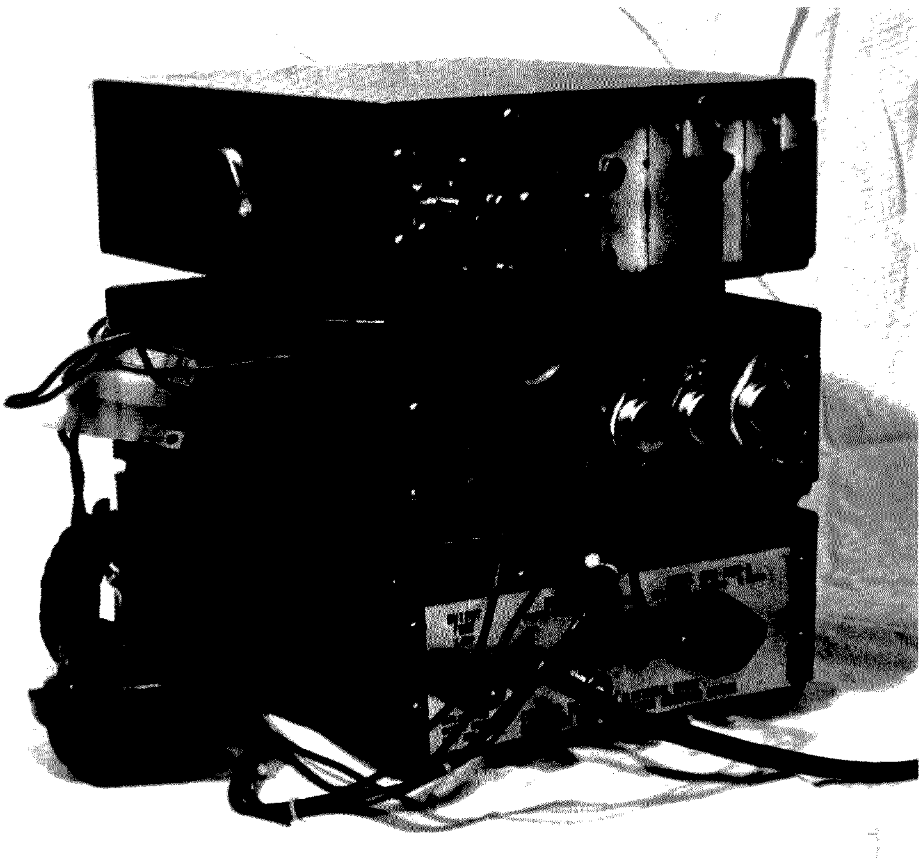
There are a number of possible ways a builder may wish to customize this circuit, so I'll mention a few. Scan rate could be made variable by using a pot. It could also be made asynchronous so that the channel counter would increment, wait for the synthesizer to achieve lock, time out a specified delay — maybe 50 to 100 milliseconds — and then increment again. Scan rate would then depend on how fast the synthesizer locks up rather than a fixed rate.

The builder may also consider putting pots on the squelch delay and in the LED brightness circuits. I didn't because most of my operating is mobile and I didn't want any more knobs to twiddle than necessary.

You may want to use a reed relay to tie thumbwheel ground to ground. I used four sections of a 7406 IC paralleled so that I could get the voltage drop as low as possible. Remember that the synthesizer board has to be able to detect a logic 0, and there are a diode and the 7406 IC producing voltage drops in series. I've had no problem with ambiguous voltage levels in this respect, but, if you have a reed relay in the junk box, there's a good place to use it.

Acknowledgement

I'd like to acknowledge the assistance of Tom Cronick WB9YVY for his help in fabrication of some of the parts of this scanner, and Brian Herzog WD5GYS for the photography.■



Rear view of scanner showing locations of the three LM309K regulators.

Trickle-Cost Trickle Charger

—junk-box project

1947 revisited.

Carl C. Drumeller W5JJ
5821 NW 58 St.
Warr Acres OK 73122

A catchy title, huh? What it really means is that you can build a trickle charger for just about zero cost. This one was for a 12-V lead-acid storage battery in a recreational vehicle that sits idle for considerable periods. It belongs to one of my sons, and one day he came up with, "Hey, Dad, do you remember that trickle charger you built for the Mercury back in 1947? Could you build me one like it?" What a memory that boy has!

Yes, I remembered it . . . and yes, I could build one like it. The original was a zero-cost project, and the reproduction would fall in the same category.

A bit of pawing through what remains of my once extensive junk collection (I've given away two truck loads!) revealed a transformer with three 5-volt windings. There's nothing sacred about the total voltage needed from the transformer. Anything above about 15 volts and below about 35 volts can be used. The hyper-simple method of controlling the charge rate can cope with a wide range of ac voltages.

The three windings were hooked in series-aiding. Yes, there's "polarity" to ac . . . use a voltmeter to ensure series-aiding and not series-bucking! A bit more digging in the junk heaps produced an ancient base-mount socket for a light bulb. Sniffing through my diode collection nosed out one with a 3-A rating; one with a lesser capability would have served quite well.

Now for the circuit.

What could be more simple! All that remains is to ascertain the size of the light bulb you'll need for the desired charge rate. Here my multimeter came into use. Starting with the 10-A range and with a 25-W bulb in the socket, the charger was hooked across a 12-V battery. The meter barely moved. A milliampere meter was substituted. It showed about 35 mA, a bit on the light side. Other light bulbs were tried, revealing that the charge rate could be varied from a few milliamperes to over an Ampere just by swapping bulbs. The size bulb you might need will depend upon what voltage your transformer produces plus what charging rate you desire. A few moments of trial-and-error will show just what you need. Be sure you start with a low-wattage bulb, or you might end up with a popped diode or a bent needle!

Other than that small precaution, it's a foolproof project, one providing a useful product at a very minimum cost. Try it! ■

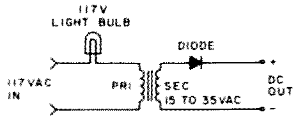


Fig. 1.

Reader Service—see page 211

Looking West

from page 6

No one can hurt you there. In fact, you stayed away from purchasing a 220 radio because of all the ongoing hoopla over 220 CB. Why should you give a damn about what happens to 220?

You have got to care. If this theft of 220 is successful, then your days of sanctity are numbered. A very evil precedent has been set here, one with far-reaching implications. If maritime mobile can be successful in convincing the military to give up spectrum, it would open the door for other services to do likewise. It's no secret that aircraft would love 144 to 148 MHz and remote broadcasting would be overjoyed to procure 420 to 450 MHz. The door is now open for them to lobby to that end. Even the low bands are not safe since there are always more services wanting spectrum than spectrum available. Do not be surprised to see the amateur media in the near future filled with just such stories. That is, unless the current situation can be beaten down in a way that will make the next spectrum thief think twice about going up against us.

WHAT MIGHT BE DONE

In gathering input for a Westlink item on this story, I placed calls to several coordination councils to gather reaction and input. Normally I wait for such calls to come to me, but this time the story seemed to warrant the expense. The reactions I got ranged from resignation that 220 was lost, to "we had better start moving repeaters off the band now so that there is no real crunch later," to "fight it to the wire" and beyond. These were the up-front emotional responses, but in most cases they were given with a sense of commitment.

Constructively, what can you as an individual do to stop this theft? Letters are important, as are petitions. Write your congressman and senators. Explain your feelings on the matter, and back this up with facts about amateur radio's projected growth and use of the spectrum over the next few years. To a politician these numbers mean votes, and every vote lost means less chance of his or his party's reelection to that office. Letters directly to the President might not hurt either.

Petitions hold the same or a greater value. Each signature is a potential vote, so if you circulate a petition, be liberal on the matter and get support from the general public as well as your fellow hams. The effect that a couple million signatures would have on the politicos would amaze you.

One avenue which is being explored is going on the offensive rather than staying on the defensive. There is talk of taking the initiative and going after 216 to 220 MHz as an addition to 220 to 225 MHz, in light of the fact that the government no longer has interest in its utilization. The rationale here is that (at least in southern California) 220 to 225 MHz is overflowing with activity and the 216-to-220-MHz spectrum would be able to handle the overflow from both 220 and two meters. At least one amateur I know is writing a direct request for rulemaking to the FCC on that very topic.

Finally, there is one more thing you can do. If you have been thinking of getting on 220 and now again fear the loss of the band, do not let this latest attempt at spectrum theft deter you. Now, more than ever before, it is important to populate 220 to the bursting point. Make the band overflow with activity. There is still time to make 220 into a band that would be very hard to change. 220 radios of the crystal-controlled variety are not expensive, and with the overall low noise floor of the band, the point-to-point simplex range will amaze you. You do not need a repeater to enjoy the advantages of this band.

REHAB RADIO DEPARTMENT

April Moell is a physical therapist at St. Jude's Hospital in Fullerton, California. She also happens to be a licensed amateur with the callsign WA6OPS. If you are fortunate enough to meet April in person, one thing becomes immediately evident: she loves people and loves being a ham. I guess it had to happen that April would eventually find a way to combine her two vocations into a new type of therapy: "rehab radio."

April is not trying to make her patients into amateur operators. I doubt if she would mind that happening, but if it ever does, it will be but a welcome by-product of the rehab radio program. You see, the basic purpose of rehab radio is to give severely ill or injured persons who must be hospitalized for long periods of time a "will" to recover. As it was explained to me, many times a person who is in the hospital for a prolonged stay loses track of the world outside the hospital walls. The hospital is a "safe" place, and it is easy for someone seriously ill or injured to retreat within himself in that environment. Rehab radio tends to counter that by placing the patient in contact with those outside his place of confinement. Being able to speak with a total stranger whose tone of voice says "I care" can have remarkable results.

It is the text of the QSO which is important—not the basic contact itself. To quote April: "Do not worry about chasing DX. Patients are not impressed by waiting through pileups to hear a signal report from the Isle of Yap. Also, you must keep in mind the third party agreement. Patients are quite impressed by working someone on the other side of the United States or someone in a state where the patient used to live. It is the person who is at the other end who is important, not his or her QTH."

On the day that I was there, a contact was made with a station in Alaska. I do not remember that station's call at this time. After establishing contact, April explained to the station exactly what was going on and then introduced each patient to the station at the other end. Our friend in Alaska spent quite a bit of time giving his greetings to each patient. As he did, each one either smiled or expressed an obvious sense of joy in some way. When "radio time" was about over, April again passed the mike around so that each patient could bid farewell to his newfound friend in Alaska.

If this interests you, you can get more information on the rehab radio concept by sending an SASE to April Moell WA6OPS, c/o St. Jude's Hospital and Rehabilitation Center Amateur Radio Association, 101 E. Valencia Meas Drive, Fullerton CA 92635. April has prepared a two-page information sheet that outlines the major points of how to get a rehab radio project started and lists related activities and how they can help patients. Please don't forget the SASE. You might also include a QSL card, since the rehab radio patients at St. Jude's really enjoy receiving them.

FLYING 220 AND OTHER PLACES REVISITED DEPARTMENT

As a result of publishing the story of one amateur's cross-country flight while SWLing on 220 MHz, we have received quite a bit of mail. Most of it had a Xerox® copy of an editorial written by Jim Fisk W1HR which appeared recently in *Ham Radio* magazine. Mr. Fisk pointed out the many hazards of operating an amateur transceiver while in a commercial airliner. He also went deeply into the legalities or illegalities of such operation, and quoted the experience of one amateur who wished to operate while airborne. In that case, the amateur did receive permission to operate, but only after exhaustive tests of the radio by the airline and then only for that particular flight on that specific aircraft.

This interested me, since I have been told by a number of amateurs over the years that they had operated "air mobile" by obtaining the consent of the particular captain in command of a given flight. Had they been breaking the law unknowingly? I did a little of my own exploring into the federal regulations governing air-carrier operation. It turns out that the regulations specifically state that, other than certain exempted devices such as tape recorders and hearing aids, the use of electronic devices aboard aircraft in commercial air-carrier service is forbidden. Amateur equipment is *not* on the exempted list.

How about asking the captain for his permission? He is the man in command, isn't he? Not in this case. The regulations are very clear on this. He does not have the authority to permit you to use your radio. Only the carrier has that authority, and in this case "carrier" signifies the airline itself rather than "rf." Therefore, if you feel that you must operate from the wild blue yonder the next time you are whisked away on the wings of a 747, you had better plan well ahead. It may well take months or even years to obtain the permission you need, and the amount of red tape may well boggle your mind. I suggest that anyone giving consideration to such operation first obtain a copy of the October, 1978, *Ham Radio* and read Jim Fisk's editorial on page 4. It does tell it like it is.

My thanks to all who wrote and brought this matter to my attention. It's just this kind of interaction which makes LW what it is. Without you, it would not mean very much. With you, it means a lot. Thanks.

Ham Help

I need a schematic for a Measurements 80 signal generator and a service manual for an Icom 22A 2m transceiver. I will copy and return.

Bill Mollenhauer
Box 3, RD 1
Glassboro NJ 08028

FCC

Reprinted from the Federal Register.

ITU 1979 WORLD ADMINISTRATIVE RADIO CONFERENCE (WARC)

Announcement of Proposals

The FCC adopted yesterday[1] a *Report and Order* announcing its proposals to amend the International Radio Regulations to be considered at the general World Administrative Radio Conference in September 1979.

The FCC's *Report and Order* in this proceeding comes at the end of four years of inquiries in preparation for the general World Administrative Radio Conference (WARC). The Department of State will now use this *Report and Order* to prepare United States proposals which will be delivered to the International Telecommunication Union (ITU) in January 1979 for circulation among the nations of the world.

The ITU is an international organization of 154 member nations and has a history dating back to 1865. It is headquartered in Geneva, Switzerland. Through the ITU, nations cooperate in the use of telecommunications of all kinds to prevent interference, to provide common standards, and to promote the development of efficient technical facilities. It does this by several means, the most significant of which are: agreement among the member nations on a common set of international regulations [the function of Administrative Conferences]; agreement on common technical recommendations [the function of the international Consultative Committees (CCIR and CCITT)]; and registration of radio stations to avoid harmful interference [the function of the International Frequency Registration Board (IFRB)]. Each country participates on an equal basis.

The purpose of the 1979 (WARC) is to amend nearly the entire set of international Radio Regulations. These regulations consist of various definitions and operational and administrative requirements. The most extensive provisions are contained in a Table of Allocations which proceeds from one end of the radiofrequency spectrum to the other, and allocates various bands to defined "services." The Table is divided into three world regions. The Americas are contained within Region 2; Europe, Africa, and the Soviet Union within Region 1; and Asia, Australia, and the South Pacific within Region 3. Past General Administrative Radio Conferences were convened in 1927, 1932, 1937, 1947, and 1959. Numerous specialized Conferences have been held since the 1999 General Conference.

The FCC's Conference preparatory effort began in January 1975, with the issuance of a notice of inquiry, and establishment of a supporting Commission staff, including a Steering committee having overall management responsibility, and several specialized Functional Committees. In addition, the FCC created a number of industry advisory committees to serve as advocates for the various radio user groups through the preparation of reports and the filing of comments in this proceeding. During these past four years, the notices of inquiry have not only served to elicit public comment, they have also represented successive revisions in a process of refining FCC proposals.

Because the Radio Regulations affect all radio users, the Commission has coordinated all of its preparatory activities with the Department of Commerce/National Telecommunications and Information Administration (NTIA) [formerly the Executive Office of the President/Office of Telecommunications Policy (OTP)]. NTIA has the responsibility for coordinating U.S. government use of radio, which is managed by the Interdepartment Radio Advisory Committee (IRAC). IRAC established a 1979 (WARC) preparatory structure similar to that of the Commission's. Because of this ongoing coordination, the proposals adopted by the FCC are consonant with those of IRAC.

During this proceeding, thousands of United States citizens contributed their work and thoughts to the effort. Nearly 2,000 individual comments occupy almost 10 feet of file space. They range from those of a private citizen who saw his life impacted, to the massive reports of corporations and industry groups who saw their businesses potentially affected. The Commission is grateful for all these comments which, large or small, were considered and appreciated for the unique perspective which they afforded. Although the envisioned needs for radio spectrum exceeded the amount available, the FCC believes that in each case it has suggested a position which is equitable, in the public interest, and capable of being accepted by most of the ITU member nations.

The resulting Final Acts of the Conference will be in the form of a multilateral treaty and, in order to be binding, must proceed through the U.S. ratification process. Where the ITU Regulations impose a new affirmative obligation, the Commission will amend its Rules and Regulations to reflect the obligation. Where the ITU Regulations allow new allocations flexibilities, the Commission will, in appropriate future proceedings, consider the available options and offer them for public comment.

After the 1979 GWARC, there will be additional ITU Conferences which will also be of substantial importance to the U.S. Among them, the Plenipotentiary Conference [the equivalent of a constitutional convention] in 1982 has the power to consider and modify all major ITU institutional features. The Region 2 [Western Hemisphere] Broadcasting-Satellite Conference in 1983 will review the 12 GHz band allocations.

The FCC's underlying policy goal throughout this proceeding has been to minimize the international constraints placed upon the FCC in its domestic regulatory activities. Thus, it should be noted that merely because the FCC's GWARC position provided for the possibility of implementing a service in some band in the frequency spectrum, the Commission is not required in any future domestic proceeding to actually implement it.

Many of the FCC's proposals advocate increased sharing of frequency bands among radio services, as well as minimal administrative restraints on availability of radio spectrum and geostationary orbit allotments. This position of flexibility is particularly appropriate during the period of dramatic technological change which is foreseeable during the next two decades. The FCC believes that such a posture benefits not only the United States, but all ITU members.

Some of the highlights of the FCC's proposals include:

Proposing the expansion of the AM broadcasting band. The expansion would create a band at 1615-1800 kHz which is shared between broadcasting and various other services, and a band at 1800-1860 which is exclusively allocated to broadcasting. This change could result in approximately 14 new channels [or approximately 700 new AM stations]. Because most of the available broadcasting channels have been alloted to licensees, this would provide new channels for potential diversities in broadcasting and minority ownership. However, it will require that changes in the design of AM radio receivers be made. These new receivers should not be more costly than existing ones, although a significant number must obviously be in use for the new allocations to be economically viable.

Proposing that the UHF band be internationally allocated equally among most communications services. Because communications technology is rapidly changing and the demand for local communications is increasing, it is highly desirable to minimize international restraints in this band. Therefore, the FCC is proposing to add the fixed and mobile communications services in nearly the entire band between 470 and 890 MHz which is presently allocated exclusively to broadcasting. This will give the Commission the flexibility to apportion this spectrum among these three services in whatever manner it deems appropriate in future domestic proceedings. This posture does not indicate a lessened committment to domestic UHF broadcasting, but rather a recognition of the great value of the radio spectrum resource, and a desire to make it available for use where appropriate.

Proposing that HF (shortwave) band allocations be adjusted to increase frequencies available to broadcasting, maritime and amateur communications. A number of interests have sought to use the band between 3 and 30 MHz, because of its ability to furnish inexpensive, long-range communications. The Commission has concurred in an NTIA proposal to increase the spectrum available for short-wave broadcasting because of White Bouse interests in increasing the international flow of information, to increase spectrum for maritime communications to accomodate growth in maritime industries, and to increase spectrum for amateur radio to as to accomodate the growing amateur community. With only four broadcasting licensees in the international broadcasting service, the Commission would not appear to have a substantial interest in this matter, and has largely relied on NTIA to reach a compromise among the various affected government agencies.

Proposing to double the available radio/orbital resource available for advanced satellite communication systems at 12 GHz. Because many of our country's technologically advanced, domestic communication systems will be introduced in the 12/14 GHz bands during the next decade, this issue is considered by many to be one of the most significant for the U.S. at the 1979 (WARC). In light of a number of factors, the Commission is proposing to make the entire range of the geostationary orbit available in the Western Hemisphere equally to fixed and broadcasting services; and at the same time, separating into individual 500 MHz segments the frequency bands within which the services must operate.

Proposing amendments which would allow introduction of large-scale, user-oriented satellite systems in a number of bands. Such satellite systems are those which will employ a number of emerging technologies to provide highly efficient, two-way communication capabilities (electronic mail service, voice, facsimile, slow-scan TV) directly to large numbers of very low-cost earth stations. They are systems which can bypass existing terrestrial communications systems to provide interconnection among themselves or with regional information service facilities. From the array of options available, the Commission is proposing that certain allocation and technical specification changes be made to allow appropriate introduction of these satellite systems in the 2.5/6, 10, and 12/14 GHz bands as the technology is developed.

Proposing the protection of certain frequencies for scientific uses. The Commission is proposing the allocation of certain bands, and the application of certain technical limitations, to enable the use of satellite sensing of natural microwave emissions for environmental and weather studies. This technique, known as "passive sensing," allows the determination of things such as the moisture content of the soil, the surface temperature, ice thickness, water vapor, and other data of universal benefit to mankind. Most of the needs of radio astronomy have been met, as have those for the research of the physical characteristics of space.

Proposing an amendment which would allow future consideration of a land mobile-satellite service in the 806-890 MHz band. This amendment allows the implementation of land-mobile satellite service in some 20 MHz segment in the 806-890 MHz band. Such a service could provide inexpensive two-way voice and data communications to a wide variety of local, state, and federal government users in mountainous or rural areas where such systems are not presently feasible.

Proposing allocations to various radio services between 40 and 275 GHz. The present International Table of Allocations ends at 275 GHz. In the spectral region between 40 and 275 GHz, only a few allocations have been made. The Commission said that specific allocations would encourage experimentation and development, and certain bands associated with natural microwave emissions must be protected for the scientific community.

Proposing a number of changes to transmitter technical standards which would improve the efficiency of spectrum use. These changes include additional limits on unwanted signals of radio transmitters, on the requirement that a transmitter stay within a certain frequency range, the eventual conversion to single sideband equipment in the short-wave broadcasting service, and improved control over the pointing of satellite antennas.

The text of the FCC's *Report* and *Order* has been released publicly December 28, 1978. The document consists of 437 pages. Because of the cost of printing so voluminous a text, it will not be published in the FEDERAL REGISTER. However, the FCC has prepared a limited number of copies that are available upon request (*Report* and *Order* FCC 78-849, Docket No. 20271, adopted December 5, 1978, "An Inquiry relative to preparation for a General World Administrative Radio conference of the International Telecommunication Union to consider revision of the International Radio Regulations.") at its Information Office, Room 202, 1919 M Street, N.W., Washington, D.C. 20554. The *Report* and *Order* is also available for inspection at the Commission's Docket Reference Room.

FEDERAL COMMUNICATION COMMISSION.
WILLIAM J. TRICARICO,
Secretary.

STATEMENT OF CHAIRMAN CHARLES D. FERRIS

DECEMBER 6, 1978.

RE: Docket 20271, 1979 (WARC) Proposals.

For over four years the Federal Communications Commission has examined literally hundreds of issues related to the 1979 general World Administrative Radio Conference (WARC). This Conference, which will begin next September, will review the international Radio Regulations and make decisions about use of the airwaves for the next twenty years.

The Commission's proposals will be forwarded to the Department of State which is responsible for forwarding the final U.S. proposals to the ITU. The *Report and Order* represents a careful and in-depth examination of thousands of comments and an expert determination of the future needs of the non-governmental users of the radio spectrum in the United States.

Throughout this process, I have sought, as Chairman, to have the Commission's recommendations reflect several important themes. The first is that our recommendations be based on the public comments of the thousands of interested individuals and groups who petitioned the Commission.

The second is that our proposals provide the United States—and every other nation—with the greatest possible flexibility in deciding how to use the available spectrum. Too often, international and national regulations are inflexible—restricting innovation, *dramaticaly increasing* communication costs, or even precluding development. If the Commission's recommendations are adopted at the Conference, each

Continued on page 180

[1] January 12, 1979.

W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

from page 4

For over twenty years I have been pointing out that the key to the future of amateur radio is a political one. Providing service is great, but it won't buy us anything with politicians. Politics are centered in Washington, and this is why all the other users of radio frequencies have strong organizations in Washington to lobby for their interests. Lacking any such power, amateur radio has been pushed around by the FCC and any other group almost at will. The recent ridiculous 220 MHz grab by the maritime interests should prove this point clearly even to the most iron-headed ARRL supporter. The saving of the 220 band from the CB interests and the EIA had little to do with any ARRL efforts, despite their bragging about it . . . they just don't have any clout in Washington.

An efficient manager of an organization first makes sure that his books balance. This means that income and outgo should be brought together, with income slightly exceeding outgo. That sounds simple, but when you have a fundamental policy of keeping ad rates low to try to make life miserable for other publishers, you have an artificial hold on income. I don't think the chaps who worked out that scheme ever expected someone like me to come along, someone who would start a magazine and not even take any salary for several years, someone to whom the money or lack of it was no serious problem, someone who wanted to provide a magazine to help get hams building at any personal cost.

The first "employees" of *73* were college dropouts who worked more for the fun of it than money, getting $20 a week plus keep. I cooked the meals and we had a ball. Most of them went back to school and we gradually were able to hire local people at more reasonable wages.

To get on a firm financial footing, *QST* should first increase their advertising rates to match those of other magazines with their claimed circulation. Then they should increase their membership fees to a more reasonable rate, comparable to those of other organizations. With the added income, they could set about actually providing some of the services hams think they've been getting, and perhaps providing us with some protection against the FCC, the ITU, and other frequency users.

To give you an idea of how off-base the advertising rates for *QST* are, they claim nearly twice the circulation of *73* and yet have lower advertising rates! How is this possible? And how in the world, under these circumstances, can *73* consistently have more ad pages than *QST*? The answer is simple enough: The ads in *73* pull far better than those in *QST* . . . manufacturers and dealers find the readers of *73* are far more active and buy a lot more ham equipment than *QST* readers.

Part of that situation has to do with the high percentage of older ARRL supporters who get *QST* but obviously don't read it, or at least don't read the ads. They already have their Collins equipment . . . indeed, they've had it for many years, so they look over the articles, note that many of them use transistors, and put the magazine on the shelf. The readers of *73* are a different breed, fed on a barrage of articles on the latest techniques and many simple construction projects. About 90% of the *73* readers are into building to some degree. This explains the many pages of ads for parts . . . a heavier percentage of such advertising than was in *QST* even in the supposed heyday of ham building in the '30s.

QST needs a new crew. They need to come out of the dark ages and fill their magazine with projects which will inspire people to build and enjoy amateur radio. They should cool some of the excessive contest coverage and the endless self-congratulation. They should get their directors to stop being messengers from HQ to the members and get traffic moving the other direction so the official journal of the club can inspire clubs to greater efforts and fun. Do I really have to set up such a section of *73* just to show the League what they should be doing in *QST*?

I'll tell you what . . . let's try it. If your club has a building project, make sure that you have a PR officer whose job it is to document what is happening. Have him write an article for *73*; include good photographs of the item being built, the people who organized the project, and those who participated. Let's run some good solid picture stories in *73* and show what is being done by clubs.

Then there are public service events . . . emergency or otherwise. Have the PR officer take pictures and quickly write up the story, and don't forget good pictures of the people, the important people. I want not only group shots of workers, but also good close-ups of the faces. Let's show who is doing what.

The next time you have a hamfest, picnic, or other group event, try to get a big poster or banner with the club name or call on it and line the whole group up for a mass photograph. Have someone with a good camera take the picture . . . none of your 35mm for this . . . at least 6 x 7 cm . . . black and white, please. If you can get a good color shot, do that, too, but black and white comes first in publishing. It's a whole lot less expensive. Field Day is incomplete without the group photo. Send it quickly to *73* and let's get this going. Please be sure to identify every person in the pictures so our captions will be accurate.

DXpeditions all too often go unheralded. Let's be sure we have someone along on important DXpeditions whose main job is to handle the PR. He must have a camera and take a lot of photos. You've seen the job I did on my trip to Navassa and Jordan. Now, with larger pages to work with and more money for color, we can do even better. Color shots should be taken with good equipment, not with Instamatics.

WOULD IT WORK ?

Instead of people leaving the ARRL like rats from a sinking ship and the rest of the employees living in fear of being fired, the League could meet the world as it is today and do the job that is there to be done. They could easily solve their economic problems, even without selling their million dollars worth of stocks and bonds which they've squirreled away over the years.

Do they really need to put nearly a million dollars into building more offices now that many of them are empty? They don't even have the staff to put out decent books anymore. When we needed more room for people to work in our computer program business, we looked long and hard, finally acquiring a local motel which provides us with room for at least 100 more people to work . . . and at a relatively low cost, less than half what it would cost to build something.

THE ADVISORY COUNCIL

Word was released recently that in a panic over the falling fortunes of the League, the executive committee had formed an ARRL National Advisory Council. Named as honorary chairman was Senator Barry Goldwater. Acting chairman was Buzz Reeves K2GL. Many of the well-known gentlemen announced as council members are millionaires. Council members named were Dave Nurse of Heath, Art Collins, Bill Leonard of CBS, Walt Henry of Henry Radio, Bob Cushman of Cushcraft, Bill Muller of Icom, and John White of Cooper Union. I know most of these men personally and hold them in the highest regard.

Soon after the initial announcement, there was a second one saying that Art Collins had bowed out of the council with the explanation that he felt that "more constructive measures should be found to meet the total needs of the ARRL." I think Art has something there. The problems which have brought the League to this stage of disintegration cannot be solved by passing the hat again for another membership collection. The problems are managerial and are deep rooted.

If there was any simple way to get new management for the League, the directors would have done it long ago. The fact is that once a group gets well entrenched, it is very difficult to blast 'em out.

We'll all be watching to see what powers the Advisory Council has, if any. The word in the title is "advisory," so the assumption is that they have merely the power to advise. I suspect that this limitation may have had a lot to do with Art quitting the group. The men listed are spread all around the country, so it is doubtful if they will be able to get together in a group to tackle the situation. They are certainly as busy as I and won't be able to just drop everything and spend the needed time for an investigation of the many factors which brought on this disaster.

Since the heart of the problem apears to be the little HQ clique running the ARRL, people who for the most part have little background in trying to run an organization of that size and complexity, the committee may have its hands full trying to get cooperation in their investigations. How much help will HQ give to a committee which they see as being organized primarily to bring about their demise?

The gentlemen on the committee are hard-working men,

but they can afford to take on outside projects such as this only as long as they get a lot of cooperation and don't have to spend too much time fighting management. I devote some of my time to working with the local Chamber of Commerce and I enjoy having a hand in governing what is happening in my town. I also spend some time working to make my old submarine crew have a little better yearly reunion. If I can take a bit of time off from running *73, Microcomputing, Microcomputing Industry,* Instant Software, etc., then most businessmen can do the same . . . if it seems worthwhile.

BULLET BITING

The position some of the Advisory Council members are in is not enviable. The needed increase in advertising rates could directly affect their own businesses. The current *QST* ad rates are around $1,500 per page and should, to be consistent with those of other similar magazines, run around $4,500. This would increase the cost of a full-page ad by about $36,000 per year and have to be reflected in higher equipment costs to amateurs. This change alone would bring up ARRL income by about $2.5 million a year and eliminate the necessity for increasing membership fees. It would certainly get the League out of the financial hole the present management has gotten it into.

HOW ABOUT THE IoAR?

Several longtime readers of *73* responded to my December editorial with the question as to why I have not resurrected the Institute of Amateur Radio, particularly in view of the problems with WARC. That deserves an answer.

First, for new amateurs, let me explain what an IoAR is . . . or was. Back in 1963, when *73* was just about three years old, I got the foolish notion of promoting ham-to-ham friendship through a ham tour of Europe. Oh, the idea was good, but the work involved was monstrous. The idea was to get groups of amateurs together and visit amateur groups in Europe.

In order to qualify for a group fare on the airlines, it was necessary to have a formal group. I formed the Institute of Amateur Radio with the primary purpose being the organizing of ham trips to visit DX hams. I advertised the idea in *73* and gathered together a group of 73 for the tour. Odd number.

I made all of the arrangements for airline travel, ground transportation, hotels, etc., including a hamfest in most of the places we would visit. I did all this in addition to editing and publishing the magazine, selling the ads, helping with the subscriptions, etc.

The first place we visited was London. The RSGB (Radio Society of Great Britain) refused to do one damned thing to greet or offer a friendly hand to the 73 visiting U.S. hams and their families. Despite that, a nice dinner was arranged and our group was able to get together with the local amateurs.

The frigid reception from RSGB may have been more of a reaction against the ARRL than U.S. hams in general, since we found the British amateurs to be very willing to put themselves out to show our group around. One of the high points was a visit to the British Science Museum, where the restrictions against third-party traffic had been waived and many of us were permitted to make phone patches back home.

The next stop was Paris and a fantastic reception organized by Pierre Catala F2BO, the local representative of the then quite active Ham Hop Club (a club which organized places for visiting hams to stay with other hams in foreign countries). I'd met Pierre on my first visit to Paris in 1958, so we were old friends by this time. In 1964, Pierre came to the U.S. and worked for *73* as long as Immigration would permit. Then he went to college in New Hampshire and graduated from the University of New Hampshire. He's now in Haiti working for the ITU.

The French amateurs pulled out all the stops and we had a beautiful visit to Paris. We all got together for a big hamfest and most of the group had French homes to visit.

The next stop was Geneva, where an international hamfest had been organized by the ITU hams. There we had a dinner with hundreds of hams from all over Europe who had come in for the occasion. Just about everyone got to operate 4U1ITU and we all had a ball.

From Geneva, we flew to Rome, where we had an audience with the Pope. From Rome, we flew to Berlin and another great hamfest-dinner, getting together with just about every active Berlin ham. We arranged bus tours of the east and west sections of the city, and it was a memorable visit.

How much did I charge for all this? The complete price for the trip, including round-trip airfare, ground transportation, hotels, all breakfasts, tours of some cities, and a hamfest in most cities with dinner, came to $550 per person. Not bad for a three-week trip to five major cities. The regular tourist round-trip fare to Rome alone was $625 at that time.

Everyone had a fantastic time. I still meet people at hamfests and conventions who were on the trip and say they wish we could do it again. It was a memory all of us will carry with us.

At $550, we obviously didn't make any money, But then, despite the claims of my critics, money has never been anything more to me than a way to get things done, so I have tended to just scrape by.

The tour was in October, 1963, just at the time that the League petitioned the FCC for what they amusingly called "incentive licensing." This beaut, for those of you who were not there, called for throwing most of us off the phone bands we had been using and forcing us to take a new license exam to get back our previous privileges. It went over like a lead balloon. Sales of ham equipment dropped from $35 million in 1963 to under $5 million in 1965, largely in response to this fiasco. Ham growth stopped in its tracks, not going into the plus column for over ten years after this bomb.

The reaction of many hams was to look desperately elsewhere for some organized support. Suddenly my little travel club was being pushed to become a national organization. The $1 membership fee was increased to $10 and the IoAR was up and running. The purposes of the Institute were to do the things which the ARRL could not or would not do, such as lobby in Washington, furnish cash for hams fighting legal battles which could affect us all, etc. It was set up so as not to challenge the ARRL in any of the activities it was actually doing.

This is not the place to cite all of the dirty tricks the ARRL cooked up to try to scuttle the Institute. Several ARRL directors bragged to me that the League would spend *any* amount of money to shoot down the Institute and it didn't take long before I realized that this was a fact. Directors rushed around to every club in their divisions denouncing any

Corrections

Two errors exist in "Light Up Your Life" (December, 1978). First, the PC board layout (Fig. 2) should be replaced with the one shown here. The original Fig. 2 shows, incorrectly, the component side, rather than the foil side. Second, the pin numbering scheme for the 5th digit readout (Fig. 1) contains *two* pin 11s. The *lower* pin 11 should be labeled 7.

We regret the trouble that these errors may have caused.

Gene Smarte WB6TOV
News Editor

Since the time that I wrote the article for the WR7AEK battery charger, Tri-Tek has stopped advertising in *73*. Please print their address as follows: Tri-Tek, Inc., 7808 N. 27th Ave., Phoenix AZ 85021, 995-9352. Please send your money to them and not to me. Specify you want the "WR7AEK battery-charger kit," not "the thing by WA7DPX in *73 Magazine*." For Mr. R. B. Hintenoch and others who have written (or called)—no SASE, no answer. I have enough bills without making the post office rich. Thanks to those who have written letters to me about the article.

James Wyma WA7DPX
Casa Grande AZ

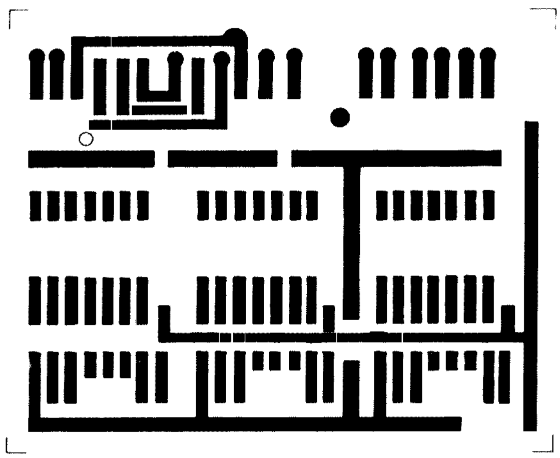


Fig. 2, "Light Up Your Life." PC board.

ham supporting the Institute as a traitor to amateur radio. A newsletter began being sent to clubs everywhere and to every member of the Institute (I published their calls) telling them, month after month, that I was a crook, that everyone involved with the Institute was a crook, that I was going to kill amateur radio, etc. Dick Cowan dutifully helped with some similar comments in *CQ*.

In the midst of this increasing war, I got involved with a really miserable divorce. Unless you've been through something like that, you don't know what it is. It stopped me more than anything else for quite some time. I realized this and got together with the board of directors of the Institute and insisted that they find someone else to act as secretary for the organization until I could get back into better working shape.

The board tried hard to find someone to work for the same price I did . . . nothing. They finally settled on Dave Middelton W7ZC, who would do the work but insisted on a very nice salary for his time, even though he was retired. This resulted in the funds which I had built up for the Institute being spent for his salary and little else, finally running out completely. My main expenses had been for publishing and mailing newsletters to Congress telling them about the good things radio amateurs had been doing . . . such as helping get medicine to remote parts of the world and the amateur radio service during the Alaska earthquake.

By the time I had managed to get back into some sort of good working shape, the Institute had collapsed from the attacks of the ARRL and the internal bleeding by the secretary. I decided to sign up again as secretary, but instead of soliciting members, I decided to do the needed work myself. It was more trouble to get memberships, fight off the ARRL, send out membership cards, etc., than to spend the needed PR money out of my own pocket to get the job done.

MORE HAM TOURS?

With the 1963 trip such a success, I wanted to do more of this ham-to-ham friendship activity. I announced another ham tour of Europe in *73* for 1965 and waited for the deluge of people to sign up. The first trip had been so much fun for everyone involved that I felt we would have an even better trip the second time. Imagine my surprise when, on looking closely at the list of those signed up, I found that virtually all of the people were repeaters from the first trip. It was then that I realized that there was a very limited number of hams with $550 and the time for such a trip. I called it off.

We did try it again in 1968 and had a very nice tour of Europe, visiting Madrid, Amsterdam, Paris, Copenhagen, etc., but the smaller crowd involved confirmed again that the number of hams able to participate in such a tour is very limited. Hams are, for the most part, middle and lower-middle income people, and not many can afford the luxury of a three-week vacation in Europe with the XYL. Better to put the money into a new rig, I suppose.

WHITHER THE INSTITUTE?

In view of the present growing disenchantment with the League over their bumbling of the WARC planning and other recent problems, is there a need for a second national amateur organization? Right now I don't see any serious need for one. There is no question that with the usual 20-20 hindsight, we can see that we sure should have had one last year to get the WARC situation covered in Africa.

If we do manage to come through WARC with enough ham bands to survive as a hobby, then we will definitely need a second national ham society. The key to the whole situation facing us is a political one, and this means that if we are going to cope with the government, the FCC, the ITU, etc., we must have a strong lobby in Washington. That's where the power is, and that's where we need to be covered.

A good lobby can not only put pressures on the FCC to prevent gross miscarriages of justice like the recent linear amplifier ban and the 220 MHz maneuvering by CB and the maritime interests, but it could also help us get things through Congress and put pressure on other government agencies to support amateur radio, which we need desperately at WARC.

At the last WARC, where I was one of the two active ham delegates, I found that this lack of clout in Washington had resulted in amateur radio having little more than lip support by even the U.S. delegation. Despite the official U.S. position that amateur radio would be supported 100%, the private instructions of the delegates from their organizations were that if their service lost any frequencies, they were to be replaced by frequencies taken from the nearest ham band. Our allocations were considered a sort of emergency supply source for frequencies. The delegates pointed out that this was purely a political matter that the service with the least clout was bound to be the loser. Just about every other user of radio frequencies maintains a strong lobby in Washington, so they come first.

NOVICES ON 220?

The Canadians are all upset over an ARRL proposal to open the 220 MHz ham bands to Novices. Frankly, if I already didn't have a petition on file with the FCC for this band to be opened for Communicator use, I'd probably get upset, too. Not very much, though.

The ARRL has, in the past, endorsed the Communicator idea for 220 and not a few of the major manufacturers are quite convinced that such a new class of license is inevitable . . . and soon. For my part, I think I could get up in front of a large group of amateurs and argue effectively either for or against a Communicator license. There are many benefits to be derived from such a plan . . . and there are many drawbacks.

I filed the original petition so long ago that I forget just when it was . . . about ten years ago, I think. My scheme in filing it was to present a viable alternative to taking the band away for CB use and hopefully to divide the manufacturers enough so that CBers wouldn't take our band. I figured that if the Communicator Class license actually did go through, it would have more benefits than drawbacks, although I felt that the two proposals might just defeat each other with the result that there would be no major change in 220.

The League surprised me with a historic first . . . they supported the Wayne Green petition. They really had little other choice. With the CB manufacturers pushing hard through the EIA (Electronic Industries Association), the ARRL *had* to come out with a positive move. To just try to hold the status quo was far too weak an argument and would obviously lose the 220 MHz band for amateurs. To come out with a third proposal would split the ranks too much for success . . . so they had to support my proposal, much as they hated the idea. I had a good laugh with several of the directors over this.

As a passing matter and off the point, I am on good terms with some of the ARRL directors and hold a few of them in great respect. I'm not personally at war with anyone at the ARRL and hold no personal grievances. I'm neither in awe of nor afraid of the men running the show. They don't seem to feel the same about me, so we do have difficulty in getting together. That's a pity, for I've found that even the widest differences can usually be overcome if people will sit down and discuss things. This presumes that those participating are honestly motivated.

At any rate, now that the 220 threat to CB has finally been laid to rest, I think the ARRL wanted to put a stop to the proposed Communicator Class license and felt that the safest way to do this, while still appearing to support the manufacturers, was to put in a counterproposal. This would in all probability stall things for a few more years and permit the whole matter to eventually be washed away.

I see no real point in taking up any argument for or against releasing tens of thousands of Novices on 220 MHz since I don't think the ARRL is serious about it.

ST. LOUIS, MARCH 31

Mark off March 31 on your calendar and plan to come to St. Louis for one of the most fun hamfests yet. It'll be worth the trip. I'll be there to talk about hamming and also about microcomputers and answer any questions you have. Sessions like this are great because there are a lot of things that I can tell you in person that I wouldn't dare to write.

What started out as a simple visit by Wayne Green to St. Louis has been escalated into a full-fledged hamfest. It will be at the H. J. Cervantes Convention Center and there will be forums on many aspects of amateur radio all through the day. Planned are sessions on OSCAR-AMSAT, repeaters, RTTY, 10/10 International, YLRL International, SWOT, linear amplifiers, DX with Father Moran 9N1MM from Nepal, SSTV by Robot, antennas by Hy-Gain, and some special sessions for the XYLs, etc.

Exhibits? You bet. So far the following are signed up or expected: Yaesu, Kenwood, Robot, VHF Engineering, Hy-Gain, MFJ, HAL, ETO, Kantronics, Ham Radio Center, Henry Radio, Cushcraft, Tennalab, Sinclair, Telrex, Rohn, Southwest Technical Products, CB Products, Ten-Tec, DSI, Info Tech, Microlog, Radio Shack, Drake, DenTron, Icom . . . and there will be a lot more. Dealers will be coming with some fantastic special prices.

Just to get the show off to a good start, I'll be in a day ahead and will be on the radio and television stations through a good deal of Friday drumming up interest in the hamfest for Saturday.

The event is going to be called "ARCH MARCH" . . . ARCH for the famous St. Louis Arch and MARCH for Midwest Amateur Radio and Computer Hobbyists. The show will be put

on by an amalgamation of 22 clubs in the area, led by Bob Heil K9EID.

The idea for the hamfest grew out of a phone call to me from Bob Heil. He wanted to get me out to talk to the Marissa Amateur Radio Club (Marissa, Illinois). The more we talked, the bigger it grew. On December 15, Bob met with representatives of nine area ham clubs and the show was on the road.

There has been a need for a hamfest in the St. Louis area and I'm delighted to see this shaping up so quickly and so well. The idea is to make this a yearly event. If you can possibly make it to the hamfest, please come and help make this a winner. Bring all the hams that you can.

Since, as far as I know, I'm not on the program to speak at either Dayton or Atlanta, this may be the *only* place where you will have an opportunity to find out what is really going on . . . and to ask the questions you wish you could get answered.

SWISS REPEATER

They may not have as many repeaters in Europe as we do, but you can't fault them on innovations. A Swiss repeater has a very sophisticated receiving system . . . it uses a microprocessor to check the direction from which a received signal is coming and switches the receiving antenna to that bearing from an omnidirectional pattern. It can also be used to check the location of the station and compare that with the callsign. Does that give you repeater owners any ideas? The Swiss repeater is so effective that it is able to cover virtually all of France.

HELP YOUR LIBRARY

Presumably you enjoy *73 Magazine* and realize that if more hams would read it, they would get a lot more enjoyment out of amateur radio. The articles are also top-notch for getting newcomers fired up with an interest in amateur radio. You can help enrich some lives by making sure that *73* is in your local library. Oh, it won't cost you anything except the time to check and ask.

If you find that it is not in your library, please make sure that the head librarian knows that you think it should be there. You might point out that *73* is the largest of the ham magazines and has more articles than any other . . . indeed, more than all the others combined some months! *73* is more of an ongoing encyclopedia of amateur radio than just a ham magazine.

In most cases, by the time two or three people have asked that *73* be in your local library, and they know where to write, we'll be getting a purchase order from them. And what school library is adequate without this reference? Let's see what you can do.

NOVEMBER WINNER

Dr. Ralph E. Taggart WB8DQT will be receiving our $100 bonus check for the November issue's most popular article, "Be A Weather Genius." Keep those Reader Service card ballots coming in!

COINCIDENCE

During the recent Aspen ham industry conference, we had quite a group sitting around a table at one of the nicest restaurants in town. I had just handed out some brochures by a ham advertising agency promoting the use of a ham-run ad agency for advertising and marketing when the waiter asked if I was a ham. I said sure, and he asked my call letters. Just to be smart, I turned my belt buckle with my call engraved on it up and looked at it . . . and read off W2NSD/1. The waiter gave a laugh and introduced himself as Fred WB0FOR, and said that he was the one who had made the belt buckle for me.

I'd tried to get in touch with him the year before, but he'd been away during our conference. Colorado Silver, located in Aspen, had been advertising in *73* and turning out extraordinarily good belt buckles for hams who are proud of their calls. The buckles come in bronze for $13.50 and have to be one of the nicer gifts a wife can give a ham. I wear mine a lot and it gets noticed. I remember once in Berne, Switzerland, when a woman saw it and said that her son was a ham . . . etc. For a bit extra they are available in solid silver. You can look up their ads during 1978 in the April and June issues.

New Products

from page 19

ged, compact unit which fits easily into the palm of the hand, the LX 303 features a large, ½-inch, angle-mounted LCD readout for high readability indoors and out, even in bright sunlight. A reading rate of 3 readings per second makes accurate reading fast and convenient. Battery life is 200 hours minimum (300 hours typical) from a single 9-V alkaline battery. Handy battery check capability is also provided.

Ruggedness is achieved in the LX 303 by combination of light weight (12 oz., including battery), compact size, a high-impact thermo-plastic case, and glass-epoxy PC board construction. Ruggedness is further enhanced by a snap-on cover which protects the entire front panel during storage or transmit, whether in a briefcase, toolbox, or storage bin. The snap-on cover can also be used to store the test lead set included to effect a totally self-contained, protected instrument. All input jacks are recessed for operator safety.

Reliability is assured by the use of LSI circuitry and laser-trimmed thin-film resistor networks for low parts count. The excellent overload characteristics provide 1000-volt protection on all dc voltage ranges except the 200 mV range (which is protected to 500 V). All ac ranges are protected to 600 V. All Ohms ranges are protected to 120 V. Maintainability is also excellent, due to the use of sockets for the major components (including the display) and the extensive use of standard components. The unit is covered by a 1-year warranty.

A full complement of accessories is also available, including an ac adapter (115 V ac and 220 V ac versions), a padded vinyl carrying case, a 10-A dc current shunt, a x10 dc V probe adapter which protects the input to 10 kV, and a x100 40-kV dc probe. For further information, contact *The Hickok Electrical Instrument Company, 10514 DuPont Ave., Cleveland OH 44108; (216)-541-8060.* Reader Service number H35.

PALM-SIZE CSC MAX-550 MHZ COUNTER

The newest and most capable frequency counter in the "Max" line from CSC is the MAX-550, a new, palm-size frequency counter which boasts a 1-kHz-to-550-MHz range. This counter is no bigger than most pocket calculators.

The counter's 50-Ohm input (via a BNC connector) has a sensitivity in the milliwatt range. Its 6-digit LED display features 1-kHz resolution. Any of several sources of 7-12 V dc can be connected through the counter's coaxial power connector. And a number of accessories—including cables, a case, alternate power sources, and so on—will be offered.

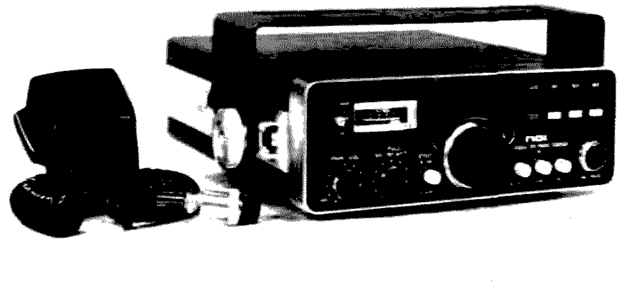
Additional information is available from *Continental Specialties Corporation, 70*

CSC's MAX-550.

Fulton Terrace, New Haven CT 06509; (203)-624-3103. Reader Service number C9.

NDI ANNOUNCES 800-CHANNEL 2 METER TRANSCEIVER

NDI, Inc., has announced the HC-1400, a new high-performance 2 meter FM mobile transceiver. This microprocessor-controlled, digitally-synthesized unit has 800-channel capability within the amateur 144-148 MHz band, and offers 5- or 10-kHz channel spacing. A fast-acting single knob selector shifts LED digital frequency readout in 10-kHz steps, and the rig also has a 100-kHz "speed-up" button. Transmit offsets are preprogrammed and switchable to plus or minus 600 kHz. Simplex operation is also available. This set can be programmed to hold three Tx-Rx pairs in memory, and has capability for instant recall. The receiver uses an FET front end with three coax resonators, a crystal lattice filter and multi-tuned circuits in a dual i-f. The FM transmitter delivers 25 W output at 13.8 V dc. Power is reducible to 5 W. Size: 7.1" W x 2.6" H x 10.1" D. A mounting bracket and a detachable microphone are also supplied. For further information, contact *NDI, 22125½ South Vermont, Torrance CA 90502; (212)-320-3312.* Reader Service number N19.



The HC-1400, NDI's new 2m transceiver.

TEMPO 800-CHANNEL HAND-HELD TRANSCEIVER

The amazing pocket-sized Tempo S1 SYNCOM offers the first fully-synthesized 800-channel 2 meter miniature amateur hand-held transceiver. Other units which are larger, heavier, and similarly priced (by the time you add crystals, batteries, chargers, and antennas) can offer only 6 channels. The S1's price of $349 *includes* the battery pack, charger, telescoping antenna—and 800 channels!

Top-panel thumbwheels allow selection of the receive frequency to 10 kHz. The +5-kHz slide switch offsets to 5 kHz if desired. Then you have the choice of transmitting simplex, +600 kHz, or −600 kHz.

The S1's separate speaker and microphone are both built-in. Rf output is better than 1.5 Watts nominal. A matching 30-Watt output amplifier is available for mobile or fixed operation. The dual-conversion receiver section has a sensitivity of better than 0.5 microvolts nominal for 20 dB of quieting, and spurious and harmonic attenuation is 60 dB nominal below the carrier power level. Measuring 2.5" wide x 6.5" long x 1.6" deep, the unit weighs 16 ounces with batteries.

The Tempo S1T is the S1 with a factory-installed 12-button touchtone™ pad ($399). Accessories for the S1 and S1T include the TS-CC heavy leather holster with snapped belt loop ($16), the S30 matching 30-Watt amplifier ($89), the TS-MC cigarette-lighter-plug mobile charger ($6), the TS-HA rubber-coated flexible antenna ($8), and a full line of tone accessories, all types of touchtone pads, many different amplifiers, and power supplies.

The Tempo S1 and S1T and accessories are available from dealers throughout the US and all over the world. *Henry Radio, 11240 West Olympic Boulevard, Los Angeles CA 90064; (213)-477-6701.* Reader Service number H3.

Morgan W. Godwin W4WFL
Peterborough NH

HUSTLER INTRODUCES NEW 2 METER MAGNETIC-MOUNT ANTENNAS

The new Hustler Model BBLM-144A 2 meter magnetic-mount antenna was recently announced by New-Tronics. The base-loaded 52" antenna offers a unique magnetic-mount design with much stronger grip per square inch of magnetic surface than is normally available in magnetic mounts.

Careful design of the shunt-fed matching system guarantees maximum signal radiation at the point of lowest swr. The tapered stainless steel radiator provides maximum protection against flutter and detuning at freeway speeds. The power capacity exceeds 200 Watts. The BBLM-144A includes 17' of top-quality RG-58 coaxial cable with factory-installed connectors.

The SFM 2 meter mobile antenna with magnetic mount also inlcudes 17' of RG-58 coaxial cable with factory-installed connectors. The 54" tapered whip is ground of 17-7 PH stainless steel. A bandwidth of 6 MHz and better than 2:1 vswr can be expected. The power capacity is 100 Watts.

For further information, contact: Sales Department, *New-Tronics Corporation, 15800 Commerce Park Drive, Brookpark OH 44142.* Reader Service number N2.

NEW BEARCAT® THIN SCAN™ IS WORLD'S SMALLEST SCANNER RADIO

The new Bearcat® Thin Scan™.

A new portable scanner radio, just 2¾ inches wide and 1 inch thick, has been introduced by Electra Company. Named the "Bearcat Thin Scan," it is described by Electra as the "world's smallest scanner radio." Because of its exceptionally small size and light 10-ounce weight, the radio is a truly practical pocket portable unit. Featuring a rugged all-metal case with a polished, anodized aluminum front cover, the radio is expected to be especially popular with professionals and others who require a scanner in demanding on-the-go situations.

The new Bearcat Thin Scan has 4 channels and receives both "low band" (36-44 MHz) and "high band" (152-164 MHz) with excellent 0.6-microvolt sensitivity. Each channel is provided with a lockout control for bypassing when desired. The radio can be operated from external power as well as internal batteries. Also contributing to the radio's versatility are provisions for plugging in an external battery charger, headphone, and external speaker. A flexible "rubber ducky" antenna is supplied, but the radio can also be used with wire antennas.

For further information, contact *Electra Company, PO Box 29243, Cumberland IN 46229.* Reader Service number E40.

YAESU'S FT-7

I've owned my FT-7 low-power mobile rig for a year now and have really enjoyed it. I bought it on Okinawa while with the US Navy, so I have the Japanese version instead of the US one. The main difference is the language of the manual.

The FT-7 covers 500 kHz of the 80-15m amateur bands, plus one 500-kHz portion of ten meters (28.5 to 29.0 MHz). The FT-7 operates on USB, LSB, and CW, with a choice of vfo, RIT, or fixed channel operation. The rear panel has provisions for a standard SO-239 rf connector, a ground post with butterfly nut, subminiature jacks for key and external speaker, a six-prong plug for power, and a multi-pin jack for an external vfo (although they don't make a vfo specifically for this radio).

The FT-7 input power is 20 Watts dc. The receiver is rated at .5 uV sensitivity for a 20-dB S/N ratio. It has an audio bandwidth of 2.4 kHz − 6 dB and 4.0 kHz − 60 dB. The audio output is 3 Watts with 10% THD into 4 Ohms. The FT-7 requires .4 Amps on receive and 3 Amps on transmit of 13.8 V dc. It measures 9" W x 3" H x 12" D.

The FT-7 came well-packed and included a hand mike, 3 subminiature connectors, a fused power cable, an rf connector, a phone-plug-to-subminiature-connector adapter, and a mobile mounting bracket.

My personal impressions are very favorable. The audio is clear and crisp, and the styling is smart and functional. I've had no trouble working the world with just the FT-7 and a trap vertical. My only two complaints are the lack of a CW filter and the inconvenience of only having one ten meter position on the radio. Overall, it is a very nice radio.

Yaesu will soon be coming

out with the FT-7B, which is basically the same radio with the addition of all of the ten meter band and with the power having been raised to 50 Watts input. Reader Service number Y1.

John Price WD8OPE/KA6JP
Warren OH

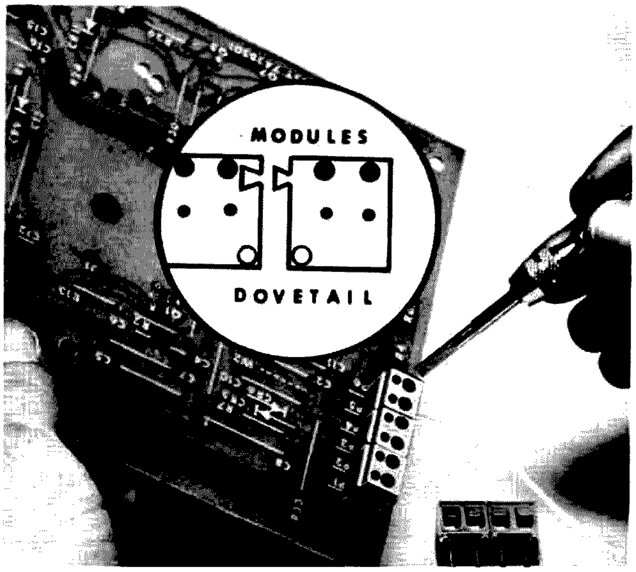
MODULAR TERMINAL STRIPS

TS-6MD terminal strips are 2-position modules which are end-stackable via interlocking dovetails to create strips of any desired length. Each module consists of two screw terminals on .200-inch (5.08mm) centers, each terminated with a .197-inch (5mm) long x .039-inch (1mm) diameter pin for easy soldering to the PC board. Screw terminals feature corrosion-protected tubular clamp contacts and captive, self-locking, vibration-proof screws for secure clamping of solid or stranded wires 16-26 AWG without solder. Bodies are molded of durable high-dielectric nylon and are unaffected by severe environments. Electrical rating is 5 Amps at a nominal 50 V dc. TS-6MD are available from stock at your local electronics store or directly from *OK Machine and Tool Corporation, 3455 Conner Street, Bronx NY 10475.* Reader Service number O5.

WIRE-WRAPPING KIT

OK's new wire-wrapping kit features selected items of particular value to the prototype engineer and hobbyist alike. It includes a unique new wire-wrapping tool, a roll of wire-wrapping wire, and pre-stripped wire in 4 popular lengths.

The tool, Model WSU-30, is a combination one which wraps *and* unwraps 30 AWG wire on .025" square pins, plus strips 30 AWG wire using a handy built-in stripper. The wire is top-quality, Kynar-insulated, silver-plated copper. Supplied in the kit are a 50-foot roll, as well as pre-cut and stripped wire in insulated lengths from 1-4 inches, stripped 1 inch on each end. Available with blue wire as Model WK-2B, white wire as WK-2W, yellow wire as WK-2Y, and red wire as WK-2R, the kit can be purchased from your local electronics dealer or directly from *OK Machine and Tool Corporation, 3455 Conner Street, Bronx NY 10475.* Reader Service number O5.



OK's TS-6MD modulator terminal strips.

NEW HUSTLER FIVE-BAND TRAP VERTICAL FIXED STATION ANTENNA

Hustler recently introduced the new Model 5-BTV, a five-band trap fixed station antenna. The unit covers 10, 15, 20, 40, and 80 meters (tuneable to 75 meters). The 5-BTV consists of the popular Hustler Model 4-BTV and RM-80-S resonator and spider assembly.

In restricted or unlimited space locations, the Hustler 5-BTV delivers top signal performance, consistent contacts, five-band operation, and complete coverage. Switching or matching devices are not required.

The total antenna length is 25'5". It is constructed of the finest-quality heat-treated seamless aluminum and all-stainless-steel hardware. The antenna mounts to any 1¾"-o.d. vertical support. Vswr is better than 1.6:1 at all band edges. The power capability is the full limit on SSB and CW.

For further information, contact: Sales Department, *New-Tronics Corporation, 15800 Commerce Park Drive, Brookpark OH 44142.* Reader Service number N2.

DX

from page 12

and Industry, Government of the British Virgin Islands, Tortola, British Virgin Islands, B.W.I.

Mr. Swain doesn't say if the license will be mailed to you or you must pick it up. Apply early just in case and bon voyage.

NOVICE CORNER

Some have written to complain about the name of this section. The term "novice" doesn't necessarily apply only to Novice license holders. It just means one who is inexperienced. You may be an old-timer with an original two-letter call and still be a novice when it comes to DX. This part of the column receives more comment than any other, but with more than 100,000 new licenses issued since 1975, I guess there really are a lot of newcomers active on the DX bands today.

A few weeks ago, I was calling a C5 station when someone called me and asked where the C5 was located. He needed to know so he would know in which direction to point his beam.

If you really intend to be a serious DXer, one of the first things you need to learn is the different prefixes used by each country and where these countries are located. Any DXer worth his bandwidth should be able, when he hears a station, to instantly know what country is calling and where that country is located. I realize that with over 300 countries on the DXCC countries list, that seems like a formidable task, but it really isn't that hard and it comes naturally with experience.

You should always have within fingertip reach at the operating position a copy of the ARRL DXCC countries list, a world atlas, and a Great Circle beam direction chart centered on your QTH.

The DXCC countries list can be obtained by writing to the ARRL and requesting a copy of Operating Aid #7. If you use an ARRL logbook, then you can use the countries list in the back of the logbook. Every time you hear a call that you don't recognize, look it up in the countries list and try to remember where it is from. Also, study the calls of the countries you need so when you hear one, you'll immediately recognize where it is.

If you're not sure where a country is located, look it up in a world atlas. It's always interesting to locate the various countries on a map. You can see what countries they border and find other information on a map. The people that publish the *Callbook* also publish a very good world atlas showing the call letter prefixes, zones, continents, etc., of every country in the world.

A Great Circle beam direction chart centered on your QTH will show you the exact direction to point your antenna in order to work any country on the DXCC countries list. Order one from Interproducts, 2377 Pollard Ct., Los Gatos CA 95030.

With these tools to work with and a little practice and experience, you should soon be able to recognize any call you hear on the bands and know exactly which direction to point your beam for maximum signal strength.

HEARD ON THE BAND

Due to a problem with the local MARS station and a desire to relax for awhile, WA4YVG/VQ9 on Diego Garcia has gone QRT. QSL to 102 Schoolfield Drive, Danville VA 24541.

That EU prefix being heard is White Russia. Replace it with UC and you have the correct call.

YI1BGD's signal has definitely improved. Word has it that the FT-560 supplied by the NCDXF is now on line.

A9Z was a special prefix to mark National Day in Bahrein.

Bhutan has begun a program of training wireless operators in the hopes of becoming self-sufficient in that area. It is hoped that some of these will become hams.

ZS6DN has a two meter beacon on 144.13 MHz. He would like reports from anyone hearing it.

In the Pacific area, the Gilberts go independent in July and will thereafter be known as Kiribati.

If you are looking for some old XW8 QSLs, this might help. XW8FN is Lloyd Gruhn, 1640 South Parfet Court, Lakewood CO. XW8AL is now FØDAJ. XW8LA is now in Pakistan and can be reached at the U.S. State Department. W3HNK is reported to have the old XW8FN logs.

VP8PL left South Georgia in January.

Beata Island, off the southern coast of the Dominican Republic. This island is the site of the HI1RCD DXpedition.

Some JAs are looking at an island a few hundred miles from Okino Torishima which they feel would be a new one because it is under separate administration.

That HDØE heard during the CQ WW Contest was from the Kingdom of Chaullabamba Nudist Camp. A special QSL is available that should rekindle your interest in QSL card collecting. QSL to WA8TDY/K9LJG with usual SASE.

FY7BC was on from Devil's Island. Ron plans to submit documents to the DXCC desk showing that Devil's Island is administered from France and should be considered as a separate country.

DX NOTEBOOK

Aves Island YVØ

A big operation by K1MM, YV5DFI, YV5ANF, and YS1RRD is being planned for the March/April period. Initial thinking calls for three stations and an allband around-the-clock operation.

Malpelo HKØ

Early plans are being made by the Colombian Radio Club for a 1980 effort. Plan ahead.

Jan Mayen

LA7JO keeps the following skeds with JX4GN and JX9WT: each Wednesday/Thursday at 1700Z on 14270 or 14240 kHz, same time Saturday on 14270 kHz, earlier at 1100Z on 28570 kHz, 0900Z on 14270, Sunday at 1400Z on 28570 kHz.

Navassa

The recent Navassa operation was a huge success with over 22,000 QSOs. SSB accounted for 62% of the total and the special push toward Asia netted 902 JA contacts. Thirty-three OSCAR contacts were made and one six meter contact.

QSL INFORMATION

3YØBZ to VE7ZQ
3Y1VC to LA1VC
3Y5DQ to LA5DQ
4X4CW to WBØYHG
5T5ZR to Box 202, Nouakchott
9L1CA to WA3NCT
9X5AL to SM5HHJ
9X5P to PO Box 1035, Kigali
9Y4VT to N6AA
A7XAH to DJ9ZB
A9XBD to Box 14, Bahrein
C5AAO to OZ6MI
C6A/N4UM to N4BP
CE9AH/AI/AM to Antarctic Dept., FACH, Comando De Combate, Ministry of Defense, Santiago, Chile
FGØ/FØANY to DJØUP
FM7AV to F6BFH
FY7BC to F9LM
GJ5CIA/GU5CIA to N6MA
H44CB to PO Box 332, Honiara
HC8A to PO Box 289, Quito
HDØE to WA8TDY/K9LJG
HH2CQ to W4ORT
HS1ABD to K3EST
HS1AIV to W1YRC
HZ4GNA to WB4LFM
J3AAG to K1DBA
J4JH to DJ9ZB

Thanks to the *West Coast DX Bulletin*, the LIDXA newsletter, and *WorldRadio Magazine* for much of the preceding information.

WCDXB NEEDED COUNTRIES LIST

Although several "Most Needed" lists have appeared in the past, the list in Table 1 compiled by W1AM from the personal lists of over 900 subscribers worldwide to the *West Coast DX Bulletin* is the most extensive and complete. The poll was based on the 150 top countries from the 1977 list plus additions of a few new countries which have come on the scene in the past year. The list as printed in Table 1 represents the overall U.S. need on a mixed mode basis. The entire list runs to 153 countries, but we have included only the top 25.

The biggest loser was Clipperton, which dropped from #4 last year all the way down to #152 this year. The biggest gainer was FW8-Wallis Island, which jumped from #126 to #67. This should give you a clue as to where to plan your next DXpedition.

1978 Rank	Country	% need	1977 Rank
1	3Y Bouvet	85	2
2	BY China	84	6
3	8Z Neutral Zone	82	5
4	VS9K Kamaran	81	7
5	XZ Burma	78	8
6	ZA Albania	76	9
7	1S Spratly	76	12
8	VKØ Heard	75	11
9	Laccadives	72	14
10	Abu Ail	71	15
11	7J1 Okino Torishima	70	25
12	South Yemen	69	10
13	Mt. Athos	66	27
14	Bhutan	65	22
15	Annobon	64	23
16	Crozet	64	19
17	Qatar	64	20
18	Congo Rep	63	16
19	Cambodia	63	30
20	Central African Rep	58	29
21	Andamans	58	35
22	Guinea	57	31
23	Somalia	56	13
24	Geyser Reef	55	18
25	Glorioso	55	41

Table 1.

Ham Help

I have been an avid reader of your magazine since 1973, when I discovered it on a newsstand at the PX at Ft. Jackson SC. I have been in the Air Force fourteen years as an electronics technician. Now I am stationed in Germany and am so tired of waiting for Stars & Stripes bookstores to stock your latest issues every month that I just gotta subscribe! You put out the best magazine I have seen.

I have been poring over all the back issues of every electronics magazine I have and have not found a good general-coverage receiver project anywhere. I sure would like to build my own from scratch! It would be nice if it was PLL circuitry, covered 0.5 to 50 MHz AM, CW, and SSB, with possible provisions for the later addition of either Hi or Lo VHF/UHF scanner or FM band converters. If it is the latest technology, it should include digital readout and possibly a clock! Power requirements should be 120/240 V ac and 12 V dc.

Well, got anyone working on such a gizmo for possible future inclusion in *73 Magazine*?

Patrick T. Berry
Box 222
APO NY 09692

Corrections

In "Time-Domain Reflectometry," January, 1979, Fig. 6 shows a 74S104, which is not only difficult to find, but also incorrect. The correct IC should be a 74S140.

Gene Smarte WB6TOV
News Editor

RTTY Loop

from page 24

Fig. 4(b). This prevents the chip from sourcing current and looks like the open collector at the expense of a 1N914. If you need a circuit that keys "upside down," then use the 7406, shown in Fig. 4(c). In fact, by using two inverters and feeding one or both, a normal/reverse mode can be implemented.

To get this single character stunt box working, hook up the clock, UART, and buffer chip of your choice as shown in the diagrams. Again, be sure to provide a negative twelve-volt supply for the UART in addition to the normal TTL 5 volts. If you have a frequency counter, set the clock to 727 Hz. If not, program in an R and use your TTY machine to tell you when you've got the right speed. The table from last month can be used to program in any letter or character you desire.

I'll give you all a month to play with this one. Next month we'll hook up the matrix to give a real purpose to all this dilly-dallying. A look into the crystal (FT-243 style) ball shows some more programming in store for you computer buffs. A full transmitting program, with buffers and a true FIFO, is under way for the 6800. Watch for it in RTTY Loop.

OSCAR Orbits

Courtesy of AMSAT

The listed data tells you the time and place that OSCAR 7 and OSCAR 8 cross the equator in an ascending orbit for the first time each day. To calculate successive OSCAR 7 orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the day's first ascending (northbound) equatorial crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world from you, it will descend over you. To find the equatorial descending longitude, subtract 166° from the ascending longitude. To find the time OSCAR 7 passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR 7 when it is within 45 degrees of you. The easiest way to determine if OSCAR is above the horizon (and thus within range) at your location is to take a globe and draw a circle with a radius of 2450 miles (4000 kilometers) from your QTH. If OSCAR passes above that circle, you should be able to hear it. If it passes right overhead, you should hear it for about 24 minutes total. OSCAR 7 will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15° east or west of you, add another minute; at 30°, three minutes; at 45°, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

OSCAR 8 calculations are similar to those for OSCAR 7, with some important exceptions. Instead of making 13 orbits each day, OSCAR 8 makes 14 orbits during each 24-hour period. The orbital period of OSCAR 8 is therefore somewhat shorter: 103 minutes.

To calculate successive OSCAR 8 orbits, make a list of the first orbit number (from the OSCAR 8 chart) and the next thirteen orbits for that day. List the time of the first orbit. Each successive orbit is then 103 minutes later. The chart gives the longitude of the day's first ascending equatorial crossing. Add 26° for each succeeding orbit. To find the time OSCAR 8 passes the North Pole, add 26 minutes to the time it crosses the equator. OSCAR 8 will cross the imaginary San Francisco-to-Norfolk line about 11 minutes after crossing the equator. Mode A: 145.85-.95 MHz uplink, 29.4-29.50 MHz downlink, beacon at 29.40 MHz. Mode J: 145.90-146.00 MHz uplink, 435.20-435.10 MHz downlink, beacon on 435.090 MHz.

Oscar 7 Orbitsl Information

Orbit	Date (Mar)	Time (GMT)	Longitude of Eq. Crossing °W
19623	1	0105:56	78.3
19635	2	0005:16	63.1
19648	3	0059:33	76.7
19661	4	0153:50	90.3
19673qrp	5	0053:10	75.1
19686	6	0147:27	88.7
19698X	7	0046:48	73.6
19711	8	0141:05	87.2
19723	9	0040:25	72.0
19736	10	0134:42	85.6
19748	11	0034:02	70.5
19761qrp	12	0128:19	84.0
19773	13	0027:39	68.9
19786X	14	0121:56	82.5
19798	15	0021:17	67.3
19811	16	0115:34	80.9
19823	17	0014:54	65.8
19836	18	0109:11	79.4
19848qrp	19	0008:31	64.2
19861	20	0102:48	77.8
19873X	21	0002:09	62.6
19886	22	0056:26	76.2
19899	23	0150:43	89.8
19911	24	0050:03	74.7
19924	25	0144:20	88.3
19936qrp	26	0043:40	73.1
19949	27	0137:57	86.7
19961X	28	0037:17	71.6
19974	29	0131:34	85.1
19986	30	0030:55	70.0
19999	31	0125:12	83.6

Oscar 8 Orbital Information

Orbit	Date (Mar)	Time (GMT)	Longitude of Eq. Crossing °W
5026Abn	1	0032:18	51.1
5040Abn	2	0037:30	52.4
5054Jbn	3	0042:42	53.7
5068Jbn	4	0047:54	55.1
5082Abn	5	0053:05	56.4
5096Abn	6	0058:17	57.7
5110X	7	0103:29	59.0
5124Abn	8	0108:41	60.3
5138Abn	9	0113:53	61.6
5152Jbn	10	0119:05	62.9
5166Jbn	11	0124:17	84.2
5180Abn	12	0129:28	65.6
5194Abn	13	0134:40	66.9
5208X	14	0139:52	68.2
5221Abn	15	0001:50	43.7
5235Abn	16	0007:02	45.0
5249Jbn	17	0012:13	46.3
5263Jbn	18	0017:25	47.6
5277Abn	19	0022:37	49.0
5291Abn	20	0027:48	50.3
5305X	21	0033:00	51.6
5319Abn	22	0038:12	52.9
5333Abn	23	0043:23	54.2
5347Jbn	24	0048:35	55.5
5361Jbn	25	0053:47	56.8
5375Abn	26	0058:58	58.1
5389Abn	27	0104:10	59.5
5403X	28	0109:22	60.8
5417Abn	29	0114:33	62.1
5431Abn	30	0119:45	63.4
5445Jbn	31	0124:56	64.7

FCC

Reprinted from the Federal Register.

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national administration will be able to choose how to best meet its national communications needs. This flexibility will aid the less developed nations, as well as the U.S., in communications planning, and will facilitate the development of innovative services which may radically restructure the way we communicate as we approach the 21st Century. For example, new uses for communications satellites, new systems for electronic message distribution, should benefit from this flexibility.

A third principle underlying the Commission recommendations is that detailed analyses of the policy choices in communications planning are required. Even given the flexibility of U.S. proposals, the available spectrum is simply insufficient to meet all possible communications needs. Our recommendations make clear our policy choices.

A fourth and related principle is that every effort must be made to conserve the spectrum. The spectrum is one of our most valuable resources. Recommendations that encourage inefficient use of the spectrum will only lessen our ability to communicate—a precious ability in an interdependent world such as our own. As technology develops we must be able to utilize it to increase spectrum efficiency.

Finally the Commission's recommendations seek to provide our country with increased diversity in the electronic media. Adoption of the Commission's expansion in the AM broadcast band could provide hundreds of new stations which would allow those who have traditionally been excluded from our electronic media to enter into the communications mainstream. In another example, the adoption of our recommendations would preserve the possibility of direct broadcast satellites providing new channels across the United States.

The Commission's formal work is over with the adoption of this *Report and Order*. I look forward to following the proceedings of the 1979 Conference with great interest. Because of its fundamental importance, I hope all concerned citizens will also be watching.

JOINT SEPARATE STATEMENT OF COMMISSIONER ABBOTT WASHBURN AND COMMISSIONER JAMES H. QUELLO

DECEMBER 5, 1978.

RE: Docket 20271, WARC 1979 Proposals.

President Carter has enunicated a policy of increasing the international flow of information and, for this purpose, has adopted a policy of increasing the use by the United States of international shortwave broadcasting * * * primarily by the *Voice of America, Radio Free Europe,* and *Radio Liberty*. The frequency allocations for international broadcasting contained in today's Report and Order—totaling an increase of 865 kHz—reflect but one alternative now under active consideration within the Executive Branch of the Government. This total falls some 800 kHz short of the proposals that have been made by the International Communications Agency and the Board by International Broadcasting.

Inclusion here of the 865-kHz alternative was not based on any independent analysis by the Commission. The FCC has merely deferred judgment in this matter to other agencies of the Executive Branch.

In the interest of accuracy, we believe it should be brought to the attention of all interested parties, here and abroad, that at the time of the Commission's action (December 5, 1978) there has yet been no decision within the Executive Branch as to a final figure for a U.S.-proposed frequency allocation for international broadcasting.

This is the purpose of our joint separate statement.

Ham Help

I need assistance in setting up a Kenwood TS-520S and HAL ST-5 for RTTY.

Charles E. Martin AB4Y
PO Box 3370
Bowling Green NY 42101

I would like to obtain information and/or manuals for the following pieces of gear: RT-159/URC-4 military surplus hand-held transceiver (especially power supply voltages required), Eico model 425 oscilloscope, and the Sentinel Electronics ME-26D/U multimeter (possibly a military version of the HP-410B). I will gladly pay any reproduction or postage costs.

Frank Latos AC8P
11251 Chicago Rd.
Warren MI 48093

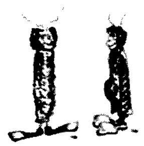
Microcomputer Interfacing

from page 14

the computer is only dedicated to the loop for a short period. For other types of converters, the conversion time may take much longer, perhaps milliseconds or even hundreds of milliseconds for a digital multimeter. In such a case, the microcomputer would spend considerable time waiting for the ADC to "flag" the 8080, indicating that the conversion was complete.

An alternative approach is to use the DONE/$\overline{\text{BUSY}}$ flag as an interrupt input to the 8080. After initiating a conversion by outputting a START pulse, the microcomputer goes to some other software task while the conversion is proceeding. When the conversion is complete, the ADC interrupts the computer and points it to the ADC's service software, which, in this case, is located at 000 070. A software example is provided in Table 2.[2] In this example, the ADC subroutine is used only to start the conversion process. The subroutine at 000 070 is called by the interrupt with the aid of a jammed RST7 instruction byte. The ADC interrupts the 8080 only when it has finished a conversion. The software starting at 000 070 inputs the ten bits of data and stores them in a data file. Interrupts should be used with caution.

References
1. *Analog-Digital Conversion Handbook*, Analog Devices, Inc., Norwood, Massachusetts 02062. Copies may be still available for $3.95.
2. The assembly-language format shown is that of the resident editor/assembler developed by Tychon, Inc., for 8080 systems.



LETTERS

from page 8

thing couldn't be that dead after taking only ten pictures. So, anyway, I put it on a VOM and discovered that it is a little better than six volts.

I temporarily put a 12-volt light bulb on the contacts and was surprised to find that it lit up quite brightly.

The next thing I did was put a motor on it that came from an HO electric train, and it ran quite well.

It seems to me that if someone were to lower the voltage a bit and use it to power things like LEDs, it would last quite a while. I had no way of telling how long it would have lasted with this continued use. I'll try that next.

However, it says on the film pack not to take the thing apart, but to throw it away.

If one were careful, you could put it to some use, after, of course, taking ten pictures with your Polaroid.

I wish you would try one out on something and let me know how it worked or if it is a good idea.

Jerry Smith WA2QEL
Port Crane NY

THANKS, UNCLE!

My main comment is about the letter in the September issue of *73* by KA2RF. I held the callsign WA2UUV for about seventeen years. I moved to California and received orders to the *USS Midway* CV-41 homeported in Yokosuka, Japan. Meanwhile, tiring of having to sign portable after my callsign, I applied for a counterpart callsign for the sixth call area (K6UUV was open) and received KA6CGF instead. My ticket has my home QTH on it, but the envelope was addressed to my military address aboard ship. So what do I do—sign portable in Japan or in the States? Head for the CPO club and put away a few 807s or take up knitting in my spare time? Can I legally operate in JA-land or what? As you see, once again Uncle has put me between a rock and a hard place.

I enjoy your tilts with the ARRL; sometimes trying to get the point across to them is like trying to get the attention of a Missouri mule—it takes a few raps with a verbal 2x4, but eventually you get its attention.

Bill Fulling KA6CGF
FPO San Francisco CA

COLLINS

Although Collins continues to offer only their vacuum-tube line of transmitters, receivers, and transceivers on the amateur radio market, they have introduced a solid-state line for commercial use. Two of the new transceivers, the HF-281 and the HF-282, have an output of 125 Watts. For commercial use, they are channelized but can be adjusted to any frequency between 1.6 MHz and 30.0 MHz in 100-Hz increments. A "clarifier" control permits excursions 150 Hz above or below the established frequency.

With the HF-281, the user may select among six preset channels. The HF-282 offers 20 channels as well as a plug-in PROM IC to permit additional 20-channel ranges to be readily available.

Each of the two models includes a built-in ac power supply for 50- or 60-Hz 115- or 230-volt operation. In addition, either may be operated from a 12-volt dc power source. Optional features include VOX, squelch, and a noise blanker.

For operation with a variety of antennas, a companion antenna coupler, the HF-280, enables use of antennas ranging from a short whip to random-length "longwires." It is not stated whether this matching device tunes automatically or must be manually retuned for major frequency changes.

It is not known whether Collins has any plans for putting similar equipment on the amateur radio market.

Carl Drumeller W5JJ
Warr Acres OK

THE RIGHT TO RULE

I read K7UL's letter in the September issue of *73*. I am really disappointed with his and apparently your opinion about the USA and other countries in the ITU.

Indeed, the US is a first-rate power (economic, military, etc.), but this does not give it the right to rule the world.

Because you live in a democracy, you know better than I that everybody's vote is equal. Otherwise, why not give Mr. Rockefeller or Mr. Kennedy more votes than Mr. Joe Smith in a US election?

Sorry for the *bad* English, but I am from an underdeveloped country that does not speak your language.

Jose Ribeiro Pena Neto
PY4VTU/2
Sao Paulo, Brazil

VE3TEN

On December 29, 1978, on a frequency of 28.172, station VE3TEN did QRM this frequency from 1600 GMT to 1715 GMT. It laid down a carrier and every 15 seconds or so IDed as VE3TEN. Look this one up in the *Callbook*. It belongs to the Canadian branch of the ARRL. What gives them special license to QRM the band? I feel this was in bad taste and I would like to have *73* find out just what they had on their minds. I called the ARRL in Connecticut and got a real pleasant runaround. They sure did make an impression on future hams.

Name submitted but
withheld by request

Ham Help

I would like to make some contacts on the Novice bands. I just got out of the hospital and live alone, and making Novice contacts would be a godsend to me. I am 86 years old. Thank you.

Glenn N. Crawford WB0SLV
207 5th Ave. N.
Humboldt IA 50548

I am searching for the following back issues of *73*: January '61—April '61, November '61, January '65, January '66, June '66, July '66. Any help in obtaining these would be greatly appreciated.

Dr. G. Puggioni
Via Salvo D'Acquisto No. 12/7
16035 Rapallo (Genova)
Italy

I would be very grateful if someone could send or loan me a service manual, schematic, or any other info regarding signal generator PP-1322/URM-25 F.

R. D. Gupta VU200
Anant Bhawan AB Road
Guna 473001
India

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	14	14	21	14A
ARGENTINA	21	14	14	7A	7	7	14	21A	21A	21A	21A	21
AUSTRALIA	21	14	7A	7B	7B	7B	7B	14	14	14	21A	21A
CANAL ZONE	14	14	7	7	7	7	14	21	21A	21A	21A	21
ENGLAND	7A	7	7	7	7	7B	14	21A	21A	21A	21	14
HAWAII	21	14	14B	7	7	7	7	7B	14	21	21A	21A
INDIA	7	7	7B	7B	7B	7B	14	21	14	14	14	14B
JAPAN	14A	14	7B	7B	7B	7	7	7	7B	14B	14	21
MEXICO	21	14	7	7	7	7	7A	14	21	21A	21A	21
PHILIPPINES	14A	14	7B	7B	7B	7B	7B	14B	14	14	14B	14
PUERTO RICO	14	7A	7	7	7	7	14	21	21	21A	21A	21
SOUTH AFRICA	14	14	7	7B	7B	14	21	21A	21A	21A	21	21
U. S. S. R.	7	7	7	7	7	7B	14	14A	21A	14	14B	7B
WEST COAST	21	14	7A	7	7	7	7	14	21	21A	21A	21A

CENTRAL UNITED STATES TO:

ALASKA	21	14	14	7	7	7	7	7	14	14	21	21
ARGENTINA	21	14	14	7A	7	7	14	21A	21A	21A	21A	21
AUSTRALIA	21A	21	14	7A	7B	7B	7B	14	14	14	21A	21A
CANAL ZONE	21	14	14	7A	7	7	14	21	21A	21A	21A	21A
ENGLAND	7A	7	7	7	7	7	7B	14	21	21A	14	14
HAWAII	21A	21	14	7	7	7	7	7B	14	21	21A	21A
INDIA	14	14	7B	7B	7B	7B	7B	14B	14	14	14	14B
JAPAN	21	14A	14	7B	7B	7	7	7	7	14B	14	21
MEXICO	21	14	7	7	7	7	7	14	21	21	21A	21
PHILIPPINES	21	14	14	7B	7B	7B	7B	7	14	14	14B	14A
PUERTO RICO	21	14	7A	7	7	7	14	21	21	21A	21A	21
SOUTH AFRICA	14	14	7	7B	7B	7B	14	21	21A	21A	21A	21
U. S. S. R.	7	7	7	7	7	7B	7B	14	21	14	14B	7B

WESTERN UNITED STATES TO:

ALASKA	21	21	14	7	7	7	7	7	7A	14	21	21
ARGENTINA	21	21	14	7A	7	7	7B	14	21A	21A	21A	21A
AUSTRALIA	21A	21A	21	14	14	7	7	7B	14	14	21	21A
CANAL ZONE	21A	21	14	14	7	7	7	14	21	21A	21A	21A
ENGLAND	7B	7	7	7	7	7	7B	14B	21	21A	14	14
HAWAII	21A	21A	21	14	14	7	7	7	14	21	21A	21A
INDIA	14	14A	14	7B	7B	7B	7B	7B	14	14	14	14B
JAPAN	21A	21A	21	14B	7B	7	7	7	7	14B	14	21
MEXICO	21	21	14	7	7	7	7	14	21	21	21A	21A
PHILIPPINES	21A	21A	21	14	7B	7B	7B	7	14	14	14B	14A
PUERTO RICO	21A	14	14	7	7	7	7	14	21	21	21A	21A
SOUTH AFRICA	14	14	7	7B	7B	7B	7B	14	21	21A	21A	21
U. S. S. R.	7B	7B	7	7	7	7B	7B	7B	14	14	14B	7B
EAST COAST	21	14	7A	7	7	7	7	14	21	21A	21A	21A

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor
SF = Chance of solar flares

march

sun	mon	tue	wed	thu	fri	sat
				1 P/SF	2 F/SF	3 F
4 F	5 G	6 G	7 G	8 G/SF	9 P	10 P
11 G	12 G	13 F/SF	14 F	15 F	16 G	17 G
18 G	19 G/SF	20 F/SF	21 F	22 F	23 G	24 G
25 G	26 G	27 G	28 G	29 G	30 G	31 G

April 1979 $2.50

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W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

WHICH PAGE DO YOU READ?

On page 6 of the March issue of *Ham Radio Horizons* (also reprinted in *HR*), an editorial discounted the gloom and doom reports about WARC, saying G&Ders "apparently get their information from the Wizard of Oz—or some other equally unlikely source." On page 11 of the same magazine, a wizard tells us in the lead item of Newsline that broadcast interests are threatening us at WARC. Some schizophrenia there?

There was no specific mention of anyone in the editorial, just a few straw men set up and toppled. Since I've written about WARC recently, I tried to identify any possible references to my writing, but failed. Like the League, I feel optimistic and agree with them that the ITU *can't* kill amateur radio. It is unthinkable and I am not thinking it. I do regret that something positive wasn't done just to make sure, particularly in the face of the massive losses amateur radio has suffered in recent years—and I consider the loss of 239,000 MHz of satellite microwave ham allocations a massive loss. *Ham Radio Horizons* knows all about this loss and just ignored it.

They also know about the meetings in the next few weeks between the African and Latin American lesser-developed countries (LDCs), which are for the express purpose of shooting down the US position at WARC. These are the countries which may well swing the tide at WARC ... and they are not friends of amateur radio.

But these are things which won't have much of an impact on us, even if the worst happens, for many years, so why get all exercised over something over which we no longer have much control? For the next few years, we are going to be in the middle of a sunspot maximum . . . DX will be good . . . the VHFs will be hopping . . . and we will have more exciting new modes coming along than most of us can handle.

If amateur radio really gets clobbered at WARC, perhaps we can use the years before our country agrees to the new allocations to do some of the lobbying for amateur radio in the LDCs that we should have done in the last year . . . and perhaps turn things around. We sure need a worldwide lobbying effort to bring the value of amateur radio to smaller countries out in the open. I'm optimistic.

1979 HAM INDUSTRY CONFERENCE

With our fourth annual ham industry conference in Aspen, new records were set. For instance, I think that this was the fourth year in a row that our confirmed reservations on either Rocky Mountain or Aspen Airlines were met with a slight smile and a shrug of the shoulders when we came to their departure desk at Denver.

Hertz and Avis were up to the situation ... no cars available for us to drive to Aspen. National really was geared for this . . . they had one car available, but with a $250 charge if we dropped it at Aspen . . . take it or leave it. We grumbled a whole lot, but we took it.

The four of us, Sherry Smythe, Chuck Martin WA1KPS of Tufts Electronics, Eric Williams WA1HON, and I drove over the mountains some 200 miles to Aspen. The road was icy most of the way, but we still made good time, after what is becoming a ritual dinner at Holly West in Denver before our annual drive to Aspen. Chuck played bluegrass on his guitar through much of the trip and we all sang as we went over the mountain passes.

The snow in Aspen was superb, as usual.

On the first evening, we had our worst meal of the week . . . a cheese fondue at Guido's Swiss Inn. Ugh. It sort of discouraged much of the shop talk that usually accompanies our meals in Aspen. But the next night we did much better at the Copper Kettle. It was there that we had our first coincidence.

I had just finished handing out some brochures from an advertising agency in New York which was pitching ham businesses to use a ham-run agency. We were all sitting around reading the brochures when the

Continued on page 152

Am I having a good time? With a 73" base of packed powder and almost nightly snow flurries of light powder, you know I am. If only New Hampshire skiing was like this more of the time!

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Looking West

Bill Pasternak WA6ITF
24854-C Newhall Ave.
Newhall CA 91321

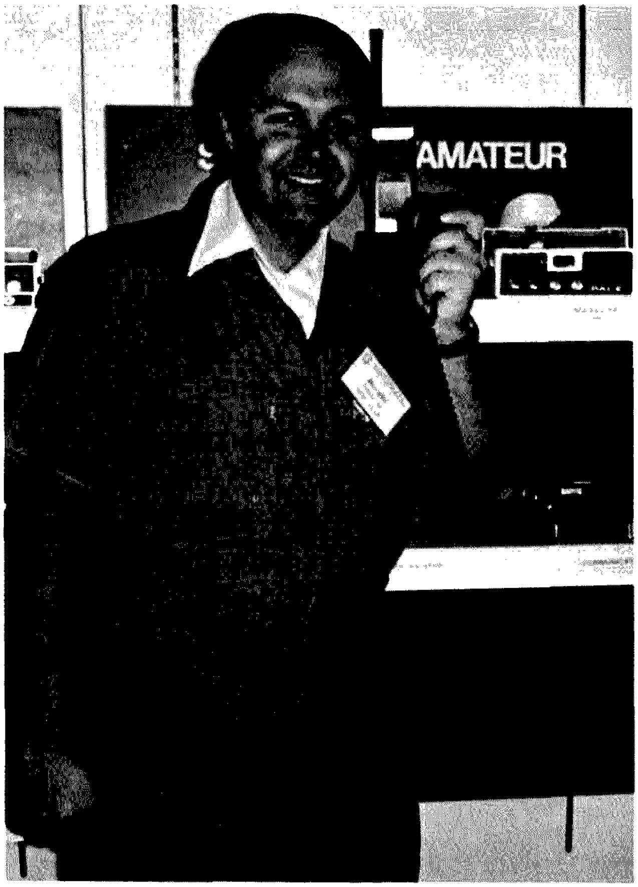
CES '79

CES: three letters with a lot of meaning to the American economy. These letters stand for the Consumer Electronics Show, a twice-yearly gathering of all those who manufacture and sell the myriad of electronic and electronic-related products which wind up in your home and mine. During the summer, the city of Chicago plays host to this gathering, but come January, it's Las Vegas where the action is.

Residing in southern California has certain advantages. Other than writing for this magazine, I earn my keep from consumer electronics, and a show like this is one I do not want to miss. Las Vegas being but a 45-minute flight or five-hour drive, I try to be in attendance when such events take place. Mother Nature being kind and keeping I-15 open made the decision to drive an easy one. Armed with my 35mm camera, extra film and batteries, a Clegg FM-27B, and a Midland 13-509, I aimed the nose of my Ford Maverick northeast along California Highway 14. Destination: the Hilton Convention Center in Las Vegas.

Two pieces of advice to anyone planning to attend a trade show such as this. First, get a good night's sleep before going. Second, buy the most comfortable pair of shoes your budget will allow. Also, if like me you intend to photograph things, get the lightest camera and strobe you can find.

The CES is the place where everyone who is anyone shows everything. There are televisions, radios of every description, VCRs, home computers, and even amateur radio gear. That's right, amateur radio. Ham gear seems to be playing a more and more significant role in this show each year. In the past, it had been CB which had cornered the personal communications aspect of CES, with amateur radio ranking a distant last. This year, however, perhaps due to the teetering condition of the CB industry in relation to its past performance, amateur radio and related products were right up there with the rest. Wilson had their entire amateur product line on display, as did a number of others such as Pace, Lunar Electronics, and Sujitsu-Ten. In the peripheral department, there were such standbys as Antenna Specialists, Hy-Gain, Hustler, and a new entry to the amateur market well known to CB enthusiasts: Avanti. In fact, Avanti has come into the amateur market with a most-advanced line of fixed station and mobile antennas, including a gain antenna for two meter mobile operation which requires no holes in the vehicle and no external wiring. You simply glue it to the window and plug it into your radio. They have a similar one for 10 meter enthusiasts, as well as a diversity beam which permits you to adjust polarization from your shack. All in all, a very interesting arrival in the amateur marketplace.



Bill Cody demonstrated the new Pace 2 meter rig at the CES.

You could easily tell the hams at the show. There was no need to look for badges—very few were visible. The hams were the ones playing with radios like the new NDI or Pace or Midland entries. They were to be found examining handhelds and antennas at the various booths. No one knows how many of the 66,000 attendees were amateurs, but there sure were a lot of them and they were not hard to spot.

Hustler, Midland, Pace, and the rest. These are all names familiar to those of us who are involved in the amateur radio game. I'll tell you one thing, though. It was nice to see them giving the amateur service the kind of exposure it needs in a place where so many could see it. CES was great. Amateur radio's representation was about 1%, I guess, but that was good. Better than ever!

THE WHATEVER HAPPENED TO HIM DEPARTMENT

Richard B. Cooper. Now, that name should ring a bell with you. No? How soon we forget. Last year a man calling himself Richard B. Cooper and professing to be an attorney startled the amateur community with such announcements as a lawsuit against the ARRL and his intentions to "grab" at least half of the current amateur spectrum for expanded CB. "Rick," as he called himself, was really making a name for himself. Then suddenly he just vanished from sight! It became impossible to contact either Cooper or the "law firm" he claimed to own: the Communications Attorney Service. Where has he gone? Your guess is as good as mine. What has happened to him over the last year or so is really what is of interest.

It seems that amateurs were not the only ones interested in Rick Cooper and his Communications Attorney Service. Rick was making a lot of claims back then as to the power and scope of his organization, its goals, and its membership. Eventually the matter drew the attention of the Office of the Attorney General of the State of California. An investigation by the Attorney General's office led to a formal civil complaint against Cooper, CAS, and Does 1 through 20, inclusive. The complaint, case #0233123, was filed in March of 1978 in the

Mr. and Mrs. Lou Anxiaux of Lunar Electronics. Lou (WB6NMT) was author of the VUAC's 2 meter band plan.

Novice, QRP, 200 w, deluxe — good, better, best — $299, $369, $399, $699, $869, $899, $1069. TEN-TEC has them all. A choice of seven HF transceiver models — a choice of power levels — a choice of operating features (and accessories) for beginner or old timer. Best of all, there's a wide choice of prices to fit every amateur budget.

TEN-TEC "OMNI" TRANSCEIVERS — REALLY CHOICE.
Top of the line. Deluxe in every respect. Deserving of a place in the finest of operating positions. All solid-state 100% duty cycle 200-watt final amp.; 8-bands (160-10 m plus convertible 10 MHz and "Aux" band positions); broadband design for no tune-up; built-in VOX and PTT; built-in Squelch; 4-position CW-SSB filter and 8-pole crystal filter with separate mode switch to permit using all filters in all modes; 2-speed break-in; 2-range offset tuning; optimized sensitivity from 2 μV on 160 m to 0.3 μV on 10 m; greater dynamic range (typically better than 90 dB) plus PIN diode switched 18 dB attenuator; WWV at 10 MHz; front panel control of linear/antenna bandswitching; phone patch jacks; "timed" crystal calibrator (on "A" model only); zero-beat switch; SWR bridge; adjustable ALC and sidetone; dual speakers; plug-in boards; "clamshell" aluminum case with black vinyl covering plus warm dark metal front panel; full shielding, optimum size for convenient operation: 5¾"h x 14¼"w x 14"d. Model 545 OMNI-A with analog dial, only $899; Model 546 OMNI-D with six 0.43" LED digital readouts, $1069. Model 645 keyer, $85, Model 243 Remote VFO, $139, Model 248 Noise Blanker, $49, Model 252MO AC Power Supply, $119.

TEN-TEC "ARGONAUT" TRANSCEIVER—QRP CHOICE.
The challenge and excitement of working the world on 5 watts. And every feature you need: all solid-state; 5 bands (80-10 m); full amateur band coverage SSB/CW; sensitivity less than 0.5 μV; offset tuning; 4-pole IF crystal filter, 2.5 kHz bandwidth; analog dial; vernier tuning; automatic sideband selection; built-in speaker; 5-watt input to broadband push-pull final amplifier; PTT; full CW break-in; adjustable sidetone volume and pitch; built-in SWR bridge; TVI filter; plug-in boards; small and light weight enough to go anywhere (4½"h x 13"w x7"d and 6 lbs.). World beating price, too: Model 509 only $369; Model 210 AC Power Supply just $34.

TEN-TEC 540/544 TRANSCEIVERS—POWER CHOICE.
200 watts from the bottom of 80 m to the top of 10 m — SSB or CW. No compromise from the leader in solid-state HF technology. Instant band change without tune-up; sensitivity 0.3 μV; offset tuning; 8-pole crystal-lattice filter; WWV at 10 & 15 MHz; push-pull solid-state final amp.; 100% duty cycle; adjustable ALC with LED indicator; built-in SWR bridge; PTT; full CW break-in; adjustable sidetone pitch and vol.; zero-beat switch in Model 544. Choose the value leading Model 540 with analog dial and built-in 25 kHz pulsed calibrator for just $699 or the Model 544 with six 0.43" LED digital readouts for $869. Model 240 160M converter, $110; Model 262M AC Power Supply with VOX, $145; Model 252M AC supply only, $119.

TEN-TEC CW TRANSCEIVERS—BUDGET CHOICE.
The "Century 21" series. Unique. Modern technology with old-fashioned value. Fine performance, reliability, and simplicity of operation, all at low cost. Win raves from novices and confirmed brass pounders alike. All solid-state; 5 bands (80-10 m) full amateur band coverage; receive CW and SSB, transmit CW; sensitivity 1 μV or less; offset tuning; 3-position selectivity (2.5 kHz, 1 kHz, 500 Hz); 70 w input to push-pull Class C final amp.; broadbanded for no tune-up or resonating; full break-in; adjustable side-tone level; built-in AC power supply. Choose Model 570 with analog dial for only $299; Model 574 has a 5 LED digital readouts for only $399.

The choice is all yours when you choose TEN-TEC HF transceivers; see your nearest dealer or write for full details.

arma

TEN-TEC, INC.
SEVIERVILLE, TENNESSEE 37862
EXPORT 5715 LINCOLN AVE., CHICAGO, ILL. 60646

WIDEST CHOICE IN HF TRANSCEIVERS: TEN-TEC

John Clark (right) of the ARRL displayed League publications at CES '79.

Superior Court of the State of California for the County of Los Angeles. It asked that the court issue an injunction against Cooper and his CAS on five specific violations of both the civil and business/professions code of the state of California, and further requested that the court exact monetary penalties on each count of each violation.

Cooper was served the necessary documentation and at that point dropped out of sight. Nothing has been heard from him since. According to Assistant State Attorney General Herschel T. Elkins, who has been handling the Cooper/CAS matter, Cooper lost the case by default. Shortly, a hearing will be held to set the penalties in this case. Collecting them may be another matter. Cooper, as elusive as a fox, has disappeared without a trace. If you happen to know of Rick's whereabouts, you might drop a note to Mr. Elkins or to me. A lot of us would like to know what ever happened to Rick Cooper.

220—A LATE-BREAKING DEVELOPMENT

The 220-MHz Spectrum Management Association of Southern California (220-SMA) has filed a formal petition for reconsideration on FCC docket 20271, the document recently issued by the Commission relative to US WARC preparations in which maritime is made the prime user of the spectrum between 216 and 225 MHz.

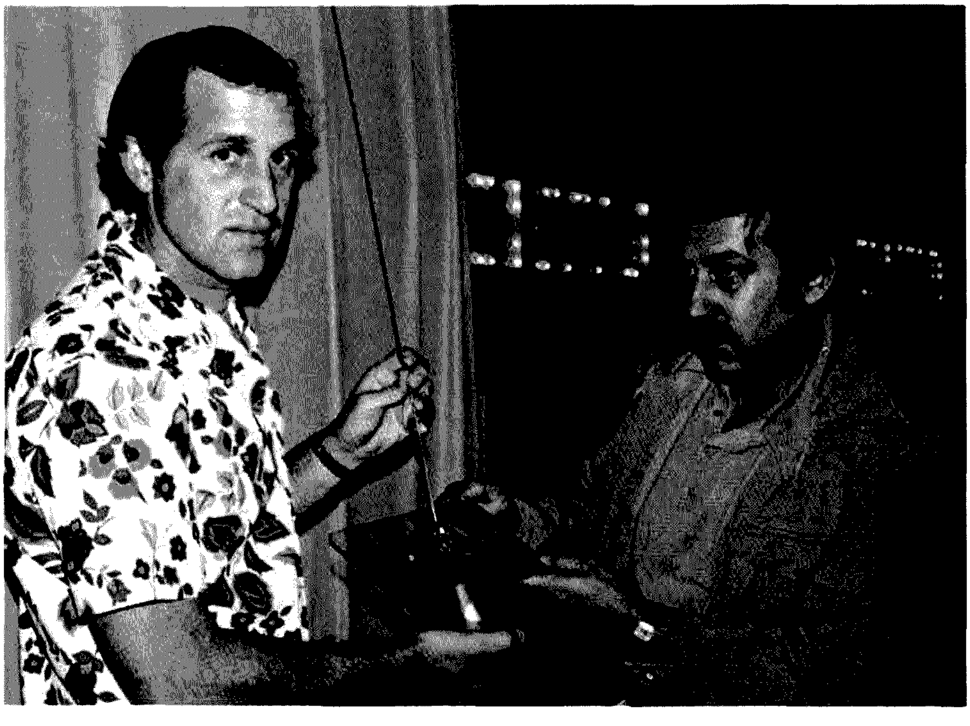
In its appeal, 220-SMA states its belief that representatives of the amateur service have not been given their chance under the structure of administrative procedures to properly comment on the proposed sharing with the maritime mobile radio service. 220-SMA goes on record as opposing the suggested reallocation and suggesting an allocation within the 890-MHz spectrum be considered as an alternative, in that such spectrum would be available worldwide since it has little or no utilization at this time. Implementation of a maritime mobile service in that spectrum would not displace any established activity and would have little environmental impact throughout the entire world.

The petition was prepared by 220-SMA advisor Henry R. Von Neumann K6PUW at the direction of 220-SMA President Larry Mohler WA6DOD, and was derived from Input obtained at a joint meeting of 220-SMA, 2mASMA, ARRL Director Holladay, and other VHF spectrum users. VRAC's local representative and the Southern California Repeater Remote-Base Association both declined to attend or take part in the initial planning on this matter, but did ask to be kept informed as matters progressed. However, 2mASMA, along with other local special-interest groups, is expected to endorse the petition, and 220-SMA is requesting that letters of support from coordinators, coordination councils, and individual amateurs be sent to the Commission as soon as possible. Those writing on the subject should refer to 220-SMA petition number 790120, submitted January 22, 1979. It's felt that enough support from the general amateur community might well force the Commission to give this petition serious consideration and perhaps reopen commentary on the matter.

CAN AND WILL THE ARRL SAVE 220?

"220 CB is dead and the ARRL slew it." With that statement, the League tried to take full credit for saving 220 MHz from the onslaught of "10-4 Good Buddy" and the evils that "10-4" would bring with him. They gave only the most abbreviated passing credit to the people who really counted, and never came near to telling the real story of what killed the 220 CB idea. I've heard quite another story. The big rumor is that formal objections from our neighbors north and south are what killed it, not the ARRL. If true, it makes a lot more sense, and I tend to believe it. Let's look at the present situation and the ARRL's power in relation to it.

First, we must assume that there were other forces which really devastated the 220 Class E CB idea. Class E was being pushed by but one entity, the EIA. For the EIA, this was a good move from an economic standpoint. It's a fact that it costs less to manufacture a radio for a lower frequency than for a higher one. This holds true even with today's advanced linear IC technology and mass production. So, if you were running an organization which represented the vast majority of those manufacturing two-way radio equipment, what would you do? You would look around at all spectrum and forge a viable attack to gain some more. When studies of available spectrum were made some years back, the 220-MHz



An Avanti rep explained the new no-holes 2 meter antenna to Bill Orenstein KH6IAF (right).

Continued on page 28

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***ALL* MODE SWITCH** puts all filters to work in any mode.

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***ALL*-VERSATILE OFFSET TUNING;** dual ranges, ±5 kHz range for off-frequency DX or ±0.5 kHz range for fine tuning.

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***ALL* LINEAR/ANTENNA BANDSWITCHING FROM FRONT PANEL;** auxiliary bandswitch terminals on back panel for external relays or circuits are controlled simultaneously by the OMNI bandswitch.

***ALL* INTERFACE JACKS FOR PHONE PATCH;** access to speaker and microphone signals.

***ALL*-LEVEL ADJUSTABLE ALC;** set output from low power to full, retain low distortion at desired drive to power amp.

***ALL* SIDETONE ADJUSTMENTS;** pitch and volume.

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LETTERS

MACARONI

After reading "Diodes of the Dead" (*73*, Jan., 1979), I have diagnosed Mr. Dunn's problem. By using high-quality audio tape (Ampex "Grand Master" or Maxell UD35-90), I had absolutely no problem "calling up" two dead aunts and some guy calling himself "Macaroni." Also, I found by using a slightly larger antenna (10'-12'), Alpha Centauri comes in "Q5". 73.

Jerry Robinson III N4KJ
Asheville NC

BRUTAL

With only one element remaining to complete my Extra class ticket, I just had the misfortune to "close encounter" the brand new exam.

My advice: If you're not a mathematician, you'd better take a crash course before you attempt the test. It is a *brutal* mother.

This new Extra class series (dated 9/78) features a central core of 20-or-so questions, each one attached to a schematic. You'll be asked to compute complex reactances, impedances, resonant frequencies, or missing component values at some arbitrary point in the circuit. No formulas are provided, and most of the values you'll be asked to compute *do not* relate easily to any of the material in any of the existing study guides.

The non-mathematical questions, by the way, are extremely esoteric and obscure. There is material on IC junctions, remote base regulations, 5 or 6 questions on SSTV and ATV, and other trivia from the fine print of the regs.

My hunch is that the FCC found itself rapidly running out of 1 x 2 callsigns and decided to plug the small conduit that lets new Extras through. They plugged it good and tight! Be warned. The test is not impossible—but you *will* need lots of math, and *we all* will need new, *competent* study guides—like pronto.

Incidentally, the exam itself is atrociously edited—with numerous typographical mistakes, misspelled words, and my copy even had the wrong element class printed on the cover! The word "ADVANCED" had been pasted over with a sticker that said "EXTRA." My confidence in Uncle's competence was not enhanced.

By the way, fellas and gals, if you haven't yet listened in on the "secret" pseudo-ham band that runs from 27.5 to 28 MHz (above CB and below 10 CW), you're missing some of the funniest (or most infuriating) SWLing of your life!

A recent spot check produced these gems:

1. A spiritualist in Houston who gives psychic readings and conducts on-the-air meditation classes every Sunday.
2. A cross-country SSB QSO between two chaps, one running a TS-820, the other a Yaesu FT-101, shooting the breeze about how they're progressing toward their NOVICE tickets!
3. Someone conducting very graphic, on-the-air sexual counseling via radio.
4. A slow-scan TV signal!
5. Many, many individuals who indicated that they also hold amateur licenses and operate (legally) on other bands.

This latter finding is the most surprising of all. Maybe it's the anarchist spirit having a go—or simple boredom with the routine and formality of the "disciplined" amateur bands. It's certainly true that 11 is a hotbed of radical and innovative radio doings—the likes of which you're not likely to hear anywhere else.

A man in Italy "skeds" his relatives in New York City each morning.

A woman in South Dakota has regular radio pen-pals from Europe to Australia.

You'll even hear high-speed CW QSOs on this crazy band—complete with "Whiskey Club" numbers for ID! It's beyond me why an op who can handle 20 wpm takes his business down there. But turn up your ears and check it out for yourself. There they are.

I will say one thing about the foreign stations who are using "secret band" to sked relatives in this country. I try to imagine these relatively easy, hassle-free contacts taking place in the licensed amateur service, where the DX station would *immediately* be pounced upon by the prick-eared wolf pack, and all hopes of a relaxed rag chew would vanish. I do begin to understand what may be driving even licensed hams to this virgin frontier!

Could it be a radio revolution in the making? Or the prelude to a determined FCC crackdown? Only time will tell. In the meantime, something is definitely happening at one of our borders. It behooves us to listen and evaluate the phenomenon.

Name and address
withheld by request

VOYAGING

The JPL Amateur Radio Club, through its club station W6VIO (*V*oyager *I*n *O*uterspace), will repeat its performance during the *Viking* landings on the planet Mars by holding commemorative contacts during the forthcoming (actually, now in progress) *Voyager* mission to the planet Jupiter.

The spacecraft *Voyagers I* and *II* are currently engaged in the first observational phases of their mission of exploration of the planets Jupiter and Saturn.

Among the data being returned will be pictures of the disc of Jupiter at various distances showing details of the planet that it is not possible to see with any terrestrial telescope of known configuration.

On slow-scan TV, these and other pictures will be sent out for amateurs to see throughout the world.

According to Dick Piety K6SVP, the project coordinator, the first contacts will have been made March 1 through March 11, 1979. This coincides with the encounter phase of the first of the *Voyagers* to arrive near Jupiter. A second encounter period for *Voyager II* will bring on more amateur contacts July 6-15.

The following frequencies will be used plus or minus QRM: CW—30 kHz above bottom edge of the bands, 80 through 10 meters. SSTV—3545, 7220, 14325, 21340, 28680. Novice—3730, 7130, 21130, 28130. SSB—3930, 7230, 14285, 21360, 28680. OSCAR—2 meters and 220-MHz transmissions are planned as well.

As presently set up, the plans call for heavier operations on weekends and between the hours of 4:00 pm and 7:00 pm PST (0000 to 0300 Zulu).

The JPL Amateur Radio Club regrets that it does not have a special commemorative call such as the N6V used during the *Viking* mission. However, W6VIO will issue a special QSL card for the *Voyager* commemorative. An SASE is requested from U.S. stations. DX stations may QSL via their QSL bureaus.

Norman L. Chalfin K6PGX
Pasadena CA

VITRIOL

It would almost be worth buying occasional copies of *73* to see if this letter changes an approach—and if it gets printed under "Letters"—but the odds are against it. Recently there was a debate at the UN between representatives of Vietnam and Cambodia. A TV commentary stressed that although each side called the other liars, it was on a higher, diplomatic, and less corrosive level than a previous controversy when Khrushchev took off a shoe and pounded the table with it. What has this to do with *73*?

Many years ago, almost when you first started *73*, I regularly purchased copies and think even subscribed for a year or so. However, the vitriol dripping from your pen so turned me off that I stopped reading it. Recently, a ham whom I regularly work touted *73*, so I bought two copies.

Even granting that the ARRL could do a better job for ham radio, that it tends to pigeonhole ideas of others, that it is biased against women, and that it is dictatorial in many ways, is it possible that a more affable indictment in publishing their shortcomings would present your ideas in a more acceptable way to your readership and (if a miracle occurred) to the ARRL?

So what do I like about *73*? The December issue had "Close Encounters," which supplied completely new knowledge of use of lasers in a study of UFO phenomena, "From CW to Computers," an interesting presentation of a technique previously known, "DX," a well-concocted column, "Receiver Diseases," some simple ideas in easily readable fashion, "The Packet Radio Revolution," again an informative article. In the January issue, "Time-Domain Reflectometry" answered my ignorance on how public utilities pinpoint problems, and, if I had a scope, a good test technique.

Although doing some necessary home brewing in 1923 (call 2AST) and some since, I am primarily an appliance operator. Making a PC board, etc., frightens me off, but I am able to make repairs to my two transceivers which are solid state. My interest is CW at 25 wpm up, except for one or two schedules per week on SSB with old-timers who have large-

Continued on page 46

Contests

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

ANNUAL APRIL QRP QSO PARTY

Starts: 1600 GMT
Saturday, April 7
Ends: 2400 GMT
Sunday, April 8

The contest is open to all amateurs and is sponsored by the QRP Amateur Radio Club International, Inc.

Stations may be worked once per band for QSO and multiplier credits. Each member QSO counts 3 points, non-member QSOs, 2 points. Stations other than W/VE count as 4 points per QSO. Multipliers are as follows: more than 100 Watts input power—x1; 25 to 100 Watts—x1.5; 5 to 25 Watts—x2.0; 1 to 5 Watts—x3.0; less than 1 Watt power—x5.0.

Final score is QSO points times total number of states/provinces/countries *per band* times power multiplier.

EXCHANGE:

Members—RS(T), state/province/country, QRP number.

Non-members—RS(T), state/province/country, power input.

FREQUENCIES:

CW—1810, 3560, 7060, 14060, 21060, 28060, 50360.

SSB—1810, 3985, 7285, 14285, 21385, 28885, 50385.

Novice—3710, 7110, 21110, 28110.

All frequencies ±5 kHz.

ENTRIES:

Send full log data, including full name, address, and bands used. Indicate equipment, antennas, and power used. Include a #10 SASE for results. Logs must be received by April 30, 1979, to qualify. Send logs to: E. V. Sandy Blaize W5TVW, 417 Ridgewood Drive, Metairie LA 70001.

Certificates will be awarded to the highest scoring station in each state/province/country, and other places depending on activity. One certificate for the station showing three "skip" contacts using the lowest power.

BERMUDA AMATEUR RADIO CONTEST

Starts: 0001 GMT April 21
Ends: 2400 GMT April 22

Sponsored by the Radio Society of Bermuda. Operate no more than 36 hours of the 48-hour contest period. Off periods to be clearly logged and each period to be of not less than 3 consecutive hours.

All stations shall be single operator only and must be operated from their own private residence or property. Each station may be worked only once per band regardless of mode. Use all bands 80 to 10 meters, but no crossband or crossmode contacts permitted.

EXCHANGES:

All stations exchange RS(T) and following: UK—county, US—state, VE—province, Bermuda—parish, West Germany—DOK #.

US and VE stations must exchange reports with UK, West German, and Bermuda stations only. UK and West German stations must exchange reports with US, VE, and Bermuda only.

SCORING:

Calendar

Apr 7-8	**ARRL Open CD Party—CW**
	QRP QSO Party
	SP DX Contest—CW
Apr 11-12	**DX YL to NA YL Contest—CW**
Apr 14-15	**SP DX Contest—Phone**
Apr 18-19	**DX YL to NA YL Contest—Phone**
Apr 21-22	**County Hunters SSB Contest**
	Bermuda Contest
	ARRL EME Contest (Part 1)
	ARRL Open CD Party—Phone
Apr 28-29	**PACC DX Contest**
	Zero District QSO Party
	Helvetia 26 Contest
	YL ISSB QSO Party—Phone
May 5-6	**NY State QSO Party**
May 12	**World Telecommunications Day Contest—Phone**
May 12-13	**Luckenbach DXpedition**
May 19	**World Telecommunications Day Contest—CW**
May 19-20	**ARRL EME Contest (Part 2)**
	Michigan QSO Party
	Mass QSO Party
May 26-27	**CQ Worldwide WPX—CW**
June 9	**DAFG Short Contest—SW**
June 9-10	**ARRL VHF QSO Party**
June 10	**DAFG Short Contest—VHF**
June 23-24	**ARRL Field Day**
June 30-July 1	**Seven-Land QSO Party**
July 4	**ARRL Straight Key Night**
July 14-15	**ARRL IARU Radiosport Competition**
Aug 4-5	**ARRL UHF Contest**
Sept 8	**DAFG Short Contest—VHF**
Sept 8-9	**ARRL VHF QSO Party**
Sept 9	**DAFG Short Contest—SW**
Sept 15-16	**Scandinavian Activity—CW**
Sept 22-23	**Scandinavian Activity—Phone**

Results

CANDLEWOOD AMATEUR RADIO ASSOCIATION 1978 CONNECTICUT QSO PARTY RESULTS

W1QI, the CARA club station, was operated by Steve WB1CVU, Skip W1PV, Dan W1QK, Louis WA1GSO, George WB2THN/1, and George WB1DIP. The group made 355 QSOs with 50 multipliers for a total score of 17750 points. They also worked all eight counties in Connecticut.

CONNECTICUT SCORES

County	*Station*	*Pts.*	*Mult.*	*Score*	*Ctys.*
Fairfield	WA1FCN*	387	63	24381	8
Hartford	WA1SQB**	561	71	39831	8
Litchfield	W1VH*	171	40	6840	8
Middlesex	W1JTD*	98	30	2940	8
New Haven	WA1UUA*	477	64	30528	8
Tolland	WB1EKI*	29	12	338	6
Windham	K1YRP*	165	34	5610	8
		Novice			
Hartford	WB1CRH/N*	20	11	220	0

OUT-OF-STATE SCORES

Section	*Station*	*Pts.*	*Ctys.*	*Score*
Arizona	WB7CPY*	14	3	42
E. Mass.	WA1LZS*	62	8	496
E. New York	WA2OTC**	94	8	752
E. Pennsylvania	N3AI*	81	8	648
Georgia	K4JSG*	90	8	720
Illinois	WA9FET*	46	8	368
Iowa	WBØTLE*	56	8	448
Kentucky	WA4OMH*	6	4	24
Louisiana	W5WG*	89	8	712
Maine	WA1ZAX*	42	8	336
Maryland	W3PYZ*	55	8	440
Michigan	W8WVU*	56	8	448
Mississippi	AF5V*	18	5	90
Nevada	AE7K	1	1	1
New Hampshire	K1ITS*	69	8	552
New Mexico	W5UBW*	15	4	60
New York, LI	W2RPZ*	46	8	368
North Carolina	WA4GLE*	22	5	110
North Dakota	WDØCCL*	16	5	80
N. Florida	W9WZV/4*	11	4	44
N. New Jersey	K2HLC*	52	8	416
N. Texas	N5UM*	51	8	408
Ohio	WB8YDN*	57	8	456
San. Bar.	W6OUL*	15	5	75
S. Dakota	WØCLS*	47	8	376
S. Florida	AA4MI*	42	7	294
S. New Jersey	W2UAP*	43	8	344
S. Texas	WA5OOB*	69	8	552
Virginia	N5BA/4*	37	8	296
Washington	WB7UXK*	25	7	175
W. New York	N2RT*	39	8	312
W. Pennsylvania	K3LVO*	14	5	70
Wisconsin	WB9PVI*	58	8	464
	Canada			
Ontario	VE3KK*	53	8	424
	DX			
Japan	JE2MDE	1	1	1

***County or section winner**
****Grand Connecticut or out-of-state winner**

Each QSO = 5 points. Multiplier for all stations outside Bermuda is the total number of VP9s worked on each band. The same VP9 can be worked on all bands. For Bermuda stations, it is the total number of states, provinces, counties, and DOK #s worked on each band.

AWARDS:

Top scorer in each state, province, county, and DOK area in West Germany shall receive a certificate. Trophy to top scorer in VE, US, UK, and West Germany. Round-trip air transportation plus accommodation will be provided to overseas winners to enable them to receive their awards.

ENTRIES:

All dates and times in GMT. All contestants to check for duplicates and to compute their own scores. Sign a statement that all rules and regulations have been observed. Each page must be clearly marked with call, name, and address, and must be received by the contest committee before June 30. Send entries to: PO Box 275, Hamilton 5, Bermuda.

Note: Please submit a log if you operate in the contest. This

Continued on page 28

Results

1978 DELAWARE QSO PARTY RESULTS

OUT-OF-STATE SCORES

*Denotes state winner

**Denotes high score for out-of-Delaware station

State	*Station*	*Score*	*QSOs*
Alabama	W4PVK*	400	33
Alaska	KL7IXZ*	60	4
Arizona	K9HRC/7*	330	11
California	N6PE*	1485	27
Colorado	NØFS*	455	13
Connecticut	W1VH*	700	20
Florida	K4YS*	1450	29
Idaho	WB7URE*	150	10
Illinois	W9QWM*	1550	31
Iowa	WBØUCP*	275	11
Louisiana	WB5UQW*	105	7
Maryland	W3PYZ*	1160	29
Massachusetts	W1JR*	1155	21
Minnesota	N9AJJ*	240	8
Missouri	KØBM*	1860	31
Montana	K7PGL*	175	9
New Hampshire	K1ITS*	2600	40
New Jersey	N2CW**	5000	50
New Mexico	W5UBW	200	8
New York	W2EY*	1035	23
North Carolina	W4OMW*	665	19
Ohio	WD8DKJ*	800	20
Oregon	AD7L*	2240	28
PA	WB3JGP*	420	12
Texas	W5NR*	600	15
South Dakota	K8JV*	630	14
South Carolina	K4BZD*	160	8
Virginia	W4ZRJ*	120	8
Washington	WB7QEL*	120	8
West Virginia	N8AMZ*	60	6
Quebec	VE2EDL*	140	7
Ontario	VE3DAP	3600	44

DELAWARE SCORES

*Denotes county winner

**Denotes high score for Delaware

New Castle	Score	QSOs
N3ND**	67650	504
K3SM	58081	410
W3HB	44499	339
K3HBP	21900	247
N3AHA	20043	200
W3HKS	1824	57
WB3GOI	702	39
(N3ND was multi-multi with K3SXA)		
All Counties—Mobile		
K3KX/M3	8200	123
(Drove from Pittsburgh, Pa., to be in test)		
Kent	*Score*	*QSOs*
WB3DDS*	27604	408
N3AKC	11193	152
WA3QLS/3	11033	187
Sussex	*Score*	OSOs
WB3IXC/3*	52096	456
WB3KYL/3	40442	449
K3JL	22743	203
WA3WIY	2016	43

Results

PUBLICATIONS CONTEST RESULTS

Results ol the Amateur Radio News Service 1978 Publications Contest have just been released by judges Norm Monro K4FRY, Vivian Douglas WA2PUU, and Dan Dolan K4RN.

Submissions for this contest were divided by publisher and size into two groups. Group I consisted of club papers: I(a). less than 100 copies; I(b). 100-199 copies; I(c). 200-299 copies; I(d). 300-399 copies; I(e). 400 or more copies. Group II contained multi-club papers: II(a). less than 1000 copies; II(b). 1000 or more copies.

The club presidents of the winning entries will receive certificates to be presented to their groups. All editors will be receiving the judges' comments by personal letter. Congratulations to the following:

Group I:

I(a): First prize: *The Salami Merchant*, Silvercreek Amateur Radio Association, Doylestown OH 44203. Al D'Aurelio W8WKY, Editor.
Second prize: *Hamtrix*, West Allis Amateur Radio Club, Inc., Milwaukee WI 53211. David J. Knaus WA9POV, Editor.
Third prize: *Mid-Sussex Matters*, Mid-Sussex Amateur Radio Society, Burgess Hill, East Sussex, England. Alfred Lee G4DQS, Editor.
I(b): First prize: QCC *News*, Chicago Area Chapter, QCWA. Lee J. Knirko W9MOL, Editor.
Second prize: *66/06 Newslines*, Westchester Emergency Communications Association, North Tarrytown, New York 10591. Mervin Genzer WA2HZD, Editor.
Third prize: *The Call Letter*, Poway Amateur Radio Society, Poway CA 92064. Glen Peterson WB6BOD, Editor.
I(c): First prize: *QUA*, Warrington Area Repeater Association, Warrington PA 18976. Bruce Gilman WB3CFE, Editor.
Second prizes (ties): *The Orbit*, The Satellite Amateur Radio Club, Vandenberg Air Force Base CA 93437. John E. Douglass WA6EZZ, Editor. *FM News*, UK FM Group (London), London, England. Alan D. Gray G8LCO, Editor. *Ham Rag:* Rockford Amateur Radio Association, Rockford IL 61110. Darrell B. Crimmins WD9FVG, Editor.
Third prize: *Red Rose Repeater Association (Newsletter)*, Lancaster PA 17601. Martin Bloomberg WA3MHP, Editor.
I(d): First prize: *Carrier*, Mt. Diablo Amateur Radio Club, Inc., Pleasant Hill CA 94523. Harold S. Mumford W6CU, Editor.
Second prize: *Cheese-Bits*, Mt. Airy VHF Radio Club, Inc., Elkins Park PA 19117. Harry B. Stein W3CL, Editor.
Third prize: *QRZ*, Rocky Mountain Radio League, Golden CO 80401. Jim Labo KØQST, Editor.
I(e): First prize: *Amsat Newsletter*, Radio Amateur Satellite Corporation, Washington DC 20044. Joe Kasser G3ZCZ, Editor.
Second prize: *The Round Table*, The Denver Radio Club, Denver CO 80202. Robert N. Jensen W9WLN, Editor.
Third prize: *The Modulator*, Baltimore Radio Club, Inc., Baltimore MD 21203. Roland Slatkoff W3RUN, Editor.

Group II:

II(a): First prizes (ties): *Mobile News*, Amateur Radio Mobile Society, Purley, England CR2 1EZ. Norman A. S. K. Fitch G3FPK, Editor. 220 *Notes*, edited by Julian N. Jablin W9IWI, Skokie IL 60076. Bus. Mgr. is Virginia L. Sterling WB9UFW, Morton Grove IL.
Second prize: *CORA Collector and Emitter*, Central Oklahoma Amateurs, Inc., Oklahoma City OK 75155. Joe K. Harding WA5ZNF, Editor.
II(b): First prize: *Repeater Journal*, Carolinas-Virginia Repeater Association, Durham NC 27705. Wayne Williams K4MOB, Editor.
Second prize: *The Hamateur*, Edited by Larry McCalvy WA9JMO, Milwaukee WI. Honorable Mention: *Radio-Hobbyist Newsletter*, American Radio Council, Garland TX 75040. Frederick W. Mala W5YI, Editor.

DX

Chuck Stuart N5KC
5115 Menefee Drive
Dallas TX 75227

DX PROFILE

This month's DX Profile is on Bob Geary 5Z4NH of Thika, Kenya, East Africa. The following is a letter from Bob describing his background and his life in Kenya:

"I first became interested in amateur radio in 1946 when I helped Larry W8VPA carry his BC-610 up the stairs. I have not recovered either my sanity or my back since then. I was first licensed in 1957 as K2ZLE and became interested in VHF as a member of the VHF Institute in New York City. I managed to work a VO1 from Brooklyn without the aid of a repeater, but I didn't realize that it was much of a feat until later.

"I arrived in Kenya in 1965 to take up the job of teaching chemistry in the Kenya schools. The courses here are the same as you would find in an American high school or junior college.

"Due to some very bad misinformation from a 'know-it-all' type who told me that I would not be able to get a license here in Kenya, I was off the air until 1972. Upon learning the true facts, I was readily and graciously issued a license by the Kenya authorities. It is interesting to note that an American can easily obtain operating permission here in Kenya, but that the reverse does not hold true for someone from Kenya trying to obtain operating permission in the US.

Bob Geary 5Z4NH.

"The people of Kenya come from a civilization and culture which is several centuries old. They are very gracious and kind to outsiders. In all my years here in Kenya, I have met only one Kenyan who was not a desirable person. The weather here is more pleasant than that of either Florida or southern California. In the highlands, the temperature ranges from 65° F in the evening up to about 85° F during the day. The rains, which come in two seasons, are heavy at times, but are warm and without strong winds. The sun shines better than nine hours a day during the dry seasons, and it is easy to develop a nice tan in only a short time. The coastal area is a bit warmer, but it is some 5,000 feet lower in altitude.

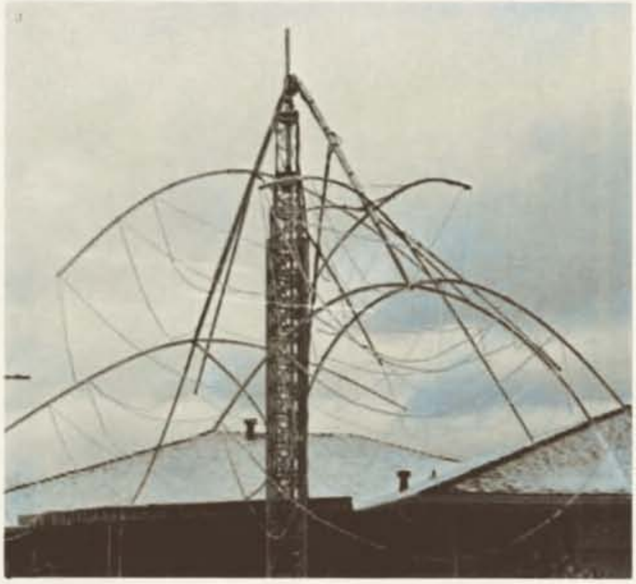
"The numerous recreation opportunities include golfing, boating, mountain climbing, camping, and, of course, the popular photo-safaris. Kenya is not only a great place to visit, but a perfect place to live as well. About the only inconvenience is having to wait until the giraffes pass before I can get to the school building some mornings. Being mute, the giraffe has few outlets for his anger; since they can kill a lion with one kick, I allow them plenty of clearance.

"Being in almost the center of the world's land masses, Kenya is a perfect amateur radio QTH. California, New Zealand, Chile, Japan, Alaska, and Antarctica are all almost equidistant from Nairobi. The elevation of 5,000 to 7,000 feet gives a perfect 360-degree downhill shot to the entire world. The low winds and easy availability of free bamboo make Kenya perfect for quad antennas. I have made better than 13,000 contacts in 250 countries without any special DX effort.

"Kenya 'Field Day' activities are functional, in that we supply communications for the annual East Africa Safari Race. The Radio Society of Kenya sets up a control station in Nairobi and dispatches members to some rather distant locations to set up and operate under horrible conditions. One year I drove 42 miles on a muddy road, set up the rig and contacted the control station, only to be informed that the race had been rerouted due to floods. I then repacked the gear and drove back to Nairobi, checked in, and was dispatched to another location, fortunately on the tarmac, but still wet and rainy. The volunteer stations are the only means of communication between the race organizers and the cars out on the course.

"Unlike field days in other areas of the world, you do not get to select your site. You are given a map reference and must hunt for your spot—and then try to get up some type of wire antenna for 40 and 80. Due to distances and conditions, verticals will not provide good results. A dipole is required for any degree of reliability.

"Usually, you do not get much chance to see any of the race activity because the cars come out of the bush, skid around a curve, slide to a stop, check in, and then roar off back around another curve into the bush again. Then there is the problem of crowd control. Little kids press around wanting to see what you are doing and are constantly in the way. Fortunately, the police, with a little judicious application of a switch from a nearby bush, usually can control the situation. The real kicker is when someone hears your call and



Before and after pictures of the editor's brand new quad. This was the result of the worst ice storm to hit Dallas in 30 years. The moral to this story is "Build it strong," even if you live in the sun belt. (Photos courtesy K5YUV)

tries to get a DX contact when you are having a rough time just hearing the control station.

"In normal times, I enjoy giving DX contacts, especially to the JA boys. They are good operators and are very good in standing by when you are working someone. If you express any note of complaint about a station, there will be a burst of Japanese on the frequency and the trouble immediately disappears for good. I can't understand the words but the meaning is clear.

"Stateside operators are usually well mannered in pileups, but there are a few who never seem to get the word. Fortunately, they are few in number and it is simple to make a list of their calls and ignore them. Another method is to give them a report to get rid of them and then forget to log their calls. I have worked one station five times in this manner and he still doesn't understand (until now) why he's never in the log.

"The great benefit of amateur radio is the really nice people I have met, especially on the Afrikaner and Clinker nets. I've made numerous contacts with these fellows over the past seven years and enjoyed every minute. To make a list of the guys who have offered to give any help needed would require several pages of fine print. I once asked for a copy of FCC Form 610 and received a copy from five different guys. These responses make life enjoyable.

"I would like to see an award given for the best QSL manager and I would like to nominate my manager, W2PPG, for the first one. I don't understand why these guys volunteer their services, but from the DX station's point of view it is greatly appreciated. I am a lot more likely to stay in and give a report to everyone who is calling when I know I won't have to miss a week of operating time filling out QSL cards. These guys are the unsung heroes of DXing.

"Well, that about covers everything from over here in Kenya. My best 73 to everyone, and if anyone needs Kenya, look for 5Z4NH any day between 21.300 and 21.355 MHz."

Gary (Grenfell) Morgan HS1ALT (ex-VE3JKD) can be heard almost daily on 20m. The QTH is Bangkok, Thailand—the only country operating from zone 26. On Thursdays and Saturdays, from 1414 to 1430 GMT, the Canadians Overseas Net is in progress, with HS1ALT, VS6CZ, and 5H3BP doing the guidance. Join this net, and you can fill your log with such prefixes as 7P8, DU4, YBØ, P29, G3, CN8, EL1, and VK, most of whom are Canadians abroad.

DX NOTEBOOK

Isle of Man GD/GT

DF7FH reports a planned DXpedition to the Isle of Man in July, 1979, to celebrate the 1,000th anniversary of the Isle of Man's parliament. During the first week of July, every station will be allowed to use the special GT prefix. They plan to operate from July 1st to July 15th on all SSB/CW bands. Operators include DF7FH, DK5FJ, DC1FP, DJ3BG, and YLs DF9ZG and DF9ZH. QSLs go to the individual operators.

Aves Island YVØAA

The Venezuela Amateur Radio Club is planning a DXpedition from April 7th to the 14th. Intended CW/SSB frequencies are 3525/3775, 7025/7085, 14025/14195, 21025/21295, 28025/28495-595. These are transmitting frequencies; listening frequencies have yet to be announced.

Heard Island VKØ

Several of the VK/ZL DXers have been gazing fondly toward Heard Island, and indications are that something may firm up before the year is out. Word has been passed that landing permission has been granted, transportation is on line, and even the callsign, VKØHI, has been issued. The last Heard Island activity was VKØHM back in the dark ages of 1970.

Christmas Island VR3AH

The following letter from WB4PRU gives some information and operating habits for those needing VR3AH:

"I am the QSL manager for VR3AH. I would like to pass along some sked times and

Continued on page 30

DXpedition QTH on the Isle of Man for the June/July operation by DF7FH, DK5FJ, DF9ZG, DF9ZH, DC1FP, and DJ3BG.

RTTY Loop

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Over the last several months, we have been investigating the components of a solid-state RTTY "stunt box," in hopes of putting together some kind of test equipment to send "THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG." Along the way, it has occurred to me that even a simple identifier would be nice, like a "DE WA3AJR" or something. Hopefully, by the end of this month's column, we will be able to put something concrete together.

To date, we have covered interfacing to a loop (January, 1979), matrix encoding (February, 1979), and the UART with its associated circuits (March, 1979). If you are not familiar with these concepts, I suggest you check back to the indicated issues of *73*. If all is OK, plow on!

Let's start with the matrix. Assume space for encoding fifteen characters, with a switch to select which character is to be sent. You would have something like Fig. 1. Now, besides being expensive, fifteen-position switches are hard to turn using TTL voltage levels. So what we will use is the electronic version of a fifteen-position switch, a 74154 data distributor, shown in Fig. 2. By grounding both the enable and data input lines, the output selected in binary will go low. Now all we need do is provide the binary code to the input and watch the data select. By the way, before you get all huffy, I know that there are really sixteen outputs from this chip, but we will need the last one later. The binary code input can be provided by a binary counter chip, such as the 7493. The beginnings of a system can be seen in Fig. 4, where the counter sequences the data distributor, which subsequently selects the matrix element.

"OK, smarty," I hear you say, "where do we get the pulse to trigger the counter?" From the UART, naturally! Reviewing the inputs and outputs of the UART, one finds a pulse on pin 22 which goes high when it's all right to load a new character. Sounds useful, no? Just as useful, we shall see, is a signal output which signifies completion of transmission of the current character.

Enough of the preliminaries. Let's throw in some more gates to control all this logic and come up with something like the suggested circuit in Fig. 5. It's not too hard to dissect this rather formidable circuit if you start at one side and proceed through it, gate by gate. On the right we have a push-button, used to start things off, which is suitably debounced and conditioned into the negative pulse needed to start the UART off. This pulse is passed through two gates on the way to the UART: an OR gate which will accept either the push-button or UART signal to trigger the UART, and an AND gate, used to turn the whole thing off at completion of the message. As soon as the UART starts sending the character presented by the matrix, an "OK TO LOAD" signal appears on pin 22. This is sent to the counter, advancing one count, and presenting the next character to the UART. When transmission of the current character is completed, an "OK TO SEND" pulse appears on pin 24 and is used to trigger the UART to send the next character. When the last character in the matrix is sent, the next advancement of the counter selects the sixteenth line (I told you I would get around to it!) and grounds it. By using that line as one input of an AND gate and the "send" signal as the other, one can block the "send" by providing a logic "0" to the other input of the AND gate. That is, with a logic "1", as will be provided when the last character is *not* selected, the output of the AND gate will follow the input. A logic "0" on one input of an AND gate inhibits *any* output from the gate. Fig. 6 demonstrates this for the disbelievers in the crowd.

If one wished to send just a test, say "RYRYRYRY . . . ," quite a bit of simplification could be envisioned. Only two rows of a matrix would be needed, and a simple flip-flop could select the row in use. Further, a "start" and "stop" control could be integrated with one more bounceless push-button. Fig. 7 offers some suggestions along that line.

Expanding the data to more than fifteen characters is also possible, but is a bit more complicated. Fig. 8 is one possible solution. Here we have used an additional 74154 as a true data distributor which selects which bank of matrices gets selected. For now, this shall remain food for thought.

Are you all ready for the

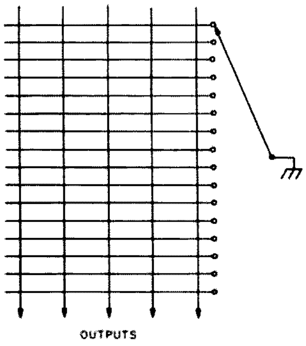


Fig. 1. Mechanical matrix selection.

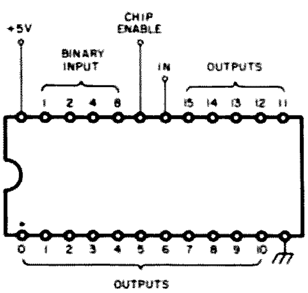


Fig. 2. 74154 data distributor pinout.

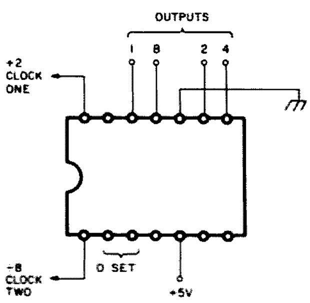


Fig. 3. 7493 binary counter pinout.

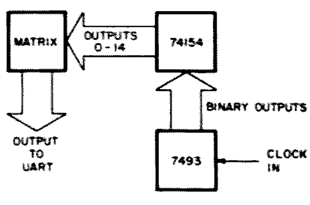


Fig. 4. Data selection basics.

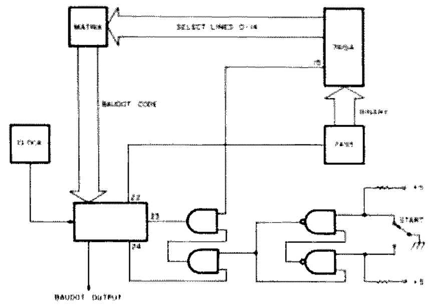


Fig. 5. Basic "stunt box."

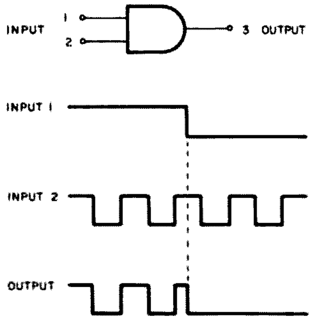


Fig. 6. AND gating.

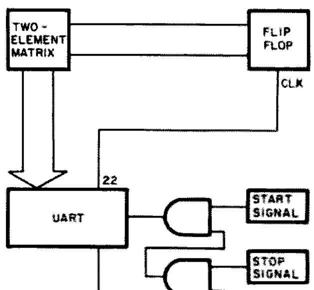


Fig. 7. 2-element generator.

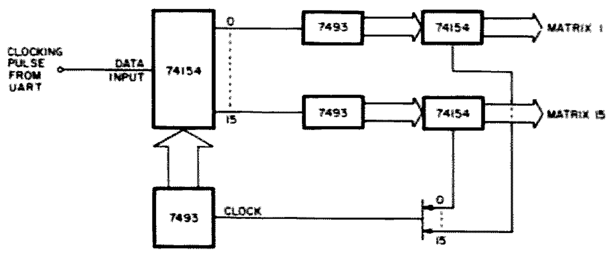


Fig. 8. Banking matrix using a 74154.

record? The single item to draw the most response which I have ever mentioned in the two years of this column was the question as to the whereabouts of the *Green Keys* and *RTTY Journal*. While no one seems to know what happened to the *Green Keys*, oh, boy, do you all know about the *RTTY Journal*. I received numerous notices that it is *not* dead, although the exact state of its health was questioned by many readers. If you're interested, you might drop a line to: *RTTY Journal*, PO Box RY, Cardiff-by-the-Sea CA 92007. Subscriptions are currently $5.00 per year for the US, and $6.50 per year for Canada and Mexico. Foreign rates are also available.

Many thanks to the many hams who sent along information about *RTTY Journal*, including Larry Filby K1LPS, Mark Wilson W0ZSU, Howard Markwell W0MT, and John Langtry, who did not give his call but hails from Ontario. John also related that there is a Canadian RTTY magazine out, published by Gwen Burnett VE3AYL. Called *RTTY News*, the magazine is a monthly. Information is available from Gwen at: 85 Fifeshire Road, Willowdale, Ontario, Canada M2L 2G9. Mention RTTY Loop when you write her, okay?

To the many readers who have written in questions and requested personal answers: By the time this is published, I should be essentially caught up. That means that if you have written me and enclosed a self-addressed stamped envelope prior to one month ago, you should have received a reply. I discovered my two wonderful kids going through Daddy's desk and "sorting mail." I don't think I've lost anything, but if you have not received a reply, it is possible.

That SASE bit is not just for me, by the way, but is common courtesy whenever you write any author whose work you enjoy and from whom you desire a personal answer. That should go for not only articles you read here, but even those in (shudder) other magazines.

Next month, we will get to some of those burning questions sent in by the readership as we complete our second year of RTTY Loop. When we pick it up again, in June, we will add the second half of the program covered last year, sending RTTY with a microcomputer. Again, while the program will be written for one specific microprocessor, I hope to present it well enough so that it may be adapted to other popular systems.

Microcomputer Interfacing

David G. Larsen
Peter R. Rony
Jonathan A. Titus
Christopher A. Titus

DATA ACQUISITION

The software in the previous column provided an example of a program used to acquire a single analog point in digital form. We are generally interested in applications in which a series of points are to be acquired, stored, displayed, and perhaps manipulated. This month's column will explore the use of microcomputers for data acquisition.

In our discussion of microcomputer-assisted data acquisition, we shall assume that the analog-to-digital converter (ADC) is interfaced as shown in the previous column. The software, which is repeated in Table 1, is also assumed to be the same. The digital value of the analog voltage is returned in the B and C registers (register pair B).

In most data acquisition programs, a fixed number of points are to be acquired over a fixed period of time. In our example, 100 points will be taken, one every second. The 100 data points will be stored in read/write memory so that they may be used later. In writing data acquisition software, we are now faced with three tasks which must be performed in addition to the actual ADC task: 1) provide a software counter to count 100 points; 2) provide a one-second timer; and 3) provide software to store the data values.

The software necessary to count the 100 acquired points will actually count 100 passes through the data acquisition software. A general-purpose register within the 8080 chip is well suited for this; conditional jump instructions may be used to detect when the count is decremented to zero. The counter may be either incremented or decremented, but decrementing is probably easiest to use if you are just starting to program microcomputers. Storing the data in memory is not difficult. Once the converter value is stored in a register pair, the H and L registers (register pair H) may be used as memory pointers to point to a R/W memory location. Note that a complete 16-bit address must be specified for the MOV M,r instructions. Since the data is acquired from a 10-bit ADC, two successive memory locations must be used to store each *point*. The INXH instruction (increment register pair H) provides an easy means of pointing to the next successive memory location. We will store the data by placing the eight least significant bits in location n and the two most significant bits in location n + 1.

The one-second timer may present some problems, depending upon the type of system which will be used. It is relatively easy to write a one-second software delay program using a series of register-decrementing loops, nested one within the other. However, this means that to accurately time a one-second period, the computer must be doing nothing else. In a system which is dedicated to data acquisition for the 100-second period, such a procedure is valid. If interrupts occur or if the computer cannot be allowed to "do nothing" most of the time, an alternate solution is needed. One possibility is to use an external clock, often called a *real-time clock*. Real-time clocks are unaffected by computer execution times, interrupts, slow I/O devices, etc. Once started, they will continue to run at an accurate rate until they have timed the particular period of interest and sent an in-

Continued on page 155

```
                     *100 000
100 000 365  ADC,    PUSHPSW /SAVE REGISTER A & FLAGS
100 001 323          OUT     /STROBE THE ADC TO START A CONVERSION
100 002 037          037
100 003 333  TEST,   IN      /INPUT STATUS BIT AND 2 MSB'S
100 004 066          066
100 005 306          ADI     /ADD 1 TO THE FLAG BIT
100 006 200          200     /TO CAUSE A CARRY IF IT IS SET
100 007 322          JNC     /NO OVERFLOW, CHECK IT AGAIN
100 010 003          TEST
100 011 100          0
100 012 107          MOVBA   /OVERFLOW, FLAG=1, SO SAVE MSB'S
100 013 333          IN      /INPUT THE 8 LSB'S
100 014 065          065
100 015 117          MOVCA   /STORE THEM IN REGISTER C
100 016 361          POPPSW  /RESTORE REGISTER A & FLAGS
100 017 311          RET     RETURN TO MAIN PROGRAM
```

Table 1. Typical ADC input routine for a 10-bit analog-to-digital converter.

```
                     *070 000
070 000 061  START,  LXISP   /LOAD THE STACK POINTER
070 001 377          377
070 002 070          070
070 003 041          LXIH    /LOAD THE DATA STORAGE STARTING
070 004 000          000     /ADDRESS IN REGISTERS H & L
070 005 072          072
070 006 315  CONVRT, CALL    /CALL THE ADC SOFTWARE
070 007 000          ADC     /SHOWN IN TABLE 1
070 010 100          0
070 011 161          MOVMC   /STORE THE 8 LSB'S TO MEMORY
070 012 043          INXH    /INCREMENT THE MEMORY POINTER
070 013 160          MOVMB   /STORE THE 2 MSB'S TO MEMORY
070 014 043          INXH    /INCREMENT THE POINTER AGAIN
070 015 175          MOVAL   /GET THE LOW ADDRESS VALUE
070 016 376          CPI     /COMPARE IT TO THE 201ST ADDRESS
070 017 310          310     /310 = 200 DECIMAL
070 020 312          JZ      /DONE YET?
070 021 047          DONE    /YES, JUMP TO "DONE"
070 022 070          0
070 023 315          CALL    /NO, DO THE 1 SECOND DELAY
070 024 031          DELAY
070 025 070          0
070 026 303          JMP     /AFTER THE DELAY, GET THE NEXT
070 027 006          CONVRT  /ADC DATA POINT
070 030 070          0

                      /THIS IS THE ONE SECOND TIME DELAY
                      /SUBROUTINE

070 031 365  DELAY,  PUSHPSW /SAVE REG A & FLAGS
070 032 325          PUSHD   /SAVE REGISTERS D & E
070 033 021          LXID    /LOAD COUNTER REGISTERS
070 034 000          000
070 035 110          110
070 036 033  DEC,    DCXD    /DECREMENT THE REG PAIR
070 037 172          MOVAD
070 040 263          ORAE
070 041 302          JNZ     /IF NOT ZERO, DO IT AGAIN
070 042 036          DEC
070 043 070          0
070 044 321          POPD
070 045 361          POPPSW
070 046 311          RET

                      /THE PROGRAM WILL CAUSE THE COMPUTER TO
                      /JUMP HERE WHEN IT HAS ACQUIRES ALL THE
                      /DATA POINTS.  A DISPLAY OR OTHER ROUTINE
                      /MIGHT BE PLACED HERE INSTEAD OF THE HALT

070 047 166  DONE,   HLT
```

Table 2. 100-point data acquisition routine for one point per second.

New Products

HAL'S NEW DS3100 ASR

HAL Communications Corporation has announced a new electronic RTTY terminal—the DS3100 ASR. The new terminal features full buffering of both received and transmitted data, thus permitting preparation of transmit text while receiving, as well as storage of up to 150 lines of received text and 50 lines of text to be transmitted. The new terminal also features a new screen format with 24 72-character lines split to show both receive and transmit buffers, line numbering for each buffer area, on-screen status indicators to show terminal code, rate, mode, etc., and a new high-contrast green P31 phosphor screen for easier viewing. The screen also uses bright/dim intensity changes to differentiate between keyboard and received data. A total of 10 HERE IS programmable identifier messages are available, two of which can be saved even while power is removed from the terminal. An IDENT feature allows Morse identification regardless of the terminal's selected data code.

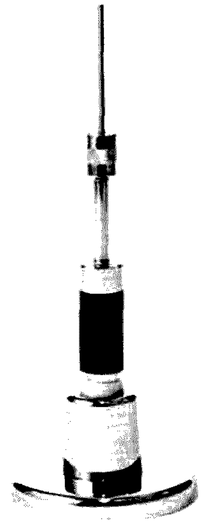
Other features include a real-time clock, programmable answer-back (WRU), upper- and lowercase ASCII, ASCII speeds from 110 to 9600 baud, four keyboard-operated output switches to control accessories, and a full 25-pin modem connector for ASCII computer connections. As did the previous DS3000 KSR V3 terminal, the new DS3100 ASR will send and receive all three data modes (ASCII, Baudot, and Morse), allows use of continuous, line, or word transmitting modes, and has synchronous idle, unshift on space, and word wrap-around. Both the electrical and mechanical features of the terminal have been completely redesigned to use a Z80 microprocessor and plug-in circuit boards, and to allow easy service. A front-face legend has been added to the keytops to fully label all control functions of the terminal and simplify operation. The keyboard and new streamlined cabinet are color-coordinated in a new two-tone castle tan and chocolate brown finish.

The terminal weighs 45 pounds and can be connected for use with 120 or 240 V ac, 50- or 60-Hz power mains. The cost is $1995.00, including shipping within the United States; deliveries of the first units will start before May 1, 1979. For further information, contact *HAL Communications Corporation, Box 365, Urbana IL 61801; (217)-367-7373.*

HAL's DS3100 ASR electronic RTTY terminal.

NEW CUSHCRAFT ANTENNAS

Cushcraft has introduced two new high-performance VHF/UHF mobile antennas. They feature 3-dB gain with 5/8-wavelength stainless steel whips and precise frequency adjustment with a fingertip collet. There are trunk-lip and magnetic-mount models which have been tested to speeds in excess of 90 mph. The antenna packages include 18' of RG-58/U cable with connectors, plus car-finish protective pads. The VHF models cover 144-174 MHz, including the 2 meter FM subband. The UHF model covers 220-225 MHz. For further information, write to *Cushcraft Corporation, PO Box 4680, Manchester NH 03108.* Reader Service number C67.



One of Cushcraft's new mobile antennas.

COMPUTER-GENERATED BEARING CHARTS

How accurately are you pointing your beam? Until recently, I thought I was doing a pretty good job of pointing mine. Oh, sure, I was using one of those standard charts centered on the nearest big city (Boston in my case), but I always figured that was close enough. Now I've changed my mind, thanks to the superb selection of beam heading charts offered by Bill Johnston N5KR.

For more than a dozen years, Bill has been supplying hams with the real McCoy: Great Circle bearing charts centered on the exact QTH you specify. No more guesswork... no more trying to make do with a chart centered hundreds of miles from your QTH. The amazing thing is that Bill can send you his basic chart for just $1.00. What do you get for a buck? The basic chart gives you beam headings from your QTH to 660 cities, countries, and islands around the world. The listings are evenly split between DX and domestic locations. The chart also shows the distance to the other QTH in both miles and kilometers, as well as the beam heading the other fellow should be using to maximize his signal to you. All this for $1.00!

I compared Bill Johnston's $1.00 chart to another I'd seen advertised for $4.95. The $4.95 chart was the loser by a wide margin. It listed only 332 different locations, and if you don't live near one of 51 American population centers, you're out of luck, because the charts are not customized to your QTH.

Bill Johnston has recently expanded his offerings, which now include enlarged DX and US beam heading charts, OSCAR/RS acquisition charts, geosynchronous satellite pointing charts, computer-generated code-practice groups, and even a computer-drawn Great Circle map centered on your QTH. All are reasonably priced. *Bill Johnston N5KR, 1808 Pomona Drive, Las Cruces NM 88001.*

Jeff DeTray WB8BTH
Assistant Publisher

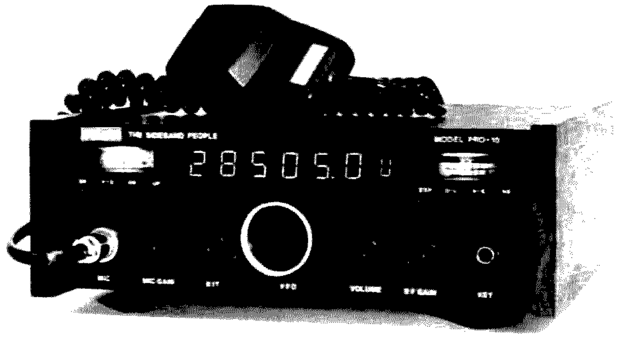
THE DIAL SPOTTER

At last, we hams and shortwave listeners have a digital product which puts new useful life into our old general coverage receivers and makes logging a snap. The Dial Spotter by Gemini Instruments enables you to quickly and easily read frequency within 1 kHz from 1 kHz to 35,000 kHz. The beautiful part about this instrument is that it adapts to any 455 kHz receiver whether it has a plus or minus or both offsets on the high frequency oscillator. My DX 160 receiver has a minus offset on the lower frequencies and a plus offset on the 13-to-30 MHz range. To change offsets on the Spotter, you simply throw an external switch which gives you additive or subtractive mixing.

The installation of the unit is quite simple. The Dial Spotter comes with an ac power supply and simply plugs in. The most difficult job is taking your receiver out of its cabinet so that you can add a simple connection. You don't butcher your receiver in any way, but just add a condenser lead out to a phono jack. The Dial Spotter comes with either 110 ac or batteries. The appearance is excellent. The readouts show up brilliantly in light and are large enough so that you do not have to squint to read them. After several weeks of use, I am delighted with its performance. There is stability in the readout, with little or no roll, and it beautifully follows your tuning.

If you are looking for a digital

The Dial Spotter.



Stoner's Model PRO-10.

readout to update your receiver, this is it. Shortwave listening becomes a pleasure, since you can quickly go back to a station or find a new station. The unit has an internal switching system which enables you to correct for a difference in i-f frequency of plus or minus 4 kHz. Thus, if your i-f is off a little from 455 kHz, you can make corrections after installation. Calibration is simple, as all you have to do is tune in a WWV or local broadcast station and adjust the switches. The calibration holds permanently.

The Dial Spotter is not a totally new design. It has been used in a slightly different configuration as the Navigator Mate, which is used by boaters for frequency readout on their portable RDF/ADF receivers. The unit weighs 6 lbs., measures 10½" x 2½" x 11", and comes with ac, 4- or 5-digit readout, black anodized finish, and several options. Also included is an excellent instruction manual.

For further information, write the *Gemini Instrument Co., Box 205, Larchmont NY 10538.* Reader Service number G27.

Wells R. Chapin W8GI
Kingsley MI

FIRST HAM RADIO WITH AMPLITUDE-COMPANDORED SPEECH

Stoner has just introduced the first amateur radio transceiver to employ amplitude-compandored speech. Officially called the Model PRO-10, it has been dubbed "The Black Widow" by those who have seen and heard it operating on the 10 meter band.

The impressive performance of the radio is the result of a tiny integrated circuit from Signetics. The "chip" contains the equivalent of a six-foot rack of tube-type telephone-circuit speech-processing equipment.

Amplitude compandoring involves logarithmic speech compression and expansion with no audible distortion. Part of the IC compresses the speech to raise the average modulation and "talk power." The other half of the Signetics "chip" is used to expand the voice on receive. The company stresses that both the incoming and outgoing signal are enhanced significantly even when the PRO-10 communicates with conventional SSB radios. A technical paper on amplitude-compandored speech is available from STONER upon request.

The PRO-10 is described by the company as a "platform" for high-technology SSB concepts. It operates on 10 meters. The SSB/AM/CW transmitter features 100 Watts minimum power output over the entire band. The receiver has a sensitivity of 0.5 microvolts for a 15 dB (S + N)/N ratio. A built-in six-digit frequency counter, which reads ± 100 Hz, features jumbo 0.5"-high LEDs.

The PRO-10 also features state-of-the-art electronic tuning (fast or slow) from either the panel or the microphone. A PLL (phase locked loop) tunes the radio in 10-kHz steps, while a vfo provides continuous tuning (1 kHz per turn) between steps. A built-in memory stores the last frequency used when the radio is turned off. Break-in CW operation is provided by carrier offset (50 Watts power output).

Another feature of the PRO-10 is the inclusion of amplitude modulation (AM). Noting the popularity of converted CB radios on 10 meters, Stoner incorporated a provision for this mode by employing a dual-bandwidth (2.5- and 5.0-kHz) crystal filter. The carrier output is 25 Watts. The operating mode (U, L, or A) is indicated by an LED to the right of the frequency display.

The PRO-10 measures 9" W, 8" D, and 3.25" H, an ideal mobile configuration. The power required is 13.6 V dc at 5 Amperes average current. *Stoner—The Sideband People, John Hancock Building, Mercer Island WA 98040; (206)-232-9464.* Reader Service number S85.

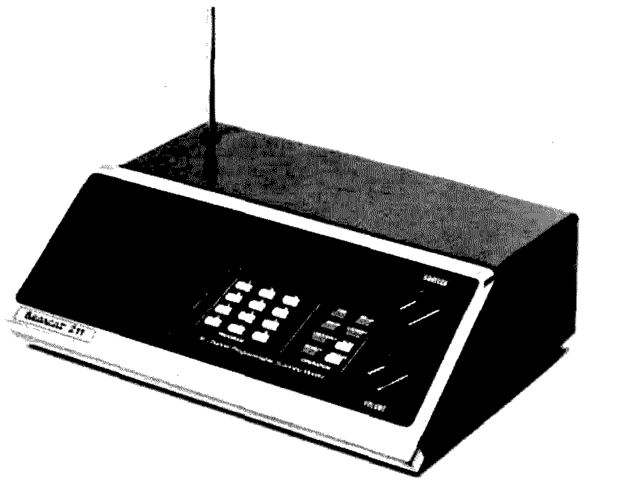
NEW "BEARCAT® 211" SCANNER HAS 18 PROGRAMMABLE CHANNELS

A new, crystal-less scanner radio with 18 channels which can be programmed with push-button ease has been announced by Electra Company. Named the "Bearcat 211," the new radio also features direct channel access which allows the user to manually select channels directly, without the need to step through other channels. In the radio's automatic scan mode, the 18 channels can be scanned at either 5 or 15 channels per second, permitting closer monitoring of desired frequencies. Also included is a patented selective scan delay which permits a 2-second delay to be programmed for any channel, allowing reply calls on the same channel to be picked up.

The new Bearcat 211 scanner radio also features a built-in digital clock function utilizing the radio's bright-red LED digital display. The high accuracy clock shows hours, minutes, and seconds. Another feature built into the new radio is automatic squelch. This feature allows the convenience of selecting a factory pre-tuned squelch level eliminating the need for manual squelch-level adjustment.

Thousands of frequencies in six bands are covered by the new Bearcat 211. Included are public safety, marine, government, transportation, and amateur communications. In the radio's "search" mode, the radio will seek out active frequencies between the limits selected by the user. Electra Company's patented Track Tuning is used to provide optimum reception across wide frequency bands. Complete details on the new Bearcat 211 scanner are available from Bearcat scanner suppliers or by writing to *Electra Company, PO Box 29243, Cumberland IN 46229.* Reader Service number E40.

Continued on page 32



The new Bearcat 211 scanner.

Contests

from page 14

is the only indication of amateur interest the Bermuda Dept. of Tourism has.

COUNTY HUNTERS SSB CONTEST
Contest Periods:
0001 GMT Saturday, April 21 to 0800 GMT Saturday, April 21
1200 GMT Saturday, April 21 to 0800 GMT Sunday, April 22
1200 GMT Sunday, April 22 to 2400 GMT Sunday, April 22

Please note the two four-hour rest periods!

This is the 8th annual contest sponsored by the Mobile Amateur Radio Awards Club, Inc. Mobile stations may be worked each time they change counties or bands, but, if worked again from the same county on a different band, count for point credit only. Mobile stations contacted on a county line count as one contact but two multipliers. Portable stations will be considered *fixed* stations. Fixed stations may be worked by other fixed stations only once during the contest regardless of bands. Repeat contacts between fixed stations on other bands are not permitted! Fixed stations may be worked by mobile stations each time they change counties or bands. Repeat contacts between mobile stations are permitted provided they are on a different band or in a different county.

EXCHANGE:

Signal report, county, and state (country for DX). Mixed mode contacts are permitted provided that one station is on SSB. (Mobiles, please keep an ear for CW county hunters calling!)

FREQUENCIES:

3920-3940, 7220-7240, 14275-14295, 21375-21395, 28575-28595. Look for mobiles on 15 meters on even numbered hours.

Please note: Again, this year there will be a "mobile window" of 10 kHz on the following frequencies: 3925-35, 7225-35, 14280-90. Mobiles will be in this 10-kHz segment and fixed stations are asked to refrain from calling "CQ Contest" in this segment. After working mobile stations in the "window," fixed stations are requested to tune and work other mobile stations or QSY to the outer edges of the suggested frequencies to call CQ or work other fixed stations in the contest. This will allow the mobile running lower power a chance to be heard and worked in the contest.

SCORING:

Contact with a fixed/portable US or Canadian station = 1 point. Contact with DX stations (including KL7 & KH6) = 5 points. Contact with mobile stations = 10 points. Multiplier is total number of US counties plus Canadian stations worked; take credit for a county only the first time it is worked. A Canadian station counts each time it is worked. Final score is total number of QSO points times total number of different counties and VE stations worked.

ENTRIES:

Logs should show date/time in GMT, station worked, report exchanged, county, state, band, claimed points (1, 5, or 10), and each new multiplier numbered. Official log sheets and summary sheets are free for a #10 SASE or SAE and appropriate IRCs from John Ferguson WØQWS, 3820 Stonewall Ct., Independence MO 64055. Submit all entries to the same address no later than June 1 to be eligible for awards; DX should use air mail.

AWARDS:

Plaques to highest scoring fixed US or VE, DX, mobile, and 2nd mobile; certificates to top 10 fixed and mobile stations in US and VE and to the highest scoring DX in each country. Only single-operator stations are eligible for these awards, but multi-op certificates may be issued if merited. A station may enter as both fixed and mobile, but separate scores are required.

WORKED ALL SOUTH EAST AWARD (WASE)

This award is offered by the Southeast Amateur Radio Club of Cleveland OH. An attractive certificate is available to all amateur radio operators who QSO with at least three members of the club on any band below six meters. Members of the club will be on 14.30 MHz every Wednesday evening starting at 0130 GMT. The club also meets on 28.70 MHz at 0130 GMT each Sunday evening for its weekly club net. To get your WASE certificate, send an SASE along with the callsigns of three club members and the date of each QSO to: WASE, c/o WD8KIS, 2196 South Overlook Road, Cleveland Heights OH 44106.

Looking West

from page 8

amateur band had little to no activity to speak of, depending upon where you lived. Remember that it's been but two short years since 220 started to come into its own—as a result of two happenings.

Happening one was the severe overcrowded conditions which developed on the two meter band in localities such as southern California, New York, metro Chicago, and a few others. Amateurs wanted to get away from these conditions and started to look elsewhere. Many migrated to 450, but in some places, especially southern California, that band, too, was very crowded. Starting first in southern California, amateurs began to look at 220 as an alternative.

This was the spur to the second happening. Recognizing that amateurs were giving 220 notice, a number of manufacturers began to produce equipment for the band which was popularly-priced. Just as Heath was credited with "making" six meters years ago, companies such as Midland, Clegg, Wilson, and Cobra will go down in the amateur annals as the pioneers of 220.

By the time the 220 Class E proposal came to fruition, amateur operation had begun to entrench itself on that band. And by the time the FCC announced that the proposal was no longer viable, we had run out of 220 repeater pairs in southern California. Even if the proposal had gone through, it would have been all but impossible to implement here.

There was one fly in the ointment, though. 220 CB might have been approved had not our neighbors taken issue with the idea. They had witnessed the 27-MHz mess and did not want an expanded version of it. Maybe, had the US been able to guarantee that it would have been a totally-structured, heavily-policed service, it could have passed, but even the most bureaucratic of bureaucrats would have thought twice about that one. So, much to the dismay of many manufacturers who had hoped that 220 would be a needed shot in the arm for the teetering CB industry, 220 Class E died. If the ARRL had said nary a word, or even if they had supported the idea, it probably would have died the same death.

There is a difference between the Class E CB proposal and the current US WARC proposal pushing maritime mobile. Unlike CB, maritime will be looked at as a structured and policed service. Moreover, this is not a proposal for a given nation, but rather for the entire world. Now, when you "lose one," as happened with Class E CB, you do not go out to get egg on your face again. The FCC "lost" in the Class E fiasco, so they are not about to take that chance again unless they thought they had a viable proposal. This means that they would at least expect support from throughout the region. I believe that the ARRL will be looked upon as no more than a radio club—unable to take on an entire region. They are just not that powerful. It would be nice if they were, but such is not the case. If they had taken the initiative years back and invested in a professional lobbyist rather than a new office building, they might have developed the necessary structure to fight such transgressions as these. In fact, had the ARRL developed an effective lobby in Washington, we would not now be facing crisis after crisis.

There is another important factor. The ARRL just does not have the overall support of our VHF community. The world of VHF communication is fascinating and fast-moving—especially that of VHF/UHF relay technology. Yet the ARRL has always been slow to react to the needs of that segment of the amateur society. In most cases, they have acted "after the fact." I seem to remember that half of the national number of repeaters had been coordinated along a 2 meter band plan before the ARRL got around to endorsing one. What is called the ARRL Band Plan for "2" is, in actuality, the Modified Texas Plan. Later, after the ARRL recognized that inverted tertiaries worked better than right-side-up ones, the Southern California Band Plan suddenly became incorporated in the ARRL one. Another recent ARRL acquisition has been the band plan for the 144.5-145.5-MHz subband. This is actually the NARC or Northern Amateur Relay Council Band Plan; it was not dreamed up by the ARRL. There is nothing original in the ARRL 2 Meter Band Plan. It consists only of what they have borrowed from others and attached their almighty name to.

If the ARRL were the true VHF/UHF leaders, they would have developed band plans for all spectral activity long before they were necessary. They didn't, and to date they have not come up with anything

original. They borrow and endorse but they fail to create. Part of the job of a leader is to be imaginative enough to plan ahead. They have not, and because of this, they cannot gain the support of the majority of the VHF/UHF community.

Another graphic example of the lack of leadership is the League's reluctance to enter into the realm of total spectrum management. This is a concept that the League should have pioneered. Instead, the idea developed from a single small regional repeater council, the SCRA. In fact, the SCRA (under its new title, 2mASMA) evaluated, modified, accepted, and implemented the recommendations of the ARRL's VHF/UHF Advisory Committee's proposed national 2 meter bandplan while the ARRL's Board of Directors debated its merits. It's a good plan, and with only one slight modification, it truly serves the needs of all 2 meter users. This plan should have been implemented nationally a long time ago, yet we still await Newington's decision. Southern California elected not to wait. Other areas, including the Southeast, seem to be reaching the same conclusion and are proceeding without Newington's okay.

All this comes down to the fact that the ARRL is not being effective enough as a VHF/UHF leader. And without support from the VHF/UHF masses, there is no way for them to obtain the stature necessary to dissuade the rest of the region and possibly the world from doing anything they want. 220 marine is just another example of this—and it may be the straw to break the VHF world's back. Those whom I have spoken with want no part of the ARRL in the fight to save 220. They feel more secure in going it alone than they do with the quasi-support of the ARRL. If the amateurs are able to fight off this latest threat to 220, the ARRL will again probably try to steal the spotlight. If 220 is lost, it will also mean an end to *any* support for the ARRL by those involved in VHF/UHF relay communication—and that's a big chunk of the amateur population.

HOW CAN THIS BE CHANGED?

There are two organs within the ARRL which could become the VHF/UHF leaders of tomorrow if the ARRL Board of Directors would let them. They are the VHF Repeater Advisory Committee and the VHF/UHF Advisory Committee. However, they both seem continually stifled by the bureaucratic attitudes of the ARRL Board of Directors. Eventually, because of this lack of Board initiative, some of those who have served on the VRAC have felt that they have had enough and have left. Can you blame them? Put yourself in the position of being an advisor to their Board on matters with which the Board was a bit unfamiliar. You were selected because of your knowledge of VHF/UHF communication and were told to advise the Board on such matters. The committee itself exists because the Board knows little about the topic. If they were experts on it, why would they have the advisory committee in the first place: By forming such committees, the ARRL Board admits its knowledge deficit in such areas.

So, you research something. Let's say it's a band plan for six meters. You present it to your fellow committee members and they agree. Your chairman then forwards this committee recommendation to the Board, where it is formally pigeonholed. Eventually you give up and do one of two things. You protest and quit, or you become a good little boy and enjoy your status as a committee member while doing as little as you can. Frankly, I can't blame anyone who does either under the current scheme of things. However, there is so much potential in both the VRAC and the VUAC that it's a shame to see all this talent wasted. It *can* be changed, and here is one way:

First, both the VRAC and the VUAC have to be taken out from under the Board of Directors' thumb. Members of both committees should not be appointed through Newington, but rather should be elected on a Division basis as are Division Directors. It would then be the people rather than the bureaucrats speaking. Within this elected body, another election should be held to determine a chairman and a liaison officer. Decisions of such committees should then be presented to the ARRL membership and voted upon by the members as to whether such should or should not be implemented. The Board should keep its nose out of it, since by creating such committees, they admit that they are not at all adept at these matters in the first place. Once the roadblock caused by the Board of Directors is eliminated, the VRAC, the VUAC, and other expert League committees can go forth and help guide amateur radio directly.

The big question is: "Can it ever happen?" It's a simple, effective idea, but one that would dilute the Board of Directors' authority. I doubt that the current regime in Newington would buy it. Therefore, the real answer is a long-term one. It means voting into power individuals whose views are the same as yours. It means evolutionary change, and, unfortunately, we in VHF/UHF just don't seem to have the time to await such a happening.

As in the past, things keep going with or without the ARRL. They will continue to take credit for what we accomplish and we will keep on accomplishing with or without them. If we survive WARC, VHF and UHF will continue to grow and prosper. New ideas will continue to pour forth. If the ARRL announced today that it was pulling out of any further involvement in this part of amateur radio, it would not matter one iota. That's what makes the whole thing so sad.

COORDINATION: THE BEST METHOD YET

Gary Pearce WA9NSO is the Illinois Repeater Council's coordinator. Over the years, I have heard quite a bit about Gary, but it was not until recently that I had the pleasure of meeting him and finding out first-hand how the IRC faced an almost overwhelming problem and was able to conquer it. Here is the story, as Gary explained it to me over lunch in San Diego.

About a year ago, the IRC simply ran out of places on two to put repeaters. There were always far more requests for spectrum than there was space available. Eventually there was no more, even with co-channeling and similar measures. At this point, the idea was born in the IRC that it was time that it became an advisory rather than an administrative group. A new concept of repeater coordination took root, which I will term "advise and consent coordination."

According to Gary, someone coming to the IRC these days for a metro-area repeater on two does not get an exact assignment. Rather, he is given an accurate listing of all area activity and told to go forth and find himself a home which will cause minimal interference to himself and all existing activity. The rationale is that nobody wants to be interfered with, and thus the new repeater owner will seek a home which satisfies this criterion. This concept takes the responsibility for minimizing and/or eliminating interference and places it squarely upon the shoulders of the new system owner. In such cases, the IRC operates on an advisory level. If all goes well, it gives final consent to the system's establishment and operation.

After listening to Gary, I took the initiative and developed a similar plan for this area, which I presented to the 2mASMA Technical Committee. The Committee decided to give it a try. Some new forms to utilize the concept were developed and included in the coordination information packet which is sent to every new repeater applicant. The results have been amazing.

2mASMA administers a very large area, one of the largest in the nation. It is impossible for a committee meeting in LA to know every bit of spectral activity in this geographic area. At least half a dozen coordinations have been made using this system to date, and not one has come back to haunt us. In the past, at least two out of every six have—especially from the overcrowded LA-San Diego rf corridor which for years has been the crux of our problem. It's no longer simply a matter of requesting a channel pair. You must go out and find one upon which you can survive—and in this no-man's-land, that's not that easy. The burden for technical excellence is now on the amateur, rather than on the council committee, and that should eventually lead to better technical excellence on the air. For coordinators and/or coordination committees interested, an SASE to PO Box 2606, Culver City CA 90230 will bring a sample copy of the aforementioned self-coordination forms, which 2mASMA will gladly let you duplicate for your own use.

GROWING PAINS DEPARTMENT

One organization which has had its share of growing pains and is now emerging to a position of leadership in the world of hobby-service two-way radio is a group called H. F. International, with headquarters in Riverside CA.

Once regarded as a renegade CB club which promoted illegal, out-of-band, and overpower operation in the spectrum between the 11 meter CB and 10 meter amateur bands, HFI, now under new leadership, has emerged as an organization dedicated to serving the needs of the hobbyist SSB enthusiast, be he CBer or ham. There is a lot more to HFI than meets the eye, and now, and in the future, I hope to give you a bit of insight into that organization and the changes which have occurred within it.

I know that some of you will take issue with my devoting space in an amateur magazine to something not purely amateur- or VHF-oriented. Others may take the view that all HFers are nothing but illegal radio operators and must not be given recognition. Neither of these statements holds much water. There is one important

reason why you should know about HFI and its people: Many of them are transitionites, in the process of leaving CB and becoming amateurs. One of the avowed new goals of HFI is to educate the CBer of today so that he/she can be the good amateur of tomorrow. Then, too, 100,000-plus hobby radio operators make up a big chunk of today's personal communicators and, just as the US could no longer fail to recognize the existence of mainland China, we in radio cannot bury our heads in the hope that HFers will all just go away. The fact is that what is termed illegal radio operation between channel 40 CB and the low end of 10 meters is growing at a phenomenal rate; another goal of the new HFI is to try to curtail this.

Like most other amateurs, for years I have been very boisterous in expressing my indignation at any illegal operation. A year ago, if you had asked me who all those bad guys were, I would have said that they were all members of HFI. The fact is that I said that many times and to many people. One day I said it to another amateur, who simply giggled a bit. He called me back later to offer LW a chance to meet with the president of HFI and judge for myself. The meeting was arranged according to certain ground rules I set down. I was still feeling indignant. There were two things. First, it would have to be a no-holds-barred interview, in which I could ask anything I darn well pleased. The second condition was that I be permitted to tape-record the interview so that later on no one could deny that what was printed had been said. This was agreed to, and early last spring I drove to Riverside and met with Norm Muller and his wife Jeannie at their home (which also serves as HFI headquarters).

We spent a rather enjoyable afternoon just "rapping" with one another, breaking now and then to change a tape or get another can of cola. I had come with the typical "ham with a chip on his shoulder" attitude well entrenched, and I was ready to do battle. The war never developed. There was an instant rapport, and it turned out to be one of the most educational afternoons I have ever spent. More in future columns.

THE JOE MERDLER REVISITED DEPARTMENT

On Tuesday, January 9th, I received the following news release from Joe Merdler N6AHU: "On January 9th, 1979, Scott Lookholder WB6LHB pled guilty to three counts of violating section 1464 of Title 18, using obscene and abusive language as a misdemeanor. Maximum penalties are up to 1 (one) year in prison and up to a $5,000 fine on each count. Sentencing is set for February 6th, 1979."

Looking West will have more on this in the future. However, we do have a rather interesting sidelight to report now. As a result of running the text of Joe's San Diego speech last December, he has been reunited with a relative he never knew existed. Joe tells the story this way:

He was in QSO on 20 meters with AA6A discussing DX when a breaker was heard. The breaking station turned out to be K8AQA in Saginaw, Michigan. K8AQA asked N6AHU: "Would you believe my name is Merdler, too?" It turned out to be Robert Merdler, and, in the course of the QSO, the two realized that they were indeed cousins. On that happy note, we will end this month's Looking West.

CARF

Canadian Amateur Radio Federation, Inc.

The DOC has announced the following changes to agreements with other countries: Add Mexico to the third-party traffic list. Negotiations are under way for third-party agreements with Australia, Haiti, Jamaica, and Liberia.

Reciprocal licensing arrangements have been made with Austria, Barbados, Bermuda, Costa Rica, Honduras, India, Indonesia, New Zealand, the Philippines, Sweden, and the United Kingdom.

On the banned countries list, the Viet Nam exceptions XV5AA, XV5AB, and XV5AC have been eliminated.

The DOC is negotiating reciprocal licensing arrangements with Haiti, Italy, Liberia, and Spain.

Lists in copies of the CARF publication, *The Canadian Amateur*, should be amended to conform.

DX

from page 18

recommended operating habits. I keep a sked with Doug every Sunday he is available on 28031 kHz at 2000Z. When he has the time, Doug will hang around and work a few stations after our sked. Doug's general operating times are from 0500Z to 0800Z, on all bands 10 through 160. I have handled all QSLs since June 1, 1978. Prior contacts should go to K2BT. There was a very active pirate using Doug's call, so unfortunately some cards are being bounced back. Best 73, Greg WB4PRU."

Palmyra Island

This summer, one of the better-heeled newcomers to the DX fraternity plans to depart from California for a four-month tour aboard his yacht *Wildfire*. Planned stops are Hilo, Palmyra, and Christmas Island. He is definitely planning the Palmyra stop, and says if the weather permits, he will take a swing by Kingman Reef. This looks to be mainly a CW-type operation, since the operator is new to ham radio and has a CW background from the Navy. He is planning to devote much of his operating time to the Novice bands.

Chad TT8

F6FFQ is in Chad and has been signing /TT8 in the 14105 area. It is hoped that he can soon be persuaded to brave the storms above 14200.

Djibouti J28AY

WB4ENI passes along the following information on J28AY: Marc plans to QRT sometime in July of 1979, when he will return to France as F6ETO. Beginning in July, all cards should be sent to F6ETO's CBA. In the meantime, they can still be sent to the Djibouti CBA. Marc prefers CW because his English is somewhat fragmentary. Look for him on 10, 15, and 20.

Korea HL9TG

Gary writes that he will be in Korea until January, 1980, and plans to be active on SSB and CW, 6 through 80. Contacts after March, 1974, go to WA7NTF, 6419 158th Street CT East, Puyallup WA 98371 or directly to Gary Kohtala, USAFS-K Box 194, APO San Francisco 96271.

Afghanistan/Pakistan

OZ1CRH will be traveling to Afghanistan and Pakistan and is optimistic about receiving YA operating permission. He will be in Pakistan from March 15th to May 30th and plans to sign AP2LJ. QSL to WA8AJG.

Spratly 1S1B

The late word had the group departing Brunei on March 28th and landing March 30th. The plan is to operate until more than 30,000 QSOs have been logged. VK2BKL and ZL1ADI from the Mellish operation will be along, and the boat will be the same one used at Mellish.

Dodecanese Islands SV

Those needing the Dodecanese should be interested in the following letter from SV1IG in Athens:

"Please inform the readers of *73 Magazine* that I and my wife will be touring the Dodecanese Islands from July 1st to August 15th. There will be many difficulties, as not all the islands have transportation. Since some are without roads, we will not have a car either. We will operate all bands, but will concentrate on twenty meters at 14205 and 14285 kHz. QSL to Anastasios Panos, 4-6 Voltairou Street, Athens 411, Greece."

SV1IG also noted that he no longer holds office in RAAG at the awards department, so letters addressed to PO Box 564 in Athens will no longer be answered. Anastasios also mentioned possible SY Mt. Athos activity in 1980.

China

Rumor has it that at least two American amateurs have applied and received preliminary approval for operation inside The People's Republic. It has long been felt by some that the first legitimate operation from China would be by Chinese nationals, but who can tell? Work 'em if you hear 'em, and worry later.

Comoros D68AD

As an accommodation to those working toward 5BDXCC, Robin maintains regular skeds on 1804 kHz from 0230Z and on 3504 kHz from 0300Z.

Sao Tomé S9

Angelo D4CBS will have been on Sao Tomé for an extended visit which began in March. Although he holds a license and will be taking his rig with him, informal inquiries as to the status of amateur radio have

gone unanswered. Hopefully, by now you will be hearing Angelo from S9.

Pitcairn Island VR6

Things should pick up from Pitcairn on April 19th, when the *Yankee Trader* puts in on its latest around-the-world journey. Aboard will be K5UC, N1DX, and K0BJ, who has been issued the call VR6BJ. The idea will be to put VR6 on bands and modes not usually available. Planned are RTTY, CW, 40, and 80. Other RTTY stops will be CE0Z, 3D2, KH8 (KS6), and 8O6. W0PAH will handle QSLs.

NOVICE CORNER

Although in the early stages of working DXCC it shouldn't be necessary to make schedules in order to work a new one, there may be instances when you want to ensure a contact with a certain station.

The best way to do this is to write to the station's QSL manager requesting possible schedule times and frequencies. Most QSL managers keep regular schedules with the stations they represent in order to pass logs or verify contacts. Often, the DX station will either show up early or else hang around afterward and hand out a few reports.

Remember, these QSL managers have plenty of work just keeping up with the QSL demand, so be sure to include an SASE with any correspondence. It never hurts to include paper as well. When schedule time comes, just let the QSL manager know you are on frequency and then stand by until all traffic has been passed. Then you can make a contact and the QSL manager will already have you in the log.

Just remember to be patient and follow instructions, and you'll usually be able to add a new one to your log.

HEARD ON THE BAND

4S7EA runs a Tuesday, Thursday, Sunday sked for the deserving DXer on 14247 kHz at 2330Z, with K9VAL as MC.

TR8AC is shooting for 2,000 QSOs per month with those deserving DXers in need of a TR8 contact. Look for him around 14222 after 2000Z.

Those new 8L2 prefixes are the old VP2L St. Lucia stations signing their newly-gained independence-type calls.

There are still two active operators on Johnston Island. KH3AA, the chief electronics technician for the installation there, is on generally once a week, and KJ6BJ can often be found around 14056 kHz from 0600Z. WH3AAA is reported to also be on the island and trying to upgrade.

The New Jersey DX Club has been supplying some needed manpower in an effort to reduce the QSL backlog at 4U1UN. They are having some success, but it never seems to be enough when you are among those in the waiting line.

Congratulations to new ARRL DX Advisory Committee members K5YY, K7LAY, and W0SR. They join holdovers W2XN, N6RJ, WB8EUN, K9AM, W3ZN, N4MM, and Chairman W1OT. Any complaints or bouquets you have concerning DX should be directed to these deserving ones.

Box 88 is slow but sure. K4IIF, who handles the *CQ Magazine* awards program, recently received six pounds of cards and applications from Moscow. The applications included 93 for WPX, 27 for CQ-DX, and 17 for WAZ. The round trip for these applications from Moscow averages 18 to 24 months. While we are on the subject, *CQ* recently raised the fee for the WAZ certificate from $1 to $2.

Apparently they will never run out of new countries. Look for the Marshall Islands, the Palau Islands, and Micronesia to obtain some form of independence by 1981.

Congratulations to WA8MOA, recent recipient of the first "Michigan DX Plaque," for his efforts in the Mellish Reef operation.

The FCC recently raided Brewer Labs in Porter, Oklahoma, and seized some 440 illegal CB linears valued at $200,000. According to a story released by the AP, these amplifiers cause TVI.

The January/February issue of *Oceans* magazine has an interesting article on Canton Island, the Auckland Islands, and Palau. Check your library for a copy.

W6KPC just put up a 12-element 20 meter beam on top of a Sky Needle at the top of a 100' tower.

The International Island DX Net meets every Friday at 0300Z on 14280 kHz. The net is operated by the Whidbey Island DX Club. Write WB7BFK for more information.

Maurice Caplan, who gave out many a new country contact as VS5MC from Brunei, has retired from the DX wars and returned to England.

KV4KV says no Desecheo activity until the ARRL decides on its country status.

Some big bets are being made among the south Florida DXers as to who will be the first to earn 5BWAZ. The winner will be entitled to use "The Big Florida Pizza" on his QSL card.

The Delta DX Association will send a computer-derived beam-heading chart to any DX station *free* for the asking. Write to Box 73, Metairie LA 70004.

Sometimes a letter to Box 88 will shake out some long-needed cards. Two years ago, K6DT wrote complaining about some overdue QSLs for contacts back in 1972. Now, two years later, the cards have finally come through. Where Box 88 is concerned, it just takes a lot of patience and sometimes a little prodding.

Word has come through that E. R. "Robbie" Robson 5Z4ERR, formerly VQ4ERR, became a silent key during December.

Chod Harris WB2CHO is in the process of setting up a permanent contest-type QTH in Montserrat, where he holds the call VP2MAY. The station setup will include a five-element quad for 10/15/20 and a two-element quad for forty. He will have three complete operating stations. Chod was with the group which ran up 7.4 megapoints from 9L1CA in the recent CQWW DX contest. In the meantime, between contests, he plans operation from VP1, PZ, 8R, TF, HB0, 3A, and other European spots. QSLs go to WA1SQB.

China recently ended their economic aid to Albania, and there seems to be a slow shifting of the Albanian axis toward the west. This opens up future possibilities of a true ZA operation by some visiting Europeans.

Don't discard your old *Callbooks*. Many of our DX friends overseas are unable to obtain US or foreign *Callbooks*. Send your old discarded *Callbooks* to WA4JQS, and Tony will mail them overseas at his expense. He will also advise you of the recipient.

The Long Island DX Association is looking for associate editors. Contact W2IYX if you are interested in helping out and getting your own byline.

Speak of the Devil, or at least a new country, SM3VE and SM4CNN advise that they have received a license and will activate ZA5A on all bands including OSCAR and 436 MHz the last week in June and first week in July.

There is really no excuse for not having worked KV4. Dick KV4A ran off nearly 50,000 QSOs during 1978. That's better than 100 a day.

The ARRL is petitioning the FCC for Novice privileges in the 220-MHz band. They have also asked for standard FM emission in the 52.0 to 52.5 MHz band.

The February *QST* carried a feature article on "incons." These are devices which combine inductance and capacitance into one component. The ARRL is issuing a news release on these and is canvassing the House and Senate Subcommittee on Communications. The feeling is that incons are helpful in reducing RFI.

TT0KP has been showing on twenty recently. He is reported to be a police officer there in Chad. QSL to F9KP.

Total US amateur licenses as of December 1, 1978, numbered 353,162. This breaks down to 61,000 Novices, 68,000 Techs, 118,000 Generals, 82,000 Advanceds, and 22,000 Extras. The gain for November was 325, and the 12-month gain was 26,404.

Contesters will be happy to note that K8TMK has filed a petition, RM-3281, asking amendment of part 97 so that contacts of one minute or less will not require an amateur station to identify the station it has contacted. This might work against the contester, since many contest-type DX stations go several minutes without identifying themselves, and the only time you hear their call is when the US station gives it.

QSL INFORMATION

6O1FG to G. D'Aurella, Via Antonio Fogazzaaro 87, 00137 Rome
7X4AN to Hermann Samson, Tannenweg 2, D-5501 Osburg, W. Germany
8P6EZ to W1RED
9L1SL/C to WA0CAE
9X5AL to SM5IB
A6XB to K1DRN
A6XJA to Box 2526, Dubai
CE0AE to WA3HUP
D68AD to G3RWU
DA2QE to Robert Chilcote, USAFSB Box 15, APO NY 09742
EA8QL to EA8QU
F6FFQ/TT8 to SP 85215-BM, France
FB8XU to F6FLZ
FB8XV to F5VU
FP0DI to VE1DI
FR7BU to F6EQN
FW8AC to F6BWX
GT5AVQ to DK5FJ
GT5CGV to DF7FH
GT5CID to DJ3BG
GT5MIR to DC1FP
H5FXT to PO Box 137, Lynden, Ontario, Canada L0R 1T0
HD0E/HD5EE to K8LJG
HH2Q CW to W4ORT, SSB to K4UTE
HL9TG to Gary Kohtala, USAFS-K Box 194, APO SF 96271
HL9WE to WB8USM
HS1ABD to W1YRC
HS1WR to Box 155, Bangkok
J28AY to Marc Bourg, Ancienne Poste, Chaniers-Le-Bourg, 17610 Chaniers, France
JT1BG to I8YGZ
K1CO/PJ7 to W8AEB
KZ0DX to 225 West Coyote Drive, Carson City NV 89701
S79WHW to Box 491, Mahe
S8AAP to Box 821, Umtata
TT0KP to F9KP

Thanks for much of the preceding information goes to the *West Coast DX Bulletin*, the Long Island DX Association *Newsletter*, and *WorldRadio Magazine*.

New Products

from page 27

THE IC-280

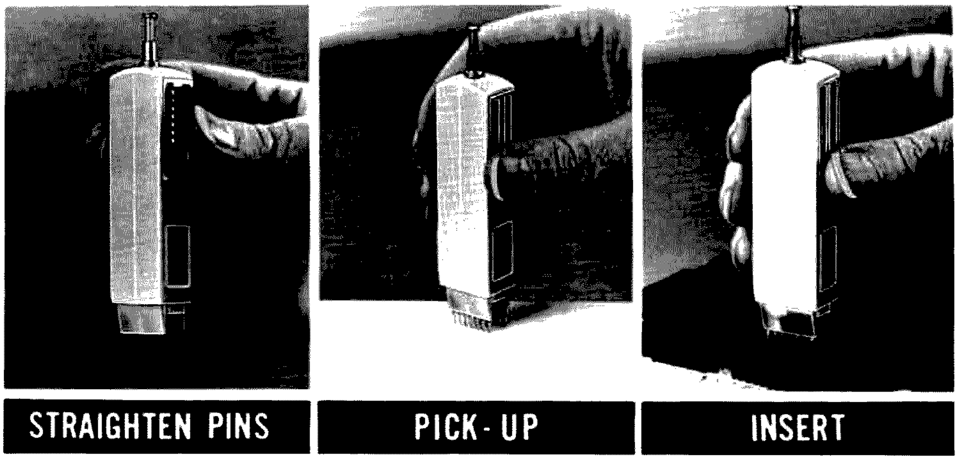
The versatility of a microprocessor is exemplified in the Icom IC-280 4 MHz + FM mobile radio for two meters. Referred to as the "remotable" radio, the IC-280 actually comes assembled for immediate operation as one box. However, the same radio may be separated by removing the head, connecting the optional remote cable to each unit, and mounting the head in a small place where almost no other radio will mount.

"Remotability" is not the only reason to have an IC-280. The microprocessor covers all 4 MHz of the two meter band, plus some at both ends in 15- or 5-kHz steps which are selected by the user or the processor. In addition, there are three memory channels which can store any frequency which can be programmed on the dial. This allows the set to act as an "eyes-on-the-road" radio for safety. The modular 10-Watt output stage has plenty of power to drive the most popular amplifiers to full output, and the continuous display of frequency in either the transmit, receive, or memory position makes the IC-280 the best FM radio Icom has come up with yet. For further information, contact *Icom East, Inc., 3331 Towerwood Dr., Dallas TX 75234*, or *Icom West, Inc., 13256 Northrup Way, Suite 3, Bellevue WA 98005*. Reader Service number I1.

Icom's IC-280.

MOS- AND CMOS-SAFE INSERTION TOOL WITH PIN STRAIGHTENER

OK's new model MOS-1416 DIP insertion tool inserts both 14- and 16-pin IC packages into sockets or predrilled boards. Total conductivity reduces static electricity. A ground strap may be easily attached for highly-sensitive MOS and CMOS ICs. Durable chrome-plated ABS construction features precision parts for long life and easy one-hand operation. The tool's narrow profile permits it to work on densely spaced patterns, while its unique insertion mechanism assures accuracy as well as excellent "feel." Finally, the tool includes a remarkable pin straightener built into the handle. Simply insert the IC, rock it on the straightening saddle, and push down on the tool. An automatic ejector delivers the IC ready to be placed in the insertion end for installation in your board or socket. The MOS-1416 is available at your local electronics distributor or directly from *OK Machine and Tool Corporation, 3455 Conner Street, Bronx NY 10475*. Reader Service number O5.



OK's new insertion tool.

HUSTLER ANNOUNCES NEW TRIBAND BEAM FIXED-STATION ANTENNA

Hustler has announced the new Model 3-TBA triband beam antenna. The amateur beam antenna covers the 10-15-20 meter bands. The longest overall element length is 23' 10", and the antenna is designed and tuned for a 24-dB front-to-back ratio. Its unique design permits the elements to be much shorter than other beams on the market today. The boom length is fourteen feet, and the antenna provides better than 8-dB gain. The 3-TBA easily handles power inputs of 1 kilowatt, and is easily matched to 50-Ohm cable.

Constructed of 100% heavy anodized aluminum with stainless steel hardware, its weight is only 36 lbs. The all-new Hi-Q trap design uses twelve-gauge aluminum wire, requires no capacitors, and, once tuned at the factory, is permanently weather-sealed for years of reliable operation. This antenna is sure to be a favorite of those operators entering DX contests.

For further information on this or other Hustler antenna products, write: Sales Department, *New-Tronics Corporation, 15800 Commerce Park Drive, Brookpark OH 44142*. Reader Service number N2.

READERS REVIEW THE WILSON MARK II HT

Have you been looking for a small, lightweight, hand-held two meter unit? I had been looking for about a year, but could not decide which brand to buy. Then, on July 4, 1978, I heard a QSO in progress on 146.52 between John Shean N9TV and Charlie Dalton WD9AGK. John said that he had bought a Wilson Mark II and had worked Indianapolis direct with it early that morning. He had climbed his tower to work Indy, which is about 100 miles north of here. I was with my family at my parents' house. Supper was finished. It was too early to light fireworks, so I broke into John's QSO on my Tempo FMH and asked if I could come to see his Mark II. Three days later, I ordered my Mark II from John AA9B, sales manager at Spectronics. It was shipped the same day. I have bought several rigs from Spectronics, and I find them to be excellent people with whom to do business.

The Mark II is small enough to carry in your shirt pocket with about half of it sticking out. It comes with crystals for 146.52 installed in channel A. It has six channels, A through F. There are separate receive and transmit crystals for each channel. Rejection of adjacent channel signals is excellent. The receive crystals must be netted along with the transmit crystals. There is a warning in the manual to avoid high rf fields, since they may cause damage to the receiver. The Mark II should not be used in close proximity to a base station antenna or closer than twenty inches from another unit. Transmission without the antenna can cause damage to the transmitter. My 25/85 repeater is here at my house running 100 Watts out, but it hasn't hurt the HT yet. My Mark II does an admirable job in this high-rf environment. The adjacent channel rejection it has is amazing, and you must do a good job of netting the receive crystals to get full performance. The Mark II uses a small 10.8-volt nicad battery pack rated at 500 mAh. The current drain is 15 mA squelched and 100 mA at full audio output. The current drain on transmit is 500 mA with 2.5 Watts out. The Mark IV draws 800 mA with 4.0 Watts out. The manual says the battery life is 8 hours with 5% transmit, 5% receive, and 90% standby duty cycle. The battery is easily replaced. The unit is housed in a Lexan case.

Looking at the manual, the only difference I see between the Mark II and the Mark IV is the driver transistor, with the Mark IV having a higher gain driver. Both units have an MRF

237 or SD 1127 output transistor. I have noticed a rise in the final amplifier temperature after several minutes of transmitting. This is normal. I have also noticed a rise in the temperature of the audio output final after several minutes at full volume, which is also to be expected. It should be possible to modify these units for switchable power output.

The accessories shown in the manual for the Mark series of HTs include a desk-type battery charger, a wall charger, a cigarette lighter-type 12 V dc charger, a speaker-mike, leather case, battery pack, and Digitran or Chomerics key pad. The Mark series uses the same kind of crystals as the other Wilson units. I put crystals from my Tempo FMH in mine with no trouble. Some of the channels I bought crystals for would not adjust to frequency properly until I changed the load capacitors to 33 pF. Caution must be used when you have the unit out of its case or else some of the small wires will come loose from the PC board. A single board houses both the transmitter and receiver, and a small auxiliary board houses some of the crystals.

The unit weighs only 16 ounces including the battery pack, and an excellent manual comes with it. It is checked out at the factory and the specifications sheet is included in the shipping box—something you don't find very often these days.

I would like to thank John AA9B for the excellent service from Spectronics, as well as N9TV for the demonstration that prompted me to buy my Mark II. Most thanks, though, go to Wilson for producing such a fine unit, the answer to my HT dreams.

How It Works

The Wilson Mark series of HTs are dual-conversion FM units with a single circuit board containing both the transmitter and receiver. An independent microphone element is installed just below the speaker. There is a connector for an external microphone. An incoming signal passes through a low-pass filter and bandpass filter to the rf amplifier, where it is amplified and passed through "selectivity elements" to the first mixer. The first oscillator uses an HC-25/U fundamental crystal with individual trimmers for netting each receive crystal. The crystal frequency is given by the equation Crystal Frequency = (Channel Frequency − 10.7)/9.

The first oscillator signal is coupled to the source lead of the first mixer, where it is mixed with the incoming rf from the rf amplifier. The output of the first mixer is tuned to the difference frequency, or 10.7 MHz. This 10.7-MHz signal goes through a monolithic crystal filter to the first i-f amplifier. "The crystal filter provides a flat-topped, extremely steep-sided selectivity curve for superior image rejection." The signal from the second oscillator running at 10.245 MHz is coupled to the second mixer, where it is heterodyned with the 10.7-MHz first i-f signal to produce the difference frequency, or 455 kHz. The 455-kHz signal goes through a ceramic filter to improve adjacent channel selectivity and spurious rejection. This 455-kHz signal is coupled through the second i-f chain which consists of four transistors followed by a limiter. The signal from the limiter is fed to the discriminator filter. The audio output of the discriminator is fed to the audio amplifiers. It has a noise-operated squelch.

The transmitter uses ten transistors and two diodes. The microphone audio is amplified, processed, and fed to the phase modulator. A deviation control is provided. Output from the oscillator is phase-modulated and multiplied in frequency by a factor of twelve. Then the signal goes through the driver to the final amplifier. The output signal is passed through a couple of filtering stages to the antenna.

Bob Miller N9RM
Louisville KY

Since I was introduced to 2 meter FM in 1968, I have wanted a Motorola HT-220 handie-talkie. Unfortunately, the price of even a used HT-220 was always out of my reach, so I made due with a variety of substitutes and eventually ended up with a battered HT-200. Now, understand that the HT-200 was a good HT in its day (1964), but it is big and heavy and limited in channel capacity (a maximum of 2). What had always attracted me to the HT-220 was its small size, light weight, and *professional* appearance.

Wilson Comes Through

Over the years, I have watched as various companies have introduced their versions of 2 meter HTs. I have found that none of them even came close to duplicating the HT-220. Sure, they had the technical performance, but they were as big as my HT-200 and just didn't look like I thought they should. Then it happened. Wilson ran their first ad for their Mark II and Mark IV mini HTs. They sure looked like an HT-220, and that price! $219.95. How could they sell it for that? Being the skeptic that I am, I figured that the ad was the typical case of marketing being a year ahead of engineering and that if Wilson ever delivered, the price would probably be up by 50%. A quick call to Wilson confirmed my suspicions. They said first delivery was in "3 to 4 months." Oh, well, I promptly forgot about it—but every month those full-page ads in *73* kept reminding me that Wilson was still there. Six months later, I began to see ads from distributors selling the Mark II and Mark IV. Surprisingly, the list price had only crept up by $10.00. In October of 1978, I saw a Mark IV at a hamfest. It really existed! What's more, it looked even better than the pictures. A long conversation with its owner revealed no problems, and apparently the unit performed as advertised. That was all it took. A few phone calls and a few days later, UPS left a package at my door. It wasn't my much-coveted HT-220, but something I think is even better—a Wilson Mark II. For a $250 package deal, I got a Wilson 2.5-Watt Mark II, nicad battery pack, rubber flex antenna, ac wall charger, and crystals for 146.52 simplex.

Overall Description

The MK II is what I would consider a *personal* portable radio. It is very small—about the size of a dollar bill and 1.8" thick—and weighs only 1 lb., even with the battery pack. It easily fits into a shirt pocket, and its appearance is really impressive. It sure is a long way from the early HTs, which looked like converted CB handie-talkies.

The case is finished in an attractive dark blue-grey textured style and apparently is pretty rugged, since mine has already survived a 5-foot drop onto a concrete floor. Inside the case is a real technical performer. Six channels are available on transmit and receive, and the performance leaves nothing to be desired. I've done extensive lab testing on my Mark II, and it easily betters Wilson's specs. On-the-air tests have been very favorable, and transmit audio quality is reported as excellent. There is plenty of receive audio, very clean with no apparent distortion. All of the controls on the top of the HT are easy to operate, and there is a HI-LO power switch on the bottom of the case. I normally leave my Mark II in the low-power position (1 Watt), since the difference in power is only noticeable in fringe areas. Low power reduces the drain on the battery by a fair amount and allows extended operating. Incidentally, the battery is a sealed, single-piece unit small enough to allow a second one to be carried in your pocket.

Receiver Description

The receiver is a double-conversion superhet with a MOSFET rf and a J-FET mixer. The first i-f is at 10.7 MHz. A 2-pole crystal filter is used for good intermod and secondary image performance. The signal is downconverted to 455 kHz, passed through a sharp ceramic filter, and then limited and detected. The discriminator uses a ceramic-type transformer and requires no alignment. The receive crystals are in the 14-MHz range and are multiplied directly to F_O − 10.7 MHz by the tuned circuits in the oscillator. Each crystal has individual trimmers for precise adjustment. The total squelched drain of the receiver is 15 mA, which allows many hours of monitoring.

The transmitter oscillator uses crystals in the 12-MHz range. Again, individual trimmers are provided to permit exact frequency adjustment. A phase modulator is used, with mike audio provided by a 2-stage amplifier. A speech clipper is used to prevent overmodulation; full modulation is obtained even when speaking a few inches away from the Mark II. Conventional transistor multipliers get the signal up to 2 meters, and a Motorola MRF 237 is used in the final stage. Incidentally, the 4-Watt Mark IV uses the same final as the Mark II. According to the schematic, the only difference in the two units is the driver transistor. The Mark II uses a 2SC741 and the Mark IV uses an MRF515. Presumably, one could replace the driver transistor, retune, and have a 4-Watt unit for less than the price differential between the Mark II and Mark IV. Maybe there is more to it than that, although I have found that 2.5 Watts is more than enough power anyway.

A solid-state T/R switch is used, and there is absolutely no noise when going from transmit to receive or back. My old HT-200 has an annoying squelch tail under the same conditions, so this characteristic of the Mark II is very welcome.

Construction

The overall construction of the Mark II is very compact, but servicing should be no problem since all the components are easily accessible. The unit is built on one single-sided PCB and uses very conventional parts—there are no custom micro circuits or even ICs. In view of this, I can't help but wonder why it took so long for anyone to develop a miniature HT. I have noticed that the

receiver and transmitter are adjacent to each other; perhaps in the past others have used more restrictive layouts to keep the two functions separated.

Accessories

In spite of its small size, there is room for installation of a touchtone pad or tone squelch option. Conventional desk- and wall-type chargers are available, along with a very attractive speaker-mike for remote operation. A leather case and 12-V car-lighter charger complete the list of accessories.

Operating and Service Manual

An excellent 22-page manual is provided with the Mark II. A detailed technical description is in the manual. Service aids include a foldout schematic, illustrated parts layout, parts list, PCB foil parts overlay, and voltage measurement chart. The manual also contains a section on isolating problems down to individual stages. If service is ever required, all the information one could want is in the operating and service manual. A 90-day parts and labor warranty comes with the Mark II.

What Do You Do With An HT, Anyway?

Like many people who have been on 2 meter FM for a while, I am way past the excitement of 100-mile HT-to-repeater contacts and have discovered that intelligent use of the HT can really enhance many situations. My wife happens to have an amateur license, and we use HTs to keep in touch when we go shopping. The Mark II is small and light enough to fit in her purse, and we can go our separate ways in shopping malls and still easily rendezvous by a quick call on the HT. It's also great for garage sales. I wait in the car listening to FM stereo, and if she spots anything interesting inside (like a KWM-2 for $50.00), I can run in and survey the merchandise. As a matter of fact, she has gotten so attached to the Mark II that I never get to use it and am back to using my old HT-200. *Wilson Electronics Corporation, PO Box 19000, Las Vegas NV 89119; (702)-739-1931.* Reader Service number W2.

Fred Studenberg W4CK
Cedar Rapids IA

Ham Help

I would like very much to use my Radio Shack TRS-80 Level II 16K microcomputer along with an interface to send and receive CW on my Yaesu FT-101E transceiver. However, to this date I have been unsuccessful in removing the bright flashes which appear on the video display when transmitting on any ham band.

One might be inclined to think that the transceiver is entirely to blame for the RFI on the video display, but I must add that the FT-101E does not cause any TVI with my home TV when it is operated in the same place as my video display or any other location in the ham shack.

The video display furnished with the TRS-80 has a "hot chassis," i.e., the chassis or internal system ground is returned to the 120-volt neutral through the power cord. Such a video display might be called an ac/dc power supply by some; the home TV has a conventional power supply. Perhaps the conventional power supply is less likely to have interference from a transmitter.

To this date, I have tried isolation transformers, power line filters, many combinations of bypass capacitors, grounding to the same ground on the FT-101E, ferrite toroid filters, and every combination of any or all of these, and none has removed the flashes on the video display.

I would like very much to hear from anyone who has solved the flashing in the video display.

John P. German W5HBH
807 South Rosemary Drive
Bryan TX 77801

The long-dormant Royal Order of Hootowls has been rechartered, and its members are again burning the midnight oil on 6 meters throughout the Southwest. I am the new custodian, and I'm attempting to contact all amateurs who were members of the original order. Original Owls may reactivate by submitting to me their name, call, mailing address, and ROHO number, along with a one-time fee of $1.00. Those who do not wish to reactivate are invited to send the information so that they may be included in the ROHO directory. A fact sheet on membership requirements is available for an SASE.

Don Abell WB5SND
6821 West Ave.
San Antonio TX 78213

I would like to modulate the Viking Adventurer transmitter for AM phone (ten meter). I would appreciate any information from anyone who has used this setup. Would an EICO 730 modulator work?

Dennis Hennigan WA1HOG
RFD 2
Pittsfield ME 04967

Can anyone assist me in obtaining a tube for an antique Westinghouse regenerative receiver, an Aeriola Sr., type RF, style 319564, made circa 1910-1920? The tube is a WD-11, Aeriotron, style 319533. The tube base is 4-prong, and has a 1½-volt filament and 22½-volt B+. The receiver is a wooden box, with a wooden chassis, rheostat, tickler, and tuning coil arrangement designed to tune 300-500 meters. I will gladly pay a reasonable price and postage for an original replacement, and welcome any advice on what to do with this nostalgic old doorstop.

Jerry Cohen WD8CJG
2568 Dysart Road
University Hts OH 44118

I am looking for an antenna which is efficient and effective, directional, and will fit in a 50 x 100 foot lot. Any designs, details, or ideas for an antenna, common or unique, would be appreciated very much.

Dennis Duckworth WB2SVR
109 Gilroy Avenue
Uniondale NY 11553

I need a manual or schematic for a "Moniscope" made by American Electronics Enterprises, Inc., of Long Beach CA.

I also need a manual and a plate transformer for a Gonset GSB-101 power amplifier. I will be happy to pay postage both ways for the manuals so that I could make copies of them.

Neil Preston WB0DQW
7024 Bales
Kansas City MO 64132

I would like to copy or purchase the manual and/or schematic for the Lafayette HE-35 six meter transceiver.

N. W. Zimmerman W7MAF
1815-17th Ave. So.
Great Falls MT 59405

I would like to put in a little request for a used model PLF 6-160 meter allband preamp (for receiver use only). I would also like to find a used 1978 U.S. *Callbook* at a reasonable price.

Paul Tremblay
8 Westfield St.
Biddeford ME 04005

I am looking for stations (including DX ones) for the International Chessplayers Net. The net meets at 2100Z, Sundays, on 14.340. No membership is required.

Rick Wentworth WB9ZJW
100 St. Mary's Blvd.
Green Bay WI 54301

I have a 2 meter power amplifier, the Amcomm 2M2. I would like to use the amplifier for SSB. Could anyone give me some information on the required modification? I have written Amcomm and gotten no results.

P. H. Schuyffel VE3JPP
8 Craggview Dr.
West Hill, Ontario
Canada M1E 4T9

I need a photocopy of an article, which appeared in the 1959 *Radio Handbook*, about a 500-Watt "deluxe" transmitter which used a 7094 in the final.

A. McGinnis WA2DTQ
55 Patton St.
Iselin NJ 08830

I would like to thank the readers who helped me out in my quest for a miniature variable capacitor for the noise bridge construction project. The letters are still coming in.

I had also requested equipment for the Pine Point Experimental School, but I am no longer affiliated with the school and there is no licensed amateur there. I regret the inconvenience caused to those readers who have tried to contact me there.

Walter Kimmel KB8CB
6033 Delafield Avenue
New York NY 10471

I have a Hallicrafters SBT 22 CW-AM-SSB transceiver. It's a military rig, fully solid-state and crystal-controlled. I need any information I can get, such as a schematic and operations manual.

Bill Meliema N3WM
13229 Old Hanover Road
Reisterstown MD 21136

I would appreciate it if anyone who has used Poly Paks' 92CU5177 and 92CU5226 (or any other circuit) to convert telephone touchtones to rotary pulses would please contact me.

Judah Schwartz KA2CES
941 45th St.
Brooklyn NY 11219

Our ham radio club desperately needs a photoelectric tube, the Cetron CE 1, or its equivalent, for an old Bell & Howell 16mm movie projector. It is no longer furnished by the projector manufacturer.

A. H. Russell WB4MAW
Tamiami Amateur Radio Club
2528 Bayshore Road
Nokomis FL 33555

I have an Avanti Moon Raker IV 11m beam, which I would like to convert to 10m. I have written to Avanti and received no results. I would like to know if anyone has converted a Moon Raker, and how I could convert mine.

Cecil R. Trail KA7ACT
Box 486
Asotin WA 99402

Social Events

MUSKEGON MI
MAR 30-31

The Muskegon Area Amateur Radio Council is sponsoring the ARRL Great Lakes Division Convention and Hamfest at the Muskegon Community College in Muskegon, Michigan, on March 30-31, 1979. This event will feature manufacturers' exhibits, technical forums, and a large swap shop. Ample parking and dining facilities are available. Friday evening at the Muskegon Ramada Inn, there will be a "Ham Hospitality" with libation courtesy of the MAARC and a Wouf Hong initiation. For additional information, contact MAARC, PO Box 691, Muskegon MI 49443, or H. Riekels WA8GVK, (616)-722-1378/9.

WORCESTER MA
MAR 31

The WPI Wireless Association will sponsor its first annual Spring Flea Market on Saturday, March 31, 1979, from 9:00 am to 4:00 pm, at the WPI campus in Worcester, Massachusetts. For more information, write WPI Wireless Association, Box 2393, Worcester Polytechnic Institute, Worcester MA 01609.

ST. LOUIS MO
MAR 31

Mayor Conway of St. Louis has proclaimed March 31st as Amateur Radio Day, and, in conjunction with this, the Gateway Amateur Radio Association is sponsoring a hamfest which promises to be a good one. Hamfest hours are 8:00 am to 6:00 pm at the H. J. Cervantes Convention Center. Scheduled events include: Wayne Green on microcomputers, an antenna forum by Hy-Gain, an FM and repeater forum by Motorola and VHF Engineering, FCC Q & A, a station-design forum by Drake, a low-cost transceiving forum by Atlas, a linear amplifier forum by ETO, a DX forum featuring the Navassa group and N9MM, a revolutionary method of learning Morse code, and an OSCAR forum. There will be special meetings for teenage hams, Ten-Ten members, Breakfast Clubbers, SWOT members, YLRL members, and others. Activities for YLs include a fashion show, a cosmetic display, and a tour of St. Louis. Talk-in on .34/.94, .37/.97, and .52. Admission is $3.00. For further information, please contact Bob Heil K9EID, PO Box 68, Marissa IL 62257, or phone (618)-295-3000.

COLUMBUS GA
MAR 31-APR 1

The Columbus Amateur Radio Club will hold its first annual hamfest from March 31-April 1, 1979, at the Columbus Municipal Auditorium, US 27 & 280, Columbus, Georgia. Donation is $1.00 at the door. There will be plenty of free parking and overnight free RV space. Exhibitors and flea market will be inside, with a free flea market outside. Talk-in on 28/88. For advance registration and details, write Bob Glasgow N4BGN, 1503 Layard Drive, Columbus GA 31907; (404)-561-7746.

PHILADELPHIA PA
APR 1

The Penn Wireless Association will hold its Tradefest '79 from 8:00 am to 4:00 pm at the National Guard Armory, Southampton Road at Roosevelt Blvd. (Rt. 1), ½ mile south of turnpike exit 28. General admission is $2.00. Setup is at 7:00 am. Sellers may rent a 6' x 8' space for $3.00; you must bring your own table. Some tables are available for $1.00, and a minimum number of power connections are available for $2.00. There will be refreshments, displays, and a rest area. Talk-in on 146.37/.97 and 146.52. For more information, contact Chuck Miller AD3X, (215)-943-3973.

PAINESVILLE OH
APR 1

The 1979 Lake County Hamfest will be held on Sunday, April 1, 1979, from 8:00 am to 4:00 pm at the Lake County Armory, 1289 Mentor Ave., Painesville, Ohio. The hamfest is all indoors. Tickets are available for a $2.00 donation. There will be refreshments, women's activities (ham and non-ham), commercial exhibits, and a 1:00 pm auction. Table rentals will be provided. Prizes include a Wilson Mark II, a Bird wattmeter, and a Drake touch-tone™ mike. Talk-in on .52/.52 and 147.81/.21. There is easy access to the hamfest via I-90 and Rte. 2.

TOWSON MD
APR 1

The Greater Baltimore Hamboree will be held on Sunday, April 1, 1979, beginning at 8:00 am, at Calvert Hall College, Goucher Blvd. and LaSalle Road, Towson, Maryland. The college is located south of Exit 28, Beltway (Interstate 695). There will be food, prizes, and a giant flea market. Admission is $3.00. There will be tables available inside the gym and the cafeteria. For information and table reservations, contact Bro. Gerald Malseed W3WVC at Calvert Hall College, 8102 LaSalle Road, Towson MD 21204, or call (301)-825-4266.

NATCHEZ MS
APR 1

The Old Natchez ARC Hamfest will be held on Sunday, April 1, 1979, at the Natchez Convention Center, Natchez, Mississippi. The event will be indoors and air-conditioned. There will be free admission and swap tables. Talk-in on 146.31/.91 and 146.52. For information, write ONARC, 1226 Magnolia Avenue, Natchez MS 39120.

WELLESLEY MA
APR 7

The Wellesley Amateur Radio Society will hold its annual auction on Saturday, April 7, 1979, beginning at 11:00 am at the Wellesley High School

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cafeteria on Rich Street, Wellesley, Massachusetts. The doors will open at 10:00 am. Talk-in on .96/.36, .63/.03, .04/.64, and .52. For more information, contact Kevin P. Kelly WA1YHV, 7 Lawnwood Place, Charlestown MA 02129.

COLUMBIA MO
APR 7

The Columbia Hamfest will be held on Saturday, April 7, 1979, from 7:00 am to 4:00 pm at the Cosmo Recreation Center, Columbia, Missouri. There will be a large flea market, forums, and a buffet supper on Friday, April 6, 1979, at the Heritage House. Tickets are 4 for $5.00 in advance and $2.00 each at the door. Food and camping and hotel/motel accommodations will be available. There will be bingo and a special program for the ladies. FCC exams will be administered for Extra, Advanced, General, and Technician Class licenses. Mail completed form 610 to License Examinations, Central Missouri Radio Association, PO Box 283, Columbia MO 65201. There will be a variety of major and minor prizes including a Kenwood TS-520S and a Wilson Mark II. Talk-in on 3963 kHz, 146.16/146.76 and 223.34/224.94. For ticket information, send check or money order, plus an SASE, to John Malinak WD0AFA, PO Box 283, Columbia MO 65201.

ROCHESTER MN
APR 7

The Rochester Amateur Radio Club and the Rochester Repeater Society will hold their Rochester Area Hamfest on Saturday, April 7, 1979, at St. John's School Gymnasium, 490 W. Center St., Rochester, Minnesota. Doors will open at 8:30 am. There will be a large indoor flea market for radio and electronic items, prize raffles, refreshments, and plenty of free parking. Talk-in on 146.22/.82. For further information, contact RARC, c/o K0TS, 2514 N.W. 4th Ave., Rochester MN 55901.

ST. CLAIR SHORES MI
APR 8

The South Eastern Michigan Amateur Radio Association will hold its twenty-first annual hamfest on April 8, 1979, from 8:00 am to 3:00 pm at South Lake High School, 21900 E. Nine Mile Road at Mack Ave., St. Clair Shores, Michigan. For additional information, contact Mark C. Wilke WD8RDA, Secretary, 171 Merriweather Road, Grosse Pointe Farms MI 48236.

MADISON WI
APR 8

The Madison Area Repeater Association, Inc., will hold its seventh annual Madison Swapfest on Sunday, April 8, 1979, at the Dane County Exposition Center Forum Building in Madison, Wisconsin. Doors will open at 7:00 am for sellers and exhibitors and at 8:00 am for the public. The Forum Building has over 20,000 feet of space for exhibitors and the flea market. There will be plenty of space for parking, with overnight camping available. Hotel accommodations are also available within walking distance of the Swapfest. There will be door prizes, an all-you-can-eat pancake breakfast, and a Bar-B-Q lunch, as well as free movies throughout the day. Admission is $1.50 in advance and $2.00 at the door. Tables are $3.00 in advance and $3.50 at the door. Children twelve and under are admitted free. Talk-in on WR9ABT, 146.16/.76. For reservations or information, write M.A.R.A., PO Box 3404, Madison WI 53704.

WEYMOUTH MA
APR 21

The South Shore Repeater Association will hold its ham auction on Saturday, April 21, 1979, at Central Junior High School on Broad Street, Weymouth, Massachusetts. The doors will open and check-in starts at 9:00 am for those wishing to participate. Doors will open to the general public at 12:00 noon. The club will share 10% of the sales. Please tag all items with call and description. There will be refreshments and door prizes available. Talk-in on 147.90/.30 and .52. For more details, write South Shore Repeater Association, Town Hall Annex, 402 Essex St., Weymouth MA 02188.

KANSAS CITY MO
APR 21-22

The P.H.D. Amateur Radio Association, Inc., of Liberty, Missouri, will sponsor the tenth annual Northwest Missouri Hamfest on Saturday and Sunday, April 21-22, 1979, from 11:00 am to 5:30 pm on Saturday, and from 10:00 am to 5:00 pm on Sunday, at the Kansas City Trade Mart. The Trade Mart is located at the Kansas City Downtown Airport, with easy access to all area interstate highways, with unlimited parking adjacent to the 45,000 sq. feet of exhibition space. Display booth spaces are available at a minimal cost of $15 for a single and $25 for a double. For further information, contact L. Charles Miller WA0KUH, 7000 Northeast 120th Street, Kansas City MO 64166, (816)-781-7313.

RALEIGH NC
APR 22

The Raleigh Amateur Radio Society will hold its seventh annual hamfest on April 22, 1979, at Crabtree Valley Mall, US 70 West, Raleigh, North Carolina. General Admission is $3.00 with activities beginning at 9:00 am. There will be a covered flea market and many prizes which include a Kenwood TS-520S or Icom 211 (your choice), a kilowatt three-element tri-band beam, and a CDE rotator. FCC Amateur exams will be administered at 9:00 am sharp. Talk-in on 146.04/146.64 WR4ACF and 146.28/146.88 WR4AOE. For additional information, details, or reservations, write RARS Hamfest, PO Box 17124, Raleigh NC 27609.

NEWINGTON CT
APR 22

The Pioneer Valley Repeater Association will hold its flea market and auction on Sunday, April 22, 1979, from 10:00 am to 5:00 pm at Newington High School, Newington, Connecticut. Tables, chairs, and electricity will be provided. There will be a flea market, an auction, dealer displays and sales, planned family activities, door prizes, free parking, and food service available. For further details, contact Arnie Depascale K1NFE, PO Drawer M, Plainville CT 06062, or Evangelo Demetriou, 38 Volpe Court, New Britain CT 06053.

DIXON IL
APR 22

The Rock River Radio Club will hold its 13th annual hamfest on Sunday, April 22, 1979, at the Lee County 4-H Center, 1 mile east of the junction of Rts. 52 & 30, south of Dixon, Illinois. Advance tickets are $1.50; $2.00 at the gate. There will be indoor facilities, a camping area, free coffee and donuts from 7:30 am to 8:30 am, prizes, and breakfast and dinner available. Talk-in on 146.52 and 146.37/.97. For advance tickets, mail to RRRC Hamfest, Chuck Randall W9LDU, 1414 Ann Ave., Dixon IL 61021.

TRENTON NJ
APR 22

The Delaware Valley Radio Association and the Lawrenceville Amateur Repeater Group will hold their annual flea market on Sunday, April 22, 1979, from 8:00 am to 4:00 pm, at the New Jersey National Guard 112th Field Artillery Armory on Eggerts Crossing Road off Route 206 in Lawrence Township, Trenton, New Jersey. Advance registration is $2.00; $2.50 at the gate with tailgating $4.00 additional—bring your own table. The selling area is indoors and protected from the weather. There will be ample parking, refreshments, and restroom facilities. Talk-in on 146.52, 146.07/.67, and 147.84/.24. For further information and reservations, write D.V.R.A., PO Box 7024, West Trenton NJ 08628.

DAYTON OH
APR 27

The 10th annual FM B*A*S*H* will be held on Friday night of the Dayton Hamvention on April 27, 1979, at the Dayton Convention Center, Main at Fifth Street, Dayton, Ohio, from 8:00 pm to 12:00 pm. Admission is free to all hams and their friends. Sandwiches, snacks, and a C.O.D. bar will be available. TV personality Rob Reider WA8GFF and his group will present a floor show. There will be drawings for many prizes, including a complete Drake UV-3 with 144-, 220-, and 440-MHz synthesized modules, power supply, encoder mike, and antenna. For further information, contact the Miami Valley FM Association, PO Box 263, Dayton OH 45401.

WORCESTER MA
APR 27

The Central Massachusetts Amateur Radio Association, Inc., will hold its auction and ham flea market on April 27, 1979, at the Main South American Legion Post 341, Main Street at Webster Square, next to Atamian Motors, Worcester, Massachusetts. The doors open at 6:00 pm, with the auction beginning at 7:30 pm. At the auction, 15% of the profits will go to CMARA. The flea market tables are $5.00 (items $5 and less only). Dealers are welcome. There will be door prizes, raffles, and refreshments available. Talk-In on 146.37-146.97 and .52. For more information, contact Rene Brodeur WA1LEA, (617)-753-7480, or Dave Penttila K1COW, (617)-885-4995.

SAN JUAN PR
APR 28-29

The Radio Club de Puerto Rico will hold its annual convention and hamfest on Saturday and Sunday, April 28-29, 1979, at the Condado Holiday Inn Hotel, San Juan, Puerto Rico. For details, write GPO Box 693, San Juan PR 00936.

WILLIAMSPORT PA
APR 29

The West Branch Amateur Radio Association will hold its 15th annual Penn Central Hamfest on Sunday, April 29, 1979, from 11:00 am to 5:00 pm at the Woodward Township Fire Hall, Rt. 220 south from Williamsport. For more information, write Richard Sheasley K3QDA, RD 1, Box 454, Linden PA 17744, or call Tony at (717)-322-6017.

SHREVEPORT LA
MAY 4-5

The Shreveport Amateur

Radio Association will hold its annual hamfest on May 4-5, 1979, at the Louisiana State Fairgrounds. Pre-registration is $3.00; $4.00 at the door. This is an ARRL sanctioned hamfest.

NEENAH WI
MAY 5

The 3-F Amateur Radio Club will hold its annual swapfest on Saturday, May 5, 1979, from 8:00 am to 3:00 pm, at the Neenah Labor Temple, 157 S. Green Bay Road, Neenah, Wisconsin, just off Highway 41 at the Highway 114 or 150 exit. Facilities include a large parking area and a large indoor swap area with a free auction at the end of the day. Food and beverage will be available. Advance admission for tickets and tables is $1.50; $2.00 at the door. Talk-in on 52/52. For reservations, write to Mark Michel W9OP, 339 Naymut Street, Menasha WI 54952.

LOGANSPORT IN
MAY 6

The Cass County Amateur Radio Club will hold its second annual hamfest on Sunday, May 6, 1979, from 7:00 am to 4:00 pm at the 4-H fairgrounds, Logansport, Indiana. Go north of Logansport on Highway 25, turn right at Road 100, and follow the QSY signs. Admission is $1.50 in advance and $2.00 at the gate. Outside set up is free and undercover set up is $1.00. Bring your own tables. There will be overnight camping, refreshments, ladies' bingo, and door prizes. Talk-in on 146.52 and Logansport repeater 147.78/.18. For information, write Dave Rothermel K9DVL, RFD 4, Box 146G, Logansport IN 46947.

DEKALB IL
MAY 6

The Kishwaukee Radio Club and the DeKalb County Amateur Repeater Club will hold their 21st annual indoor/outdoor hamfest on Sunday, May 6, 1979, from 8:00 am to 3:00 pm at the Notre Dame School, 3 miles south of DeKalb between highway 23 and South 1st St. on Gurler Rd., DeKalb, Illinois. Tickets are $1.50 in advance; $2.00 at the door. Indoor tables are available or you may bring your own. The outdoor setup is free. Talk-in on 146.13/.73 and 94. For tickets and directions, send an SASE to Howard Newquist WA9TXW, PO Box 349, Sycamore IL 60178.

WARMINSTER PA
MAY 6

The Warminster Amateur Radio Club will hold its fifth annual "Ham-Mart" flea market and auction on Sunday, May 6, 1979, from 9:00 am until 4:00 pm, at the William Tennent Intermediate High School, Street Road (Route 132), two miles east of York Road (Route 263), Warminster, Bucks County, Pennsylvania. A registration fee of $1.00 per car includes one ticket for door prizes. Tailgating is $2.00 additional. Indoor tables are available for $3.00 each. Talk-in on 146.16/76 and 146.52. For further information, please write Horace Carter K3KT, 38 Hickory Lane, Doylestown PA 18901, or phone (215)-345-6816.

FRESNO CA
MAY 11-13

The 37th annual Fresno Hamfest will be held on May 11-13, 1979, at the Sheraton Inn, Clinton and Highway 99, Fresno, California. The program includes technical talks, swap tables and flea market, transmitter hunt on 2 meters (146.52), QLF contest, ARRL CD appointees meeting, ARRL-FCC forum, commercial exhibits, prizes, eyeball QSOs, prime rib banquet, and more. For full registration and eligibility for pre-registration prize, send in $17 before April 27, 1979; it's $19 and no pre-registration prize after that date. Talk-in on 146.34 /146.94. For more information, contact the Fresno Amateur Radio Club, Inc., PO Box 783, Dept. HF, Fresno CA 93712.

DEERFIELD NH
MAY 12

The Hosstraders Net will hold its 6th annual tailgate swapfest on Saturday, May 12, 1979, at the Deerfield Fairgrounds, Deerfield, New Hampshire. There will be covered buildings, in case of rain. Admission is $1.00, with no commission or percentage. Commercial dealers are welcome at the same rate. Excess revenues will benefit the Boston Burns Unit of the Shriners' Hospital for Crippled Children. Last year we donated over $1100.00. Talk-in on .52 and 146.40-147.00. For more information, send an SASE to Joe DeMaso K1RQG, Star Route, Box 56, Bucksport ME 04416, or Norm Blake WA1IVB, PO Box 32, Cornish ME 04020, or check the Hosstraders Net on Sundays at 4:00 pm on 3940 kHz.

VANCOUVER WA
MAY 12-13

The Fort Vancouver Hamfair will be held on Saturday and Sunday, May 12-13, 1979, at Clark County Fairgrounds, Vancouver, Washington. Registration is $4.00 per person which includes a drawing ticket. Tickets are also available at the door. Activities will include contests, seminars, commercial and amateur displays, family events and a large ham radio flea market. Many prizes will be awarded with the grand prize being an Icom IC-701 HF transceiver and power supply. The fairground facilities include trailer parking and ample car parking. A catered buffet dinner is scheduled for Saturday night with musical entertainment included. Price of the dinner ticket is $5.00 for adults. For registration, contact Ken Westby W7DYX, Registration Chairman, 606 Miami Court, Vancouver WA 98664.

DAYTONA BEACH FL
MAY 12-13

The Daytona Beach Amateur Radio Association, Inc., will hold its first hamfest on May 12-13, 1979, at the Holiday Inn Surfside, Daytona Beach, Florida. For Mom and the kids, there is the "drive-on" ocean beach, and shopping in the oceanside plaza. Advance registration is $3.00 per family and $3.50 at the door. For more details, contact Funfest chairman David Rusler WA4ZTT, 1725 Hope Drive, Ormond Beach FL 32074.

SALINE MI
MAY 13

The ARROW Repeater Association will hold its annual Swap and Shop on Sunday, May 13, 1979, at the Saline, Michigan, fairgrounds. Admission, including parking on the fairgrounds, is $1.50 in advance and $2.00 at the door. There will be food, prizes, and a covered area for trunk sales, as well as indoor tables. Because of Mother's Day, wives will be given free admission. Talk-in on 146.37/97, 223.18/224.78, and 448.5/443.5 MHz. For additional details, write ARROW, PO Box 1572, Ann Arbor MI 48106, or call George Raub AD8X at (313)-485-3562.

BENSENVILLE IL
MAY 19

The Radio Amateur Megacycle Society will hold its third Antenna Measuring Contest on Saturday, May 19, 1979, starting at 10:00 am on the grounds of the Flick-Reedy Corporation, corner of Thorndale and York Roads, Bensenville, Illinois. Equipment will be available to measure the gain and swr of 2 meter, 1¼ meter, and 70 cm antennas. Equipment for higher frequencies will be brought if advance request is made. Prizes will be awarded for the highest-gain antenna in each category. Refreshments will also be sold. For further details, including directions, write Joe LeKostaj WB9GOJ, 2558 N. McVicker Ave., Chicago IL 60639. Please enclose an SASE.

CADILLAC MI
MAY 19

The Wexaukee ARA will hold its 19th annual swap and shop on Saturday, May 19, 1979, from 9:00 am until 4:00 pm at the National Guard Armory, 415 Haynes Street, Cadillac, Michigan. Tickets are $2.00. There will be free parking and lunches available. Talk-in on 146.37/.97. For more information, contact Robert Bednarick WD8RZL, Publicity Director, Wexaukee ARA, Cadillac MI 49601.

DURHAM NC
MAY 19-20

The Durham F.M. Association will hold its annual Durhamfest on Saturday and Sunday, May 19-20, 1979, at the South Square Mall, Durham, North Carolina. Plenty of prizes, exhibits, and programs will be offered, and the XYLs can enjoy shopping. Ladies' bingo will be held on Sunday. Free tailgating spaces, under a covered, drive-in-and-sell flea market, come with a one-time $3.00 general registration ticket, with vendors and dealers included. Electrical power will be available. Harmonics and unlicensed XYLs are admitted free. Talk-in on 147.825-.225, 146.34-.94, 222.34-3.94. For more information, write DFMA, Box 8651, Durham NC 27707.

BIRMINGHAM AL
MAY 19-20

The Birmingham Amateur Radio Club will hold Birminghamfest '79 and the Alabama State Convention on May 19-20, 1979, at the Birmingham-Jefferson Civic Center Exhibition Hall, Birmingham, Alabama. There will be many of last year's exhibitors, including most major manufacturers and distributors. There will also be a huge indoor flea market, lots of exhibit space, meetings, forums, activities, and plenty of free parking. Plans are being made to again offer on-site FCC exams on Saturday morning. Prizes will feature at least three complete HF stations, several VHF rigs, and a home video tape recorder system. The Saturday night banquet will feature the nationally known comedian and Grand Ole Opry member Jerry Clower. Banquet tickets will be available in advance, by mail, while they last. For more information, write Birminghamfest '79, PO Box 603, Birmingham AL 35201.

WEBSTER MA
MAY 20

The Eastern Connecticut Amateur Radio Club will sponsor an electronics flea market from 9:00 am until 6:00 pm, with an auction at 1:00 pm, on May 20, 1979, at Point Breeze Restaurant, Webster, Massachusetts. It will be held rain or shine. For more information

Continued on page 156

Blake Ember W2RZJ
39 Chestnut Ridge
Saddle River NJ 07458

A Speedy Spinner Mod

—5,000,000 Hz per minute

Knobify your rig with a minimum of effort.

After purchasing a Kenwood 820 and a Kenwood TS-700A last year, I discovered that something was missing on these two superb rigs. They needed spinner knobs so that I could QSY rapidly across the bands. So I developed a knob that can be affixed to just about any type of receiver or transceiver with a minimum of effort.

To build your own knob, refer to the labeled parts shown in Photo A.

Step 1. Place no. 2 over no. 1 and no. 3 over no. 2. Use a rivet tool or a punch on the no. 1 stem to flange it. After the stem has mushroomed, place a drop of 30-weight oil or white lube around it to ease rotation. After that, use emery paper on the base of no. 1 so that the epoxy has a good surface to adhere to.

Step 2. Epoxy no. 4 to no. 5 and let it set 10 minutes. Press no. 5 into no. 6, and then epoxy no. 7 into no. 6 and no. 8 on top of no. 6. This completes the knob.

Step 3. Take the completed top portion and lubricate the stem, no. 4 (white lube), and press it into the bottom section. The knob is now ready for mounting.

Step 4. Before mounting, make sure that both the knob surface and the rig surface are clean of oil and grease. Apply epoxy on the outer edge of the big knob and let it set for at least one hour. Then QSY rapidly across the ramps. ■

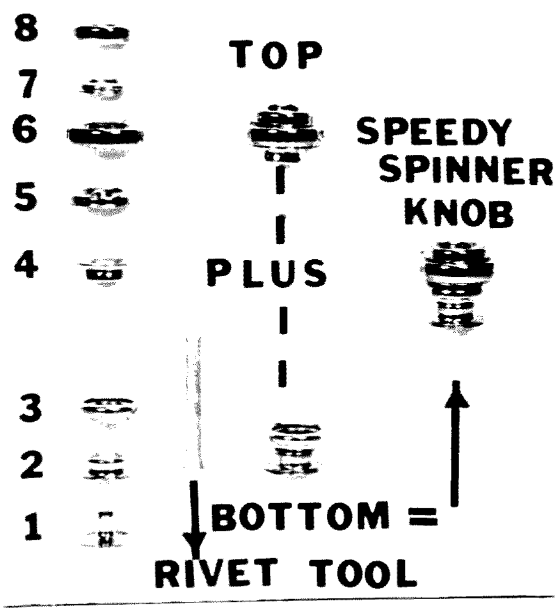

Photo A. Parts and their order for knob assembly.

Photo B. Spinner knob on the TS-700A.

Parts List

5-minute epoxy	$1.59
E Z heavy-duty snap fastener, no. 751	2.00
Prims halo buttons, 212-24 9/16"	.70
Prims halo buttons, 212-30 3/4"	.70

A Variable Bandpass Active Filter

—extremely simple design

Clean up those sine waves!

Allan S. Joffe W3KBM
1005 Twining Road
Dresher PA 19025

The op amp configured to produce an "active filter" is of general interest to the present-day ham for several reasons. His activities span a greater range of technology, op amps are rather inexpensive, and the final filter is a small unit that usually does a big job in a simple manner.

The bandpass type is rather useful for voice, CW, or RTTY modes, but the usual versions suffer from the lack of a diddle pot to vary the bandwidth without substantially affecting the design center frequency.

Fig. 1 shows a familiar bandpass filter without the variable bandwidth element. Fig. 2 shows the same circuitry with adjustable bandwidth and values for a center frequency of about 800 Hz. Using 5% value components, the measured peak frequency lucked out to be 820 Hz with the variable pot turned fully clockwise. This position is the broad position of the filter. With the pot turned fully counterclockwise (the sharp position of the filter), there is a slight shift of the center frequency to 865 Hz, but to the ear this is not detectable.

In the broad position of the filter, the bandwidth at the 3 dB downpoints is a measured 718 Hz. The bandwidth at the 10 dB downpoints is 1890 Hz. In the sharp position, the bandwidth at the 3 dB downpoints is 275 Hz and 800 Hz at the 10 dB downpoints of the response curve. Naturally, as the pot is rotated, you can generate a series of bandwidths between these maximum and minimum limits.

With a plus and minus nine-volt supply for the 741 op amp, the available output swing is about five volts rms. There is a difference in the input sensitivity between the sharp and broad positions of the bandwidth control pot. In the sharp position, it takes about 1.2 volts in to produce the five volts out. In the broad position, this input voltage rises to about 2.7 volts.

The filter demands an input resistance of no more than 22k Ohms from the input terminal to ground, especially when the bandwidth control is set to the sharp position. If this condition is not met, the filter will oscillate, a fact that may come in handy. To illustrate, set the bandwidth pot to the maximum sharp position without any input termination. A scope on the output will show a sine wave with clipped peaks. If you slowly back off the bandwidth control, the clipped peaks will go away, leaving you with a rather nice clean sine wave that also has excellent frequency stability. The frequency of this oscillation will be close to 77% of the center frequency of the filter. ■

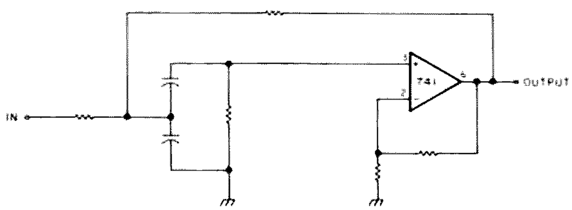

Fig. 1. Fixed bandwidth.

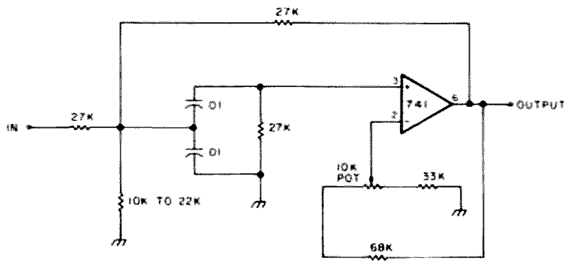

Fig. 2. Variable bandwidth.

What About an Active Antenna?

—here's a look at one

Mixed results.

Carl C. Drumeller W5JJ
5824 NW 58 St.
Warr Acres OK 73122

What's an active antenna? Usually, it is an antenna—often much smaller than normal size—that contains an amplifier in its structure. The amplifier is intended to bring signal strength up to a level comparable to that provided by a full-size antenna.

Recently, an importer commissioned this writer to investigate the capabilities of an active antenna. It's a model YN-1000B SKYNIX Electronic Antenna. The accompanying information makes no mention of the manufacturer, or even of the nation in which it was made. This arouses a strong suspicion that it is a "bootleg" copy of a similar antenna developed in Germany about 15 years ago.

The supplied information claimed a frequency range from 150 kHz (the European long-wave band) through 108 MHz (the FM broadcast band). This range makes use of two internal amplifiers, one with 15 dB gain for all the entertainment broadcast bands, and one of 10 dB gain for the shortwave bands. The internal amplifiers operate on 12 V dc, draw 8 mA, and require a negative ground.

Frequency in kilohertz	Meter Deflection Inside Antenna	Active Antenna	Outside Antenna
640	S9 + 10 dB	S9 + 20 dB	S8
940	S9 + 5	S9 + 5	S9
1560	S9	S6	S9 + 15
6150	S9	S0	S9
9000	S9 + 15	S9	S9 + 20
10,500	S9 + 15	S9	S9 + 20
11,800	S7	S0	S9 + 10
15,100	S9 + 15	S9	S9 + 10
21,500	S9 + 15	S9 + 15	S9 + 20
27,000	S9 + 20	S9 + 10	S9 + 25

Fig. 1. Tabulated results.

Armed with this information, I set up a test bench. The active antenna was mounted on a ground plane simulating a car body. Leads were run to two other antennas for comparison. One antenna was a 15-foot length of wire strung up in the same room with the active antenna, thereby putting the two under equal site limitations. The third antenna was a multiband (trap) dipole at a height of fifty feet. Provision was made for rapid shifts among the three antennas.

A general-coverage receiver, the Yaesu FRG-7, was selected for the test, and since the trap antenna would have quite good response on the amateur bands, to make a fair comparison, it was necessary to avoid checks too near amateur frequencies.

The results obtained are shown in the accompanying tabulation. (See Fig. 1.) No attempt will be made to explain the very wide variations, as no consistent pattern was established.

It is evident, though, that the active antenna finds its best application in receiving signals in the 540-to 1650-kilohertz frequency range. It's quite impressive to see an antenna only 15¼ inches long bring in signals as well as (or even better than) an antenna twelve times as large! It's possible that it might display equal ability in the VHF-FM bc band, but I had no receiver in that range with sufficient internal shielding, or a dependable S-meter; therefore, no test was made in that range.

To sum up, this one version of an active receiving antenna should be quite acceptable for reception in the MF AM bc spectrum, tolerable in some portions of the HF spectrum, and quite unsatisfactory in other HF ranges. There are other active antennas marketed in this country and in England that may be fully satisfactory. ■

LETTERS

from page 10

ly dropped A-1. Just within the past year I decided to go for DXCC and have over 110 confirmed with 40-plus more hopefully en route.

Wish you would change the tenor of your "Never Say Die." Then I probably would drop another ham magazine in favor of *73*.

John H. Pitman W1LY
Quechee VT

CARPING

I have read your magazine for a number of years and do enjoy it. However, I am disturbed at your continual carping at the ARRL, not because the ARRL does not merit considerable criticism, but because at no time have you offered us a suitable alternative.

Most organizations such as the ARRL do become inflexible and self-protective. However, challenging them directly as you do merely increases their tendency to insulation and isolation.

You have the means and, I assume, the staff necessary to develop an organization that might effectively represent the ham radio community. I can visualize an organization, not unlike the National Rifle Association, that could be a potent lobby.

Perhaps rather than indulging in ineffective criticism of the ARRL, you could invest some of your tremendous energy in the development of a real alternative organization, functioning solely in the interests of amateur radio.

Edward M. Schneider, M.D.
AA6O
Woodland Hills CA

Well, Edward, you've raised some points that perhaps should be discussed. I am often asked why I don't start a second national amateur radio organization and some answers are called for.

The question can be approached better by dividing it into parts. First, why I haven't started one in the past. Second, why I don't start one now. Some of the past history has been covered in a recent editorial. Beyond that, without going into the depressing details, I can honestly say that there has been no time when I had either the money or the time needed to get something going.

That brings us up to the present. Why not get an organization started now to do all of the things which the ARRL should be doing but isn't? My feeling is this . . . since the whole future of amateur radio rests upon what frequencies we end up with after WARC this fall, and since little can be done to influence that event at this late hour, perhaps it's best to wait and see what we have left, if anything, to work on.

The organization which I have in mind would be constructed quite differently from the League. It would be based primarily on a local foundation, with very little power in the national organization. We might call it the Institute of Amateur Radio, but perhaps better would be an International Amateur Rabio Lobby (IARL). This would be more in keeping with the goals of the organization. I've belonged to several national organizations which were set up in this way and which function much better than the ARRL as a result.

I see the thrust of the IARL as being on three fronts, all of a lobbying nature. Firstly, there would be a lobby in Washington which would make the FCC aware of the rule changes which amateurs desire. This lobby would push to get these rules accepted, using pressures on the FCC and Congress for this end. I still have the concept of a yearly or semi-yearly conference of the IARL chapters where rule changes would be proposed, discussed, and voted on. This would be almost identical to the system used by the ITU.

Secondly, I see a need for a lobby on a national level. This would be on the order of "Hobby Lobby," for those of you with longer memories. This "lobby" would organize material on amateur radio for newspapers, magazines, television, radio, etc. The main purpose of this effort would be to make amateur radio known and appreciated by the whole country. It would also help interest more people in amateur radio, which wouldn't hurt.

Perhaps even more important in the long run would be international lobbying for amateur radio. This effort would introduce amateur radio into smaller countries and build up a world appreciation for the value of amateur radio. This could reflect to our advantage at future ITU meetings. An international lobby would work with the national ham groups in foreign countries to improve amateur frequency allocations in the future.

Being realistic about the cost of the three lobbying efforts, including the estimated costs of offices, experienced people, travel, telephone, newsletters, etc., we're looking at a minimum cost of $750,000 per year. That comes to about $2 per licensed U.S. ham, which certainly seems reasonable. But by the time you take into consideration the 50% of the hams who are resistant to paying for such a service plus the costs of collecting the needed funds, issuing membership cards, keeping records, sending invoices, statements, etc., you're looking at more like $10 per amateur. It's a formidable administrative job.

Most of us have come to equate the service of a national organization with observable benefits such as contests and certificates. I suspect that the IARL would have to run a full set of contests just to establish visibility. While I personally am a contest fan, you may have noticed that I've kept 73 pretty much out of the contest business, feeling that we have enough contests already. Would the IARL have to run VHF contests, a national contest, an international contest, and perhaps a satellite contest?

Let's see, what else does the ARRL do besides run contests and publish? I think that about covers it. If the ARRL runs contests, lobbies on three levels, and publishes, it should be a viable organization.

There are some serious questions that need answering. For instance, do you prefer a membership which is tied inflexibly to a subscription to the magazine? Keeping separate records is a lot more expensive than doing both together, so a combination IARL membership and subscription to 73 would be cheaper. On the other hand, there might be some amateurs who would prefer not to support an organization devoted to promoting amateur radio and yet would want to read the magazine. Let me know what you think of that.

Another question is one of officers. Would you prefer to have a national election which would select the president of the Lobby, or would you like to go with the ARRL system where the directors select the president and manager? The ARRL system is quite parallel to that in the Soviet Union where the Politburo elects the president and party chairman.

It is tempting to set up a new organization with controls which would make it either difficult or impossible for someone to lose control. This was the system that Hiram Percy Maxim used when he set up the ARRL. The problem with that system was that it resulted in a good deal of infighting and politics within the League as people struggled for control . . . a control that was almost impossible to upset. I'd prefer to avoid this pitfall. What's your thought on this?

For that matter, are there any clubs which feel that the idea of setting up lobbies on three levels is good enough for them to align with? They would thus become a local chapter of the IARL, should such an organization be desirable.

I admit that I should have come up with this plan years ago and should have organized my business and personal life so as to implement it . . . but I didn't. So, if it turns out not to be too late for such an idea, are you with it or against it? And how about that $10? That's consistent with what other national organizations charge, by the way.

Please advise.—Wayne.

NO WINNERS?

After having read your editorial in the December issue, "Never Say Die" seemed to me to be an inappropriate title. Your comments on WARC read as if Wayne Green as well as the ARRL have given up on amateur radio. Statements like "Having been an avid ham for some 40 years, I'll sure hate to lose it. It's been a big part of my life . . ." tend to put "gloom and doom" in capital letters. So if you insist on using "Never Say Die," at least make it mean something—especially now. Make those 40 years of experience count. You're in a position to do so.

Since, like yourself, no one has asked for my opinion, I too feel free to comment. Just as an amateur station is more than a collection of radio gear, so ham radio itself is more than just a hobby. How much more is a matter of record and, in spite of what we as individuals feel concerning the League, it maintains a large file on ham radio as a public service. Hams may not be unknown to the general public, but they're not a household word, either. If ham radio is on the way out, the American public deserves to know what it's losing. That in-

cludes RACES, MARS, and *73 Magazine*. Now is as good a time as any to take an objective look at the whole amateur scene. We can't do it—we're too prejudiced. Someone has to pull ham radio out from under its rock and put it in the spotlight for a few minutes. If the amateur service goes, then commercial and military frequencies may not be sacrosanct either, and Americans may need more than the Citizens Radio Service can offer sometime in the near future.

The WARC '79 conference has been getting about as much national publicity as my last birthday. Ditto amateur radio. The time has come to reach into the dustbin of public service and use it for all it's worth. I propose a network television documentary on the whole shootin' match, written on a level of quality approaching that of *National Geographic*, fully researched, and with films and interviews of those who have been involved on both ends. Let's cover ham radio right from the beginning. If it's on its way down, it might as well go down swinging.

A project of this magnitude takes time, a lot of research, a lot of leg work, a lot of convincing, a lot of good old-fashioned salesmanship, and a lot of bucks. Most of us don't qualify in any of the above areas. Maybe Wayne Green does. Does 40 years of experience agree with my proposal or not?

Nobody has to convince a ham on the value of his hobby—convince the ones who have never heard of it. Amateur radio needs, and perhaps even deserves, national support. But if voter turnout is any indication of American apathy, then we need a lot more than a few local newpaper articles once in a while. All of us seem to require a constant reminder of our past, our present, and our future. My proposal is just a shot in the arm.

If amateur radio is no solution to third-world problems, then neither is its demise. If the African nations get the frequencies they want, can they use them as efficiently as others could? Will it take years for them to implement systems which we already have? I suspect that this latest conference in Geneva may well come out with no winners.

Lee Hughes WA2VPH
Moravia NY

SUCH IS LIFE

Having decided to try my hand at color film and print processing, and seeking a means of working a "good" timer into the budget, I dug out the July '76 issue of *73* with the W1HCI story, "Dependable Timer—for darkroom, repeater, etc." In the same issue is Al Plavcan's schematic for the low priced frequency counter, and this, of course, invited grafting parts of his schematic to that of the timer to give not only a programmable timer but also a straight 0-99 second timer for monitoring the time in the various solutions with digital readout.

I am busily hunting sources, prices, etc., for the few chips needed and expect to wind up with a precise unit at a cost far below that asked for a "normal" darkroom timer.

This prompts me to suggest that you cast about among your many contacts to see if you could stir up a circuit for a home-brew color analyst circuit. The prices asked for such as these are beyond the affordable range of the casual photo nut, and I just bet that a reliable circuit could be put together by a brother ham!

What is needed most sorely is a means of determining the subtractive filtration needed to accommodate the color negative, taking into account the particular characteristics of the print paper. This latter information is printed on each package of paper, at least by Eastman, and surely by all of the others.

I sincerely appreciate the inclusion of "other than radio" items; this is what makes *73* my favorite source.

All of my issues are carefully maintained, readily accessible, and I need not tell *you* how valuable they are as a constant source of reference.

My ham subscriptions are now limited to just two. I finally dropped the old traditional one, for two reasons: 1. Greater mileage obtained from the other two in the amount of usable material. 2. I grew to resent the rather lofty attitude assumed on the few occasions wherein I wrote to ask for clarification of a few technical points.

Apparently I had "sinned" some years earlier when I took occasion to express my thoughts about the seeming lack of proper support for the efforts of Ted Cohen and his "TV/Hi-Fi Task Force." I felt that if there was any specific area wherein the League should show real leadership in the way of aggressive action, this was it. Ted went about the problem extremely realistically and scientifically and laid the foundation for easing one of the most urgent problems of these times, the matter of improperly designed and constructed solid-state entertainment equipment which invited interference from the cleanest of transmitters.

I waited to indulge in color TV until I could find a set which would be both deaf and blind to my Swan 500. A local dealer was kind enough to let me test a few major brands at my home with my transceiver running normal input on 80 through 10 meters on CW, phone, and slow scan. Each TV was 100% solid state. I found that of them all, at that time, three years ago, only the Sony stood up to the test, even though the TV was separated from the transceiver by only 12 feet and was only about five feet from the base of the 4BTV antenna. On the basis of these tests, I bought the Sony color TV, and the Hi-Fi AM/FM stereo 8-track. To this date there has never been the slightest trace of pickup from my ham rig on either of the units in any of their functions.

I sorely wish my neighbors all owned Sony. I get into one of the highest advertised brands even when they have the power plug pulled from the receptacle! Naturally, they cannot be convinced that the fault lies in their own apparatus. Such is life.

Lee Clough W5GQV
Waco TX

SAM HARRIS

No, Sam Harris wasn't born with a beard. He grew it in 1944 when he was employed by Brush Development Co. (sometimes called Brush Bedevilment Co.) on Perkins Avenue in Cleveland, Ohio.

My former wife, Mary, who worked in the same department on the third floor, told me that he trimmed it with tin snips. At the time, I worked on the first floor.

I understand that Sam's real name was East, and that he acquired the name Harris from the family who raised him. From his call letters, he was probably first licensed in 1939.

About the end of WWII, Sam bought a duplex house at 1311-1313 Lakeland Avenue in Lakewood, Ohio. Mary (W8SBB 1938-58, K4UBT 1958-66) and I visited Sam at his home in the 1311 side about Thanksgiving, 1946. Sam was deeply involved with two meters at the time, using mostly military surplus SCR 522 equipment. Also, Helen had bought him a National NC 2-40-C, a low-band receiver he used mostly as an i-f with the SCR 522 receivers as front ends.

Sam's shack was a finished attic room I had used as a playroom as a small boy twenty years before. I had moved from that house when I was 7½ years of age. A playmate of that time, Buss Rhoades, who lived in the 1313 side, also later became a ham, if my information is correct.

In the later forties, I lost contact with Sam except for chance meetings at hamfests. By that time, he had moved to Burton, Ohio, and became well known on seventy-five.

It appears that I lost contact with Sam about the time that Wayne became well acquainted with him.

James B. Bamberg K4UBF
Charlotte NC

THE TAY NET

I would like to inform you of a new net made up specifically of operators 19 years old and younger. It's called the TAY Net, which stands for Teen and Younger Net.

The net control is myself, KA0AQZ. The net meets on 28.635 at 2300 UTC every Tuesday. An informal bit of ragchewing usually can be had a half hour before the net on the same frequency.

My age, by the way, is 13 years, and my QTH is Independence MO.

Please, no OM check-ins, unless you have something of interest to our age group. All hams and children of hams are invited to join in the conversation, provided you are 19 or less or have something of interest to that age group.

I would very much appreciate it if you would print this info to increase the activity. *Thank you.*

Brin Moffet KA0AQZ
Independence MO

KISS

The dc-to-dc converter described in "Try a Little KISS," January, 1979, is not as reliable as described. The converter shown in Fig. 1, page 59, would put 12 volts at terminals C-D if any of several components fail:
1. If the zener fails open, it will let R1 saturate Q1 and the output voltage at C-D will be about 12 volts.
2. If R1 shorts, the zener will probably blow before a 10- or 15-Ampere car fuse. Again, 12 volts will appear at C-D.
3. A collector-to-emitter short on Q1 directly applies 12 volts to C-D.

Possible explanations for the reporter test results ("... the output voltage will rise a few tenths of a volt ...") are: a) Terminals A-B were connected to the 12-volt source with very small wire which provided current limiting; or b) the 12-volt source was soft and did not provide a constant 12 volts

Input. Was the input voltage at A-B monitored during the tests?

An electronic "crowbar," i.e., an SCR across C-D, could be added to the circuit to short-circuit C-D in the event the voltage at C-D exceeds the desired output. To prevent damage to the converter, a properly-sized fuse should be inserted in series between A and the transistor, or between the emitter of Q1 and the crowbar. Such a crowbar could be used with a simple zener-resistor regulator.

No circuit is completely component-failproof! Use high-quality conservatively-rated components in any critical application.

J. T. Hancock WB8DRF
Jackson MI

VHF ENGINEERING

I would like everyone to be aware of the fine service one of your advertisers, VHF Engineering, is providing.

I have an old HT 144-B which died. After a prolonged attempt to fix it myself (with expert help), I gave up and sent it to VHF Engineering. They returned it in roughly 2 weeks, several days *before* Christmas. They didn't just fix the unit, however. They gave me a replacement piece of hardware which I had lost, and they also replaced all of the point-to-point wiring (the HT 144-B was a kit), making it look much more professional. All of this was done for the fixed nominal labor fee alone. The parts were supplied free.

I think that this kind of exceptional service should not go unnoticed.

David Rabin WB9PSD
Wilmette IL

NOW HEAR THIS!

As one of many, I have fallen for the attraction of CW machinery. My particular unit is a PET with the excellent attachment Microtronics makes.

While I work many stations on CW, I of course prefer to work other "CW machines" when using this unit, as the copy is then 100% just like the printed page. Hand-sent CW is, as a rule, 85-95% readable if the sender is using an electronic bug and down to 15-25% readable if the sender is hand-pumping with considerable swing. A typical bug error would be "6E" instead of "the" on the screen caused by improper spacing between the "t" and the "h". If it happens once, you can plan on "6Es" all through the QSO because this is that particular operator's habit! In any case, I strongly recommend systems like this; it is really fun and in my case has totally rekindled CW interest.

The reason I am writing is to suggest that a particular frequency be used as a worldwide and preferably bandwide CW-machine calling frequency. If we could settle for some kind of reasonable standard, perhaps we could more easily get together. If speed is kept to a reasonable digit, non-machine-users could hear what we are saying. Thus I suggest the following frequency: XX.069 (for XX, insert 14, 3.5 or whatever). For initial speed, I suggest 20 wpm. This would provide studious code-learners with a readily available standard code speed to practice on, and it's slow enough that it is copied easily enough by ear. .069 is an easy number to remember, for various reasons, and doesn't appear to be any net frequency or the like. Please advise if you know differently.

Now hear this, all you machinists out there: The frequency is XX.069 and the speed is twenty. CU on ur favorite band!

Ken C. Barroll W7OP
Seattle WA

A BELIEVER

I just got home from school and found my copy of *73* had arrived today. As usual, an excellent magazine! I was reading your editorial and have a few comments on the part on page 190, "What about the code?" At first, when I saw your constant advertising for your code tapes throughout your editorial, I thought that was a little uncalled for. But then I began to think. On Monday of this week (Jan. 8), I went and passed my General after upgrading from Technician. Over the summer, I purchased an ARRL code kit with two tapes and all that. I also had one of your 13 wpm tapes. I listened to the ARRL tape, then yours. I thought that I would use the ARRL tape since it was easier to copy. Every once in a while I'd put your tape in the recorder just to try it, but I always gave up. I went to the exam, then it hit me like a hammer: Your tapes are the ones to use. They are sent at the FCC standard and the ARRL tapes are spaced at about 10 wpm. Luckily, I passed, but it would have been a hell of a lot easier if I had stuck with your tapes! It may just be me, but I think the percentage of failures would be about half of what they are now if tapes offered for practice were like yours! I'm a believer! I am a student in high school (10th grade) and have little time to mess with studying for ham exams with school exams to worry about. I think that I could have upgraded with less practice and worry with your tapes.

Keith Arnold N8AOR
Columbus OH

CONGRATS

I made it through my Extra the second time I took it. I feel I can honestly say that your study guide for this class license was a major factor for my success. Even if one is not interested in getting the Extra, the book makes an excellent reference source. I've always been a poor student, but this book was fun and the learning process painless! I find that now I understand the material as opposed to merely knowing facts and information.

Congratulations on a masterpiece! There were places where I felt you were prolix and/or pedantic, but, on the whole, this book should be hailed as a classic of the study guide genre.

Thank you for helping me achieve my license.

Bob Wanderer WB2MCB
Pompton Lakes NJ

PEANUT BUTTER

Just a note to compliment you on your fine magazines, *73* and *Kilobaud*. I know they must be good because the first postal employee who handies them must tear open the wrappers and all the others down the line must read them during lunch or coffee breaks. So far I have not found peanut butter between the pages, but the way the pages look, I would not be surprised. Too bad you cannot entice these people into their own personal subscriptions! I am sure the problem is not unique to me, and if others save the issues as I do, we appreciate good copies for the bookshelf.

One last note on *Kilobaud*. For years I have been throwing away those super 1st time subscription offers only to finally knuckle under last month to a trial copy. What a super computer magazine! If I could afford it, I would purchase all your back issues of *Kilobaud*.

Keep it up—you've got the only magazines on the market with so much content it takes a month to read.

Roger Syvertsen KØVOD
Brainerd MN

COMM SPEC

I am writing to let you know that one of the advertisers in *73 Magazine*, namely Communications Specialists, is a fantastic firm to do business with.

When I had a problem with an ME-3, I shipped it back to them on a Monday. The following Monday, a repaired unit was waiting for me when I arrived home. Two months later, a different problem arose; again it was shipped back to them with a letter explaining what was wrong. One week later, a brand new ME-3 arrived with a notation that it was replaced under the warrantee. There was *no* hassle or lengthy correspondence.

Organizations such as theirs and *73 Magazine*, who is particular about the advertising that is accepted, deserve all of the praise that can be given to them. Communications Specialists and *73 Magazine* rate very highly on my list. I have been a subscriber of *73* since you published your fourth issue.

Julius Countess K2VYD
Smithtown NY

Ham Help

I need a service manual or schematic for a Polarad model KS-5799-L2 video monitor.

A. Kaiser
713 Marlowe Road
Cherry Hill NJ 08003

I have heard much about the R-391 receiver by Collins. I am not a ham but an SW DXer moving up. I am looking for performance specs, capability, schematic, etc. I would like to know where they are available. I haven't seen it advertised at all. In Germany they're hard to find!

Tsgt. Charles Bott
PSC Box 56
APO NY 09123

Lew Fitch W4VRV
109 Robin St.
Clemson SC 29631

Help for the Hearing-Impaired

—don't miss another phone call

See the light?

Note: Telephone company regulations vary regarding attachment of external devices to telephone lines. You should check with your local telephone company offices before using the equipment described in this article.—Ed.

A hearing-impaired member of my family couldn't hear the telephone in some rooms of the house. Sometimes, when I called home, the phone wasn't answered even though I knew that someone was in the house. The major problem turned out to be that the bell was not clearly audible in the room that was used extensively for reading and sometimes for TV. A solution that was acceptable to all was to flash a light when the phone rang. In this case we chose to turn off the circuit that the reading light, hi-fi, and TV were on. It also incidentally turns off the vacuum cleaner in that room, and nobody could hear the phone when that was running. The circuit for the device is shown in Fig. 1.

This device was constructed in one evening out of spare parts as follows: an old power transformer was selected for T, and the high-voltage winding is used for the phone line side. Since the ring frequency is around 25 Hz on most systems, this winding should be rated at a minimum of 200 V ac. The 115-volt winding is then used as the secondary of the transformer. (An audio plate-to-grid transformer could be used the same way if you're old enough to have one of those in the junk box.) An audio generator was then hooked to the high-voltage winding through the capacitor C, and several values were tried to get a maximum 25-Hz voltage across the secondary. In my case, 1.3 uF did the trick, but this value will be different for every transformer.

Relay A is a sensitive dc reed relay that was removed from a computer board. A 12-volt 5k-Ohm relay should work well, but the higher the resistance of the coil, the less load it will put on the ring voltage. Resistor R also serves to raise this impedance, and also helps filter the dc produced by the diode. I would suggest starting with about 2.7k Ohms for R. I used an oscilloscope across a 100-Ohm resistor to measure the current drawn from the line at 25 Hz, and the ratio of voltage to current for my version of the circuit came to 10,000 Ohms. That should be light enough loading not to upset the telephone company. The capacitor keeps you from drawing any dc current.

The contacts on the sensitive relay, A, should not be used to interrupt much current, so it is shown switching a 115 V ac power relay that actually handles the heavy current. I installed the circuit in a box adjacent to the circuit breaker box, and ran two small-gauge wires to the nearest telephone line junction. Now when the phone rings, most of the circuits in the living room go off with each ring and it is not possible for anyone in the room to be unaware of the ringing. The freedom of movement granted to a deaf person expecting a call is well worth the minor inconvenience of occasionally having the lights flash for a few seconds.■

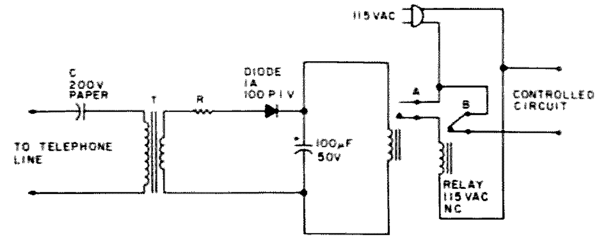

Fig. 1. See text for procedure for finding C, T, R, and A.

Try a Bi-Loop Antenna

—gets you coming and going

Two loops are better than one.

W. W. Davey W7CJB
Rt. 1, Box 121
Charlo MT 59824

This antenna design has performed as well as a 3-element beam on 144 MHz and better than a 2-element full-size yagi on 14 MHz. The idea for this design came from the antenna described by ZF1MA in the December, 1976, issue of *73*. The bi-loop configuration needs to be more or less exact to get the best performance.

Having used single loops in the past and noted their ability to reduce man-made noise, I decided to try for more gain—and still keep the closed loop design. My first experiment was on 144 MHz. It took me a whole ten minutes to nail some 3/4" x 3/4" sticks together and tack a test antenna in place. The antenna was compared with a 3-element yagi on the Lookout Pass repeater, 80 miles distant. The Clegg FM-28 S-meter readings were slightly higher with the bi-loop. Results were repeatable, so it was decided to try the 14-MHz configuration between a couple of poles. In nearly all cases, there was an improvement in signal strength of 1 to 2 S-units over my full-size 2-element yagi. With some signals coming from high angles, there was no difference in signal strength. With low-angle DX signals, though, there was a definite improvement over the yagi. The polarization was vertical.

The normal impedance of a single loop is slightly over 100 Ohms, so when two such loops are fed in parallel, the impedance comes close to a good match for 70- or 52-Ohm cable. This impedance will vary slightly with the height above ground.

As mentioned above, the loops need to be adjusted to an almost-perfect square for best performance. When the extreme ends of the loops were stretched out in a diamond shape to raise the bottom of the loop higher above ground, the low-angle gain fell off in comparison with the yagi.

The lower corner of each loop is only 6 feet off the ground and is kept in place through the use of a one-pound weight which just touches the ground when the loop is taut. Raising the entire array should further improve its performance.

This antenna is simple to build and performs well in two directions. There are deep nulls in the plane of the loops. The maximum radiation is broadside to the wire. Each loop is made up of 73 feet of #14 enameled wire, which makes each side of the loop 18'3". Use lightweight ceramic or plastic insulators and depend on nylon rope for additional insulation. The insulator which terminates the coaxial feedline is shown in detail in Fig. 1.■

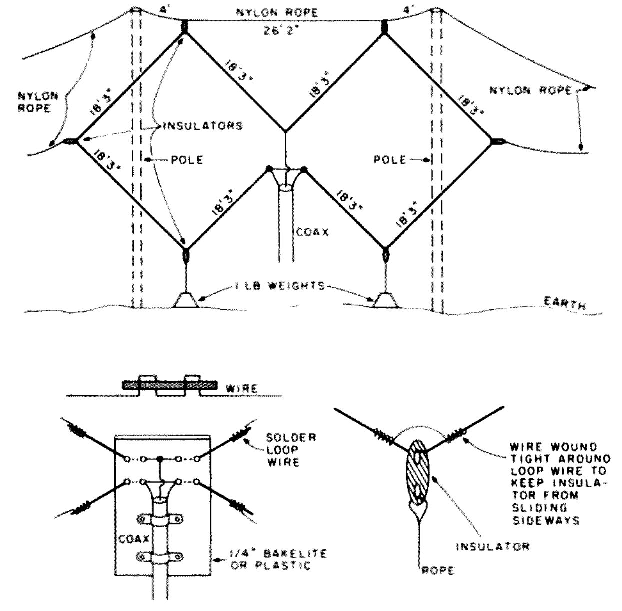

Fig. 1.

14.00 MHz	1.2:1
14.05 MHz	1.1:1
14.10 MHz	1.0:1
14.15 MHz	1.1:1
14.20 MHz	1.1:1
14.25 MHz	1.2:1
14.30 MHz	1.25:1
14.35 MHz	1.3:1

Table 1. Swr readings for the bi-loop antenna. Readings on 7 MHz and 21 MHz were high (at least 7:1), but from 28.0 MHz to 29.0 MHz, the swr was almost constant at 1.8:1.

Simple RTTY IDer

—uses five ICs

Automatic operation at the press of a switch.

Paul J. Tew G3MEJ
1-B Morton Road
Morden, Surrey
England SM4 6EF

To provide identification on RTTY without the use of keys or mics, this circuit was used for automatic operation at the press of a switch. It provides a matrix of 80 bits. With a Morse dot = 1 bit, dash = 3, letter space = 3, and word space = 5, it allows for DE and most 5 letter calls, i.e., DE G3MEJ. The DE could be omitted to give sufficient space for longer calls or, alternatively, other ICs could be used to give a matrix of, say, 128, 160, or 256 bits.

A momentary push of the ID button sets the flip-flop and enables the counters, IC1 and IC2. The BCD output of the first counter, IC1, is decoded by the 7442 and the message is selected, via the diodes, by the 74151 and output on IC4, pin 6. Complementary output is available on pin 5. At the end of the count sequence, IC2, pin 11 goes high and resets the f-f ready for the next push.

The clock, IC5A, while perfectly satisfactory, needs careful setting up. A socket for IC5 is recommended. Select a value for R1 (say 1k-4k) while tweaking RV1 to obtain oscillation at pin 6. Then adjust the value of the 100-uF capacitor to give the frequency required. RV1 allows only for a stable start and operation of the clock and is not intended as a frequency adjustment. If the output level at pin 6 is too low, change the IC! Even those of the same make and batch give different results—hence the socket. An alternative clock using a 555 or 7413 might be preferable, but this all makes the PCB larger. Values shown gave a frequency of 10 Hz and a Morse dot length of 100 ms. This is long enough to stop a mechanical printer doing its nut at 45 baud. Note that the reading of CW via two tones may need brain adjustment if you are used to single tone CW. Allow for this before assuming the circuit is not functioning correctly.

Read the matrix as a page, starting at the top left-hand corner and ending at the lower right-hand corner. The diodes can be anything in the junk box, preferably germanium, but silicon also work (1N914, etc.). Note on the matrix that there is a space at both ends of the "message," so that whichever tone is being keyed, there is a break before or after the ID. Otherwise, the first/last ID bit would merely blend into the steady tone state. A PROM could have been used instead of the diode matrix, but they cost real money against peanuts for the diodes.

A convenient PC board size, without getting cramped, is 3 x 4 inches. The output transistor, VT1, should be suitably rated for your own keying arrangements.■

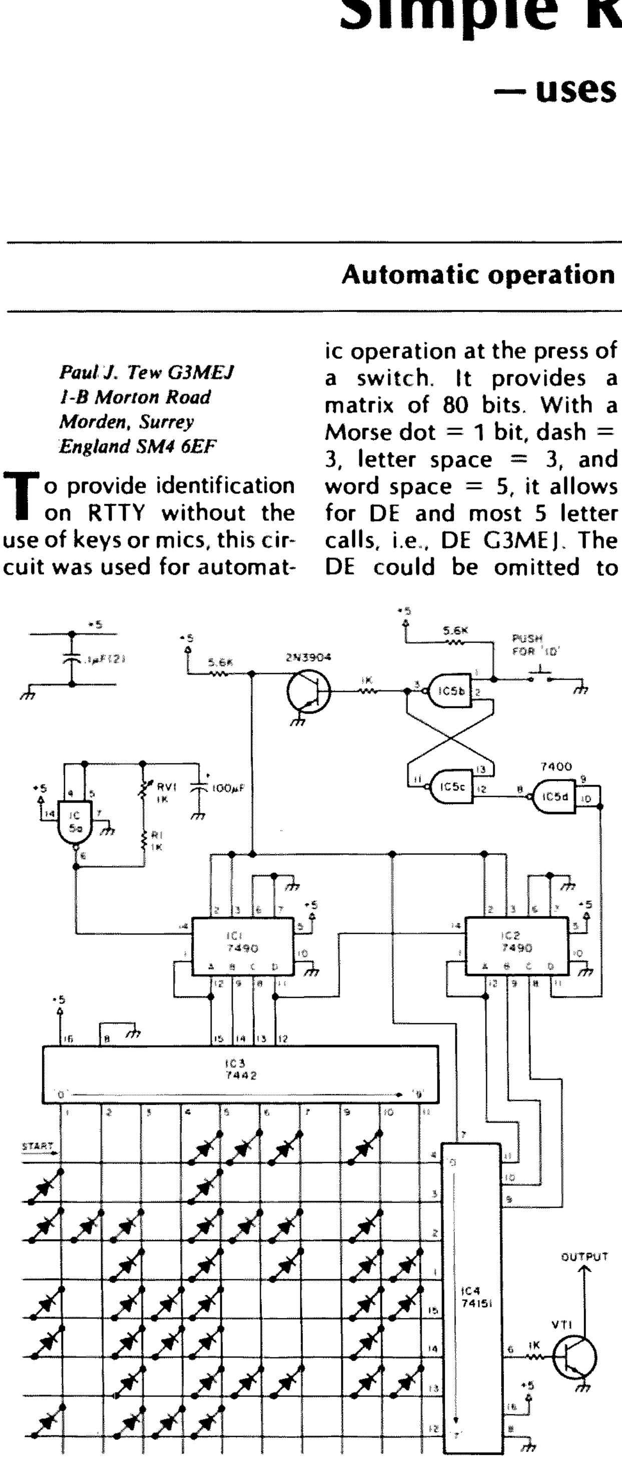

Fig. 1. CW IDer.

Tales of Speech Processing

—including a practical design

Tolerating the screamers and whisperers.

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Riverview FL 33569

Conversation overheard on 20 meter band, SSB:

"Old man, I'd like you to give me a report—I want to switch in my processor and see what it sounds like. . ."

"OK, switch it on. You're about 5 and 9 now."

"★'#"&'#★'&2&?"

". . . Ah. . . Yeah. . . Ah. . . Sounds pretty good. . . Really brought my S-meter up. But I think I missed the question . . . Try me again."

Anyone who works even a little SSB regularly has heard that conversation, usually many times. At the same time, we are all familiar with the low duty cycle characteristics of human speech. This attribute of speech has led to many schemes, some wilder than others, but all aiming to improve information transfer by speech. And listening on the bands tells one that some of the more elaborate designs can sound as awful as some of the more rinky-dink ones.

A short history of speech processing is probably in order. The basic character of speech has been known since at least the advent of the oscilloscope; and in the old AM days, several transmitters (Heath/Johnson/others) incorporated speech clipping followed by a suitable filter. The reason for the filter was obvious: when the top is lopped off a signal, harmonics are generated, increasing the modulation bandwidth and causing a fuzzy sound in the recovered audio. Some of these clipper/filters were very simple and straightforward and some of them sounded very good, with a tremendous improvement in intelligibility; some of them sounded awful.

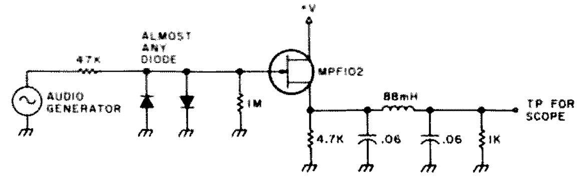

Fig. 1. Demonstration clipper/filter.

Then SSB came along, and at first it sounded awful enough to the AMers without complicating the whole thing with speech clipping/processing. In fact, in the great SSB vs. DSB controversy of the 1950s, reported in the proceedings of the IRE and other journals, it was alleged that one of the problems of the then "new" SSB was that it didn't lend itself to simple speech processing. This attitude persisted for many years, even though some unreconstructed mavericks were using speech clippers of one kind or another on SSB, and they could see a difference on the plate current meter. Some of them neglected to mention to their contacts that they were using clippers. Possibly there were some guilt feelings, especially after hearing conversations such as the one above.

A hairy mathematical proof made the rounds and found its way into the *Handbook* (ARRL). It demonstrated to everyone who had been through first year trig that clipping at audio for SSB was wrongheaded and possibly dangerous. It had terms like $Sin^{n}X$, where n was between zero and one. Oh, it was wonderful! Mathematicians rejoiced at the elegance of it.

There appeared to be one unwarranted assumption, however, and that was that the operator would attempt to modulate an SSB transmitter with these (nearly) square-topped waveforms. And as the argument proved, you can't reproduce square waves directly using

SSB. Neglected was the fact that most operators would have used a filter after the clipper which would have rounded the sharp square edges by removing the harmonic energy.

Most of us are aware of the fact that a square wave is composed of a fundamental frequency and a whole drove (infinite number) of harmonics. Some have waded through the Fourier series analysis, and some can see it intuitively. But if you have never seen it on a scope—even if you have been through Fourier analysis frontward and rearward—you should hook up a simple clipper, followed by a sharp filter that cuts off just above the frequency you are clipping. See Fig. 1 for a sample hookup.

Try this circuit; it is very dramatic. It also serves to illustrate one of the problems with audio speech clipping. The clipped waveform is cleaned up, that is, restored to a single frequency, only if the filter cutoff is relatively close to the frequency being clipped. For instance, if you clip a 200 Hz sine wave, and pass it through a 2 kHz filter, the nice sine wave does not come back. What you get is a mess; now the waveform is still sharp-edged but is usually tilted as well, due to the phase shifts through the filter.

And since the filter for an audio speech system cannot cut off before about 2000 Hz, there is an irreducible problem. Do not despair, however, there is a compromise solution which is well worthwhile. It is possible to have an audio clipper which does not sound bad.

Why do so many sound bad? One reason is obvious. The operator can't stop turning the level knob soon enough—depending on other stations to set clipping levels is haphazard at best.

Some indication can be obtained, however. You know you have gone too far when signals are 10 over 9, you are hearing no QRN/QRM and the other operator keeps asking you to repeat what you said. Many clippers, especially home brew ones, suffer from rf pickup. Rf pickup can destroy an otherwise good clipper. In addition to these problems, the low frequency phase shift/tilt problem is often heard. And finally, some operators using transmitters with sweep tube finals have discovered the tubes were not able to stand the increased duty cycle.

In spite of these caveats, clippers, as well as other forms of speech processing, are becoming more common now. The new all-transistor rigs are as comfortable with 100% duty cycle as they are with 30%, and the FCC has started to meddle with linear amplifiers.

And—are you ready?—The *Handbook* (ARRL) has a graph on page 392 (Figs. 13-20) in the 1977 edition showing 15 dB of audio clipping improves the signal-to-noise ratio by nearly 4 dB. Now you wouldn't build a linear amplifier for a four dB gain, unless you were a CBer, or instructed to by the FCC, but with an audio clipper you can get 4 dB for peanuts. Four dB, just lying around waiting for you to pick it up, like loose change, like found money.

Another goody, but not quite as satisfying as found money, is the text in the 1977 *Handbook* (ARRL) on clipping, clippers, and related subjects. A rather elaborate processor is detailed. It is good to read about, even if you don't build it; in the 60s we called stuff like that mind-expanding.

But enough of that; let's build a clipper. It ought to be simple. It ought to be cheap so some money will be left to build something else. But it ought to sound good. The filter/clipper/filter in Fig. 2 satisfies these objectives.

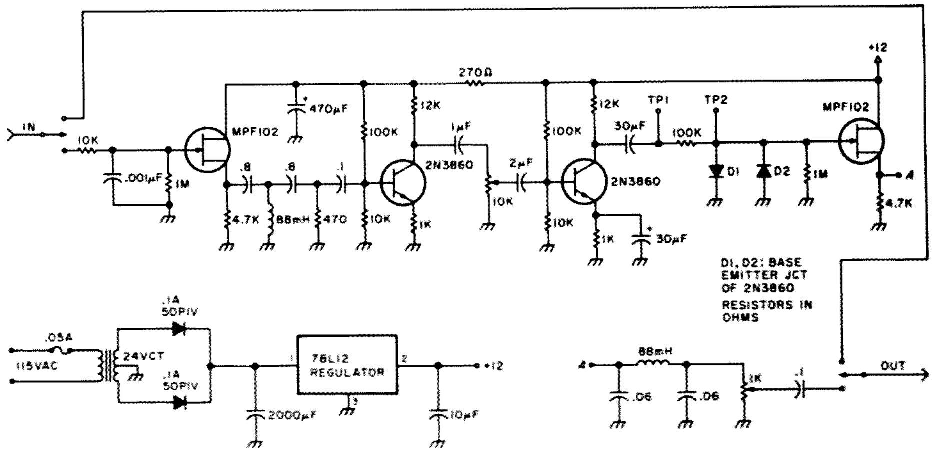

Fig. 2. Audio filter/clipper/filter.

Looking back to address the problems listed above:

1. Rf. The 10k resistor and the .001 capacitor form a low-pass filter which keeps out rf. The 10k resistor could be replaced with a 1 or 2 mH choke, but the 10k resistor is cheaper, and adequate.

2. Low-frequency square waves and tilt. This problem is addressed by using low-frequency rolloff. All frequencies below 500 Hz can be greatly attenuated or even eliminated. The first MPF 102 source-follower feeds a T-section high-pass filter which attenuates the low frequencies, before clipping.

3. Tweaky fingers, or Oops! My plates just melted. The prototype has no knobs on the outside. Knobs on the outside are OK, if you can restrain yourself. Otherwise, you are better off to set it and forget it. Use a scope.

Additional notes: TP1 and TP2 are used with a scope to initially set the clipper. You can set it for whatever clipping level you want, up to the power supply voltage limitations. Eight volts p-p at TP1 sounds good. D1 and D2 are silicon junctions, so the level at TP2 will always be about 1.2 volts p-p. However, it is interesting to look at this point anyway.

The second MPF 102 source-follower feeds the low-pass filter. Output level is set with the 1k pot. A DPDT switch is included for those people who feel insecure if they can't do a regular comparison with distant operators.

My filter is used maritime mobile, and I find it a lot easier to carry around than a linear amplifier. It is very handy when running phone patches for the crew; I can tolerate the screamers and the whisperers—without external knobs. It's not as effective as a 2 kW linear amplifier, but it's a lot easier to pack into my suitcase.■

Fig. 3. The location of slide switch.

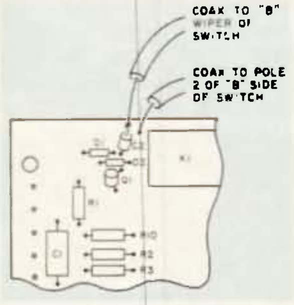

Fig. 4. Corner of top side of control board showing location of C2 and coax cable connections.

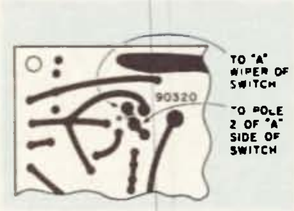

Fig. 5. Corner of foil side of control board showing location of foil trace requiring break and wiring for sec-

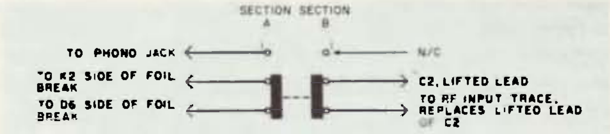

Fig. 6. The wiring of DPDT switch, placed in the T/R position.

source.

Speaking of the external voltage source to energize K2, where do we find it? If you are using the Argonaut, Model 509, the answer is easy—from the accessory jack on the back of the 509. Pin 2 of the accessory jack accesses a lit-

9.3 V dc, but I found that adequate to energize the relay, and it doesn't seem to strain the exciter. Users of the Argonaut, Model 505, the "PM" series CW transceivers, or other QRP rigs will have to do some more modifying. For the Argonaut, 505, and the "PM" series rigs, an additional reed relay was installed between the mike PTT and ground with the contacts between B+ and a phono jack added to the rear of the set.

As I wrote this up, I realized that there are many other ways to pro-

mod came from a junk box, so it was the cheapest way to go.

The main thing is to completely isolate the COR circuit when operating PTT. I had originally isolated K2 from the rest of the circuit, but the COR still takes ¼ Watt to operate. That's a 10% reduction in power at 2¼ Watts input from the exciter.

For the past year I haven't sounded like I didn't know what to say, nor have I received complaints about a maladjusted VOX. The circuit works great and when

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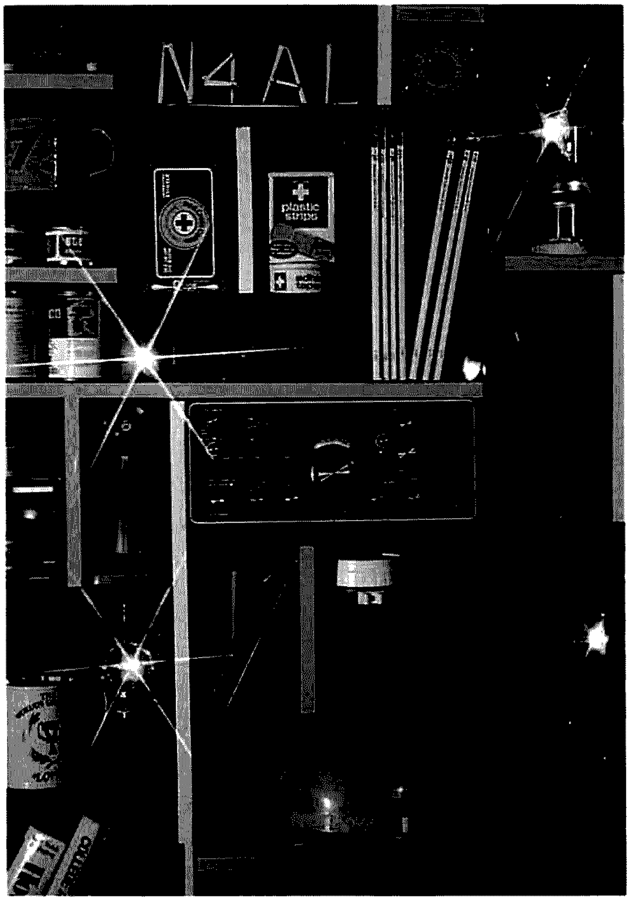
Disaster Preparedness

—it can happen here

Are you ready for a real emergency?

By the second day after the earthquake that devastated most of the cities in Guatemala, it was easy to know where the victims were buried: The smell of decomposing bodies guided the rescue workers. Removing the debris and taking out the corpses was a very painful and grueling job.

Back in Miami, after three days covering the disaster for the *Miami Herald*, I still had the stench deep in my nostrils. As I was looking at the prints coming out of the dryer, memory of the smell gave an added dimension to my thoughts. For a few seconds I believed I was still there, and in my ears I heard the voice of the little girl who sat in the dirt near the field hospital, crying, "Where is Mama? Where is Mama?"



When you are in this kind of situation, you are unable to believe that it could happen in your country, your city, your community . . .

But you are dead wrong, old man . . . This *can* happen to you and to your town, any time, any second. Are you prepared to cope with such a situation?

You are a ham radio operator, and your duty in disaster circumstances is to establish communications in the shortest period of time. That is what amateur radio is all about. We have a responsibility, and we must act accordingly.

Check Equipment

After you read this article, go into your shack and take inventory of your equipment. Then go to the main power switch (yes, the one in the rectangular gray box!) and turn the power off. Back in the shack, find out if you can call a fellow ham in Washington DC and tell him that there was an atomic explosion close to your town and the power plant evaporated with all the personnel inside.

I am not talking about war. An accident can happen. Not long ago, a Russian satellite, with an atomic plant in its guts, landed in northern Canada. Fortunately, the plant did not explode.

On a minor scale, electric power can be knocked out by a tornado, hurricane, earthquake—take your pick of many possibilities. The chance of an emergency is real, and you could be in the middle of it.

Emergency Power

After you find out that you can't establish communications without commercial power, it is time to find another remedy. A small portable electric generator could be the answer. Storage batteries are a cheaper solution and may be more reliable and safe. With a good 12 V dc power supply, you can operate the 2 meter rig to get in contact with local ham radio operators and get organized. With the same battery supply, you can go

airborne in the HF bands, if you are fortunate enough to own a solid-state rig. Long-distance communications are a must in an emergency.

There are a few all-solid-state little rigs for HF on the market, covering ten to eighty meters. Some, like the new Atlas 350-XL, go all the way to 160 meters, with listening capabilities in the WWV frequencies. Ten-Tec also makes a nice all-solid-state little rig, and jumping on the bandwagon are Drake, DenTron, and Alda. The Alda 103 is a three-band rig with battleship construction, capable of taking a lot of punishment.

Of all the rigs, I like Atlas best. Do not make the mistake of believing that the new 350-XL is a deluxe version of the popular 220-X. The 350-XL is a completely different transceiver, with many sophisticated improvements.

But let's stop talking about transceivers and get back to our hypothetical emergency situation with your lack of power.

A gas power plant costs money, and not everybody is ready to invest a lot of dough on something that will be standing by doing nothing but smell. I believe that one or two storage batteries, with 50 or more Ampere-hours, can provide power for a single sideband operation on two meters for the critical early hours after a disaster strikes.

Because storage batteries emit corrosive fumes, it is not wise to keep them indoors. Put them in a wooden box, vented on the sides, sitting on a stand, in the backyard, protected with plastic tiles. Perhaps you could use solar cells to keep them charged. I'll leave that part up to your imagination.

Mobile Equipment

Having mobile transceivers in the car for the HF and VHF bands is an ideal backup for the base station. Actually, the first news relayed to the world of the earthquake that leveled the city of Managua, Nicaragua, was sent by a ham radio operator from his mobile rig. (Enrique Gabuardi YN1EGL). After he and his family escaped from their crumbling home, he went airborne on 20 meters and contacted Adrian Espinosa YN1AEO/W4 in Miami. With tremors of fear in his voice, he told him of the disaster they were witnessing. Espinosa called Rafael Estevez WA4ZZG on the land line. Estevez was the president of SIRA (International Society of Ham Radio Operators).

Gabuardi's faint signal from Managua, from a mobile station, sparked the chain reaction that was translated into a gigantic rescue movement staged by the US Government, the Red Cross, and local and national ham radio organizations. Together with doctors, medicines, food, and clothes, two meter rigs and a group of volunteer Miami radio operators were flown to Managua to help the Nicaraguan hams in the establishment of emergency traffic.

A wounded man is helped by a friend. Thousands lost families, homes, and were injured.

An emergency situation could mean that you, yourself, are forced to leave your home and be relocated in a safe area. In a case like that, you should report

A little girl looks over the rubble which was her home. She does not know where her family may be.

This woman faces a grim future, with her home destroyed and her husband dead.

to the authorities that you are a licensed ham radio operator and can assist with communications. This could facilitate your transportation with your equipment and power source. This is one reason why I emphasize the importance of small solid-state rigs. (Another is that in flood conditions electrical equipment is dangerous, and low-voltage rigs like all-solid-state are safer.)

Disaster Training

Field Days are traditional among amateur radio operators. Every year, clubs and radio organizations all over the country get airborne and compete. But is this the real kind of training we need?

During the last ten years, I have been covering, as a newspaperman, revolutions and major disasters in the Caribbean and Central America. In my trips, I made contact with the local radio amateurs. These experiences taught me that while Field Day operations are a lot of fun, they are not remotely close to conditions one finds in a real situation. Technical skill to establish communications is not enough if you are not adequately prepared.

Preparedness and coordination within local ham clubs and Civil Defense organizations are very important. If you belong to a club which sponsors a repeater, be sure that the technicians in charge have that repeater backed up by storage batteries in case of power failure.

Hurricane and tornado warning notes are important. A well-organized system can save many lives. Mobile operation is a must and if you can work all the bands from your car, that will put you in a favorable position to help your fellow citizens. Another point: Don't risk your own life unnecessarily! You are more useful alive and in one piece.

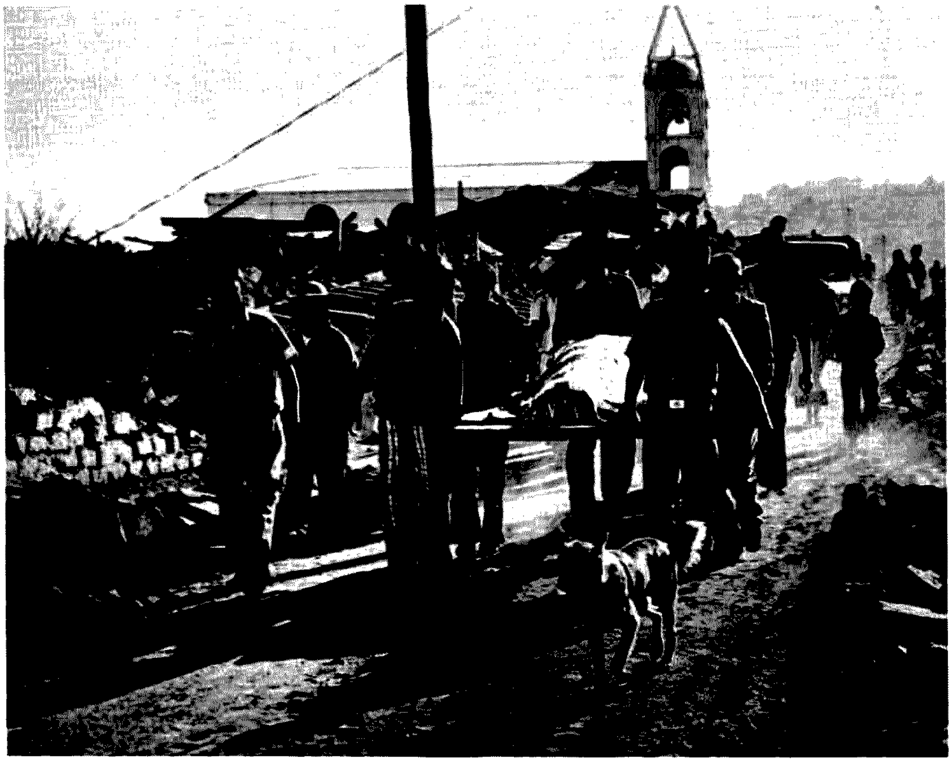
Be Ready Yourself

Finally, provide for your own basic needs. Water contamination and food shortages must be anticipated. Water purifying tablets like Halazone should be on hand. Nonperishable foods, cereal, canned beef, milk, and sugar should be stored at all times for yourself and your family.

First aid articles like cotton, bandages, aspirin, iodine, alcohol, and other standard items should be stored in a box for easy access and transportation. Good first aid kits can be purchased at any drug store.

Take your immunization shots regularly and keep your certificate on hand. This will give you clearance with the authorities to move around with freedom. It is a good idea to take courses in first aid and rescue operations with the local Red Cross. Try to stay in good physical shape. Remember that a good pair of legs can save your life when everything collapses around you.

Good luck, and 73! ■

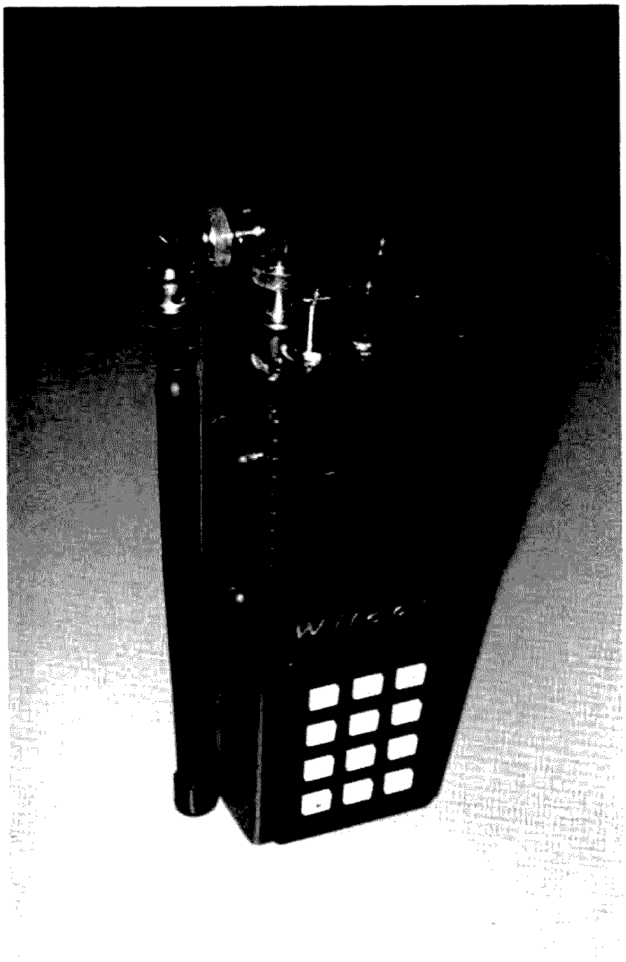


The dead can't wait to be buried. In San Pedro, Guatemala, where thousands were killed, there wasn't a single home spared from destruction.

Comfort Mods for the Mark II

—invert your duck

The latest in armpit safety.



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Marietta GA 30067

Recently I became the proud owner of one of Wilson's latest innovations, the Mark II. This new hand-held is quite compact, light, and easy to carry.

I have included a couple of features on my rig I feel make it more versatile and easy to handle.

First, I have added a belt clip to the back of the unit. The best clip I have found is by Motorola. It matches the color and texture of the plastic of the Wilson case exactly. The only way I have been able to get this clip is by ordering the complete back with clip for the HT220 from Motorola. It is part number NLN6675A and costs $9.63. (It has the big Motorola "M" on it, but just look at it as a "W" upside down.)

Installation is easy—just drill two small holes near the top of the battery cover and attach the clip with two screws.

Second, I made an addition at the antenna. When carrying hand-held rigs that are restricted to rubber ducky antennas on your belt, the ducky tends to get stuck under your armpit. To avoid this uncomfortable experience, I added two 90° BNC connectors. This allows the rubber ducky to be swiveled down alongside the rig out of the way. Granted, this is not the most ideal position for such a high gain antenna for DX work, but it's good around a hamfest to monitor for your buddies to call and even to transmit short distances or listen to nearby repeaters. When you need to work DX, just swivel the antenna into the up position.

I took my modified Mark II to the Atlanta hamfest and was stopped several times by people inquiring about the antenna arrangement. When I returned to the hamfest the next day, I noticed half a dozen people with "bent" rubber duckies on their Wilsons. ■

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An 8080 Repeater Control System

—part III: software

The finishing touches.

A development system is necessary to write and debug a program of the size and complexity of that of the repeater control. There are commercial development systems available, and hams lucky enough to have access to these systems have the opportunity to modify the program presented here with ease. Medium-to-large-size hobby computers are also equal to the task. I used my personal homemade computer for development. It has 60K of read/write memory, a high level operating system including a text editor and assembler, printer, debugging tools, and the capability to program 2708s. The processor itself is an 8080, so I was able to actually execute the repeater program on it before burning it into ROM.

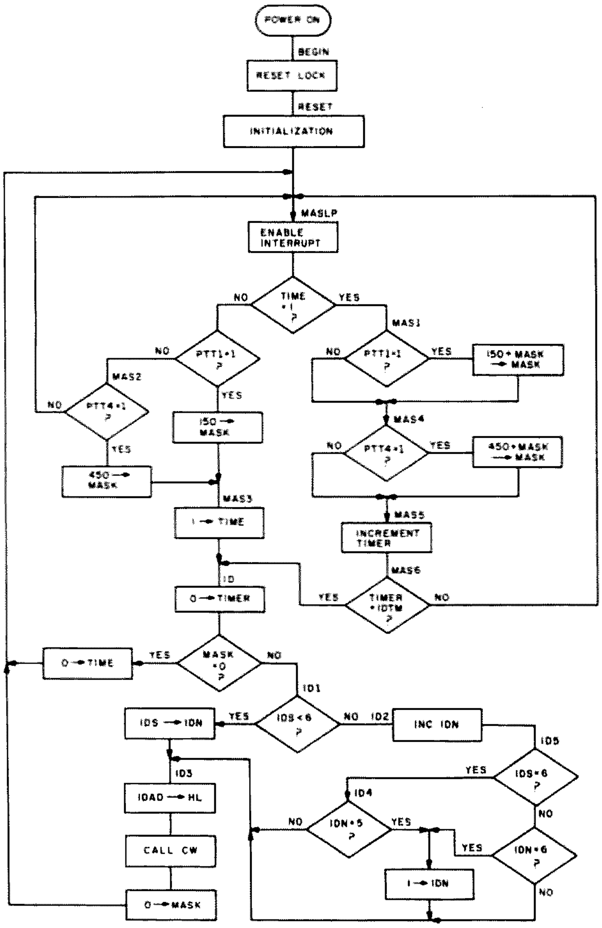

Fig. 1. Foreground program.

A good development system is a must when starting from scratch, but if the program is to be used as presented with only code changes, most any hobby computer can be made to program the ROMs. Major modifications would necessitate reassembly.

Program Analysis

The repeater control program is fairly long and it may appear quite complicated at first glance. Everything is broken down into manageable subroutines, so it is not too difficult to follow program flow. The software consists of two programs: the foreground program and the interrupt program. The two programs are separate and operate independently. The foreground program counts time, and when it is time for an identification, it performs the CW ID. Touchtones™ interrupt the processor, and control is passed to the interrupt program (which performs whatever task is required). The foreground program may be interrupted at any time, and when the interrupt service routine exits, control returns to the foreground program at the point where it left. This is apparent when listening to the repeater. If the repeater is identifying, and a touchtone is sent, the ID halts, and, after the tones are handled, the ID resumes where it left off. The beauty of the scheme is that the interaction of the programs is handled entirely by the interrupt hardware.

Foreground Program

Refer to the program listing. At the beginning, some labels are defined. The various ports are set equal to the proper values. CWSPD sets the speed of the CW. At its present setting, the speed is 19 wpm. The CW speed should be proportional to CWSPD. IDTM0 through IDTM3 set the time duration between successive IDs. This is currently set at three minutes.

When the 8080 is reset, it begins executing com-

mands at address 0. Refer to Fig. 1, a flowchart of the foreground program. At BEGIN, a lock is cleared. The lock permits the removal of the ability to enter the control mode. This will be explained in detail later. Control passes to RESET, where all variables are initialized. All of the output ports are zeroed. A note is in order about how the program handles output. The 8080 can output to its output ports, but it cannot read its output ports back in. Since we need the ability to be able to change only one bit at a time in the output ports, a memory byte is reserved for each output port. Every time the processor outputs data, it writes the output information in the locations OUT0M through OUT7M for ports 0 through 7. This way, if an output bit needs to be changed, the corresponding memory location can be read, the one bit changed, and the byte output. All bits of port 7 are set, because the row and column inputs to the touchtone generator are active low. The stack pointer is loaded, and control jumps around the interrupt location to MASLP.

At MASLP (master loop) the interrupt is enabled, and TIME is checked. If TIME is 0, the system is in the rest mode; as soon as a repeater is used, it will ID. When TIME is 1, the system is counting time to see if it is time to ID. In the program, if TIME is 0, the 150 PTT is checked to see if the repeater is in use. If not, the 450 PTT is checked at MAS2. If neither repeater is in use, the program loops around, continuously waiting for one to be used. When a repeater is activated, either a 150 code or a 450 code is put into MASK. MASK is a variable which tells the CW sending program which repeater to ID. At MAS3, TIME is made 1, and control goes to ID. At ID, TIMER is zeroed. TIMER is a four-byte counter, used to time up to three minutes. The repeater identifies, but before explaining how that occurs, the other path to ID will be explained.

At MASLP, if TIME is 1, control passes to MAS1. In this portion of the loop, the repeater has identified sometime in the past three minutes. In the subsequent three minutes, the processor keeps tab on the repeaters to see which ones should ID later. At MAS1, MASK is modified to reflect which repeaters are in use. TIMER is incremented, and, at MAS6, TIMER is checked to see if it equals IDTM (ID time). If not, three minutes have not elapsed, and the program loops back to MASLP. When time is up, control passes to ID, as before.

At ID, after TIMER is zeroed, MASK is checked to see if either repeater has been utilized in the last three minutes. If not, control resumes at MASLP after clearing TIME, placing the system back into the idle condition. If a repeater has been used, control goes to ID1. At this point, it must be determined which ID message is to be used. IDS (ID status) may have values from 1 to 7. 1 through 5 specify that that ID number is to be used, 6 indicates that the first four should be cycled, and 7 indicates that all five should be cycled. IDN (ID number) specifies the current ID number. IDN goes from 1 to 5. If IDS is between 1 and 5, IDN is set to IDS and control goes to ID3. At ID1, if IDS is 6 or 7, control goes to ID2 where IDN is incremented, advancing to the next ID message. At ID4 and ID5, IDN is checked to see if it is greater than it should be, and if so, it is set back to 1, and control goes to ID3.

At ID3, the HL registers are set to the address of the proper ID message, and the CW sending program is called. After sending the ID, MASK is zeroed and control goes to MASLP.

The CW sending routine is shown in Fig. 2. It is assumed that the address of the message to be sent in CW is in the HL registers, and that MASK indicates which repeaters to send the message to. If the destination is 150, MASK contains C0; if the destination is 450,

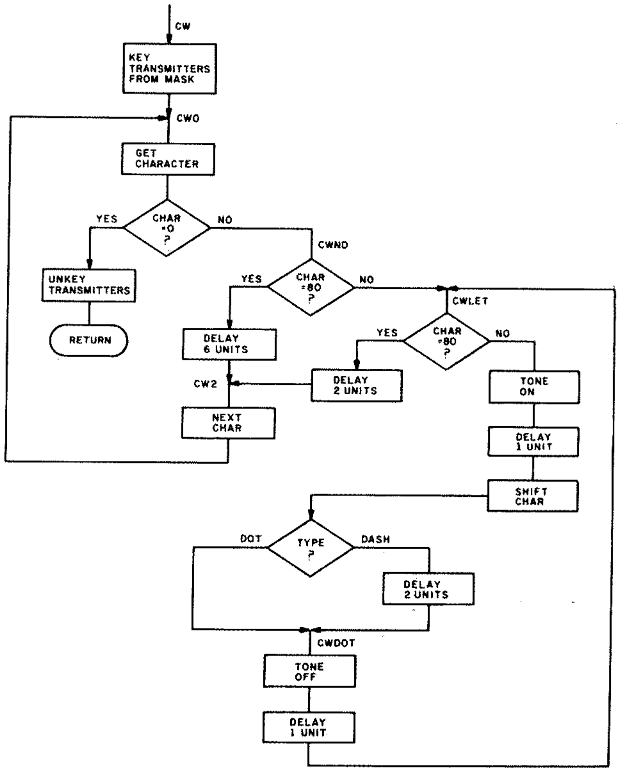

Fig. 2. CW routine.

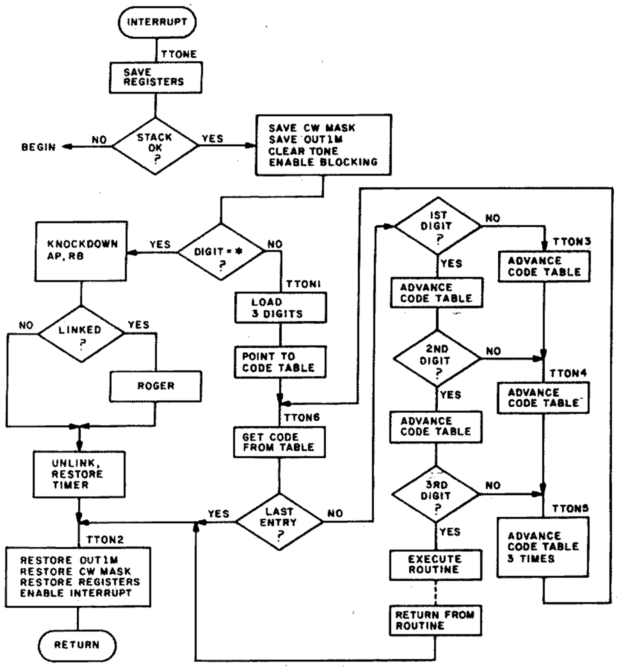

Fig. 3. Interrupt service routine.

MASK contains 30; if the destination is both, MASK contains F0. On entry, the proper transmitters are keyed, keeping them on the air for the duration of the message. At CW0, the character to be sent is fetched. A zero byte indicates that the message is done. If done, the transmitters are unkeyed, and the subroutine returns. Otherwise, at CWND (CW not done), the character is checked to see if it is the special space code of 80. If so, a 6-unit delay is made. A 1-unit delay is appended to every character, so a space is a total of 7 units long. If the character is not the special space code, control goes to CWLET (CW letter). Morse characters are stored left justified, with a 0 representing a dit and a 1 a dah. The byte is shifted left after each dit or dah, and when the byte ends up at 80, the character is done (described in *Byte*, October, 1976, page 36). After CWLET, the tone is turned on. If the character is a dah, an additional delay of 2 units is appended. At CWDOT, the tone is removed, and a trailing 1-unit space is added. The routine loops back to CWLET until the character is finished, where 2 more units are added to create a 3-unit intercharacter delay. At CW2, the next character is fetched and control loops back to CW0. The CW routine is used both by the ID section of the foreground program and various routines in the control section.

The Interrupt Service Program

The interrupt routine is shown in Fig. 3. When the 8080 is interrupted, it goes to address 38. It jumps to TTONE (touchtone), where the service routine is located. Since the foreground program may be interrupted at any time, it is necessary to save all registers. As an error-recovery technique, the stack pointer is checked to see if it is in the limited address space where RAM is located. If not, something is awry, and the program jumps to the beginning, resetting everything. If the stack is okay, MASK is saved, since it may need to be modified by the interrupt programs. OUT1M is saved because some bits are changed there as well. The CW tones are killed, in case an ID has been interrupted (which could leave a constant tone on the repeater until return to the foreground program), and BLK is set high, enabling the blocking function. The decoder is checked to see if the digit is a *, the knockdown digit. If so, the KD output is pulsed for about a millisecond to kill any possible autopatch or remote-base function. If the repeaters are linked, the routine ROGER is called, which sends the "R" in CW. The repeaters are unlinked, and the timeout timer is placed into the timing mode in case a single-digit autopatch was in progress. Control goes to TTON2, the exit point.

If the incoming digit is not a *, LOAD is called, which gets a three-digit code. The code table is checked for the three-digit code. If the code is not found in the table, control goes to TTON2, and nothing happens. If the code is found in the code table, the address of the routine to execute that particular code is obtained. At that point, the program jumps to the particular routine. After the routine is executed, control jumps to

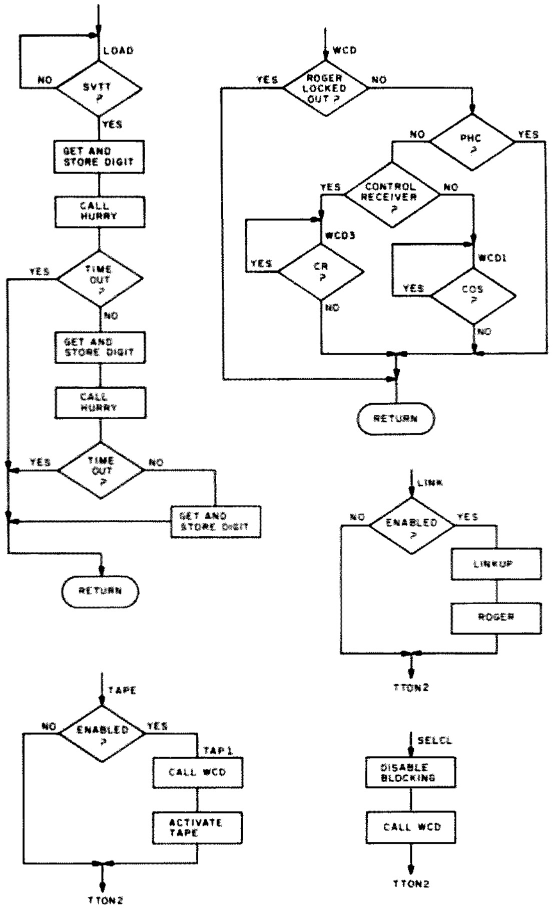

Fig. 4. Load, wait for carrier drop, link, tape, and selective call routines.

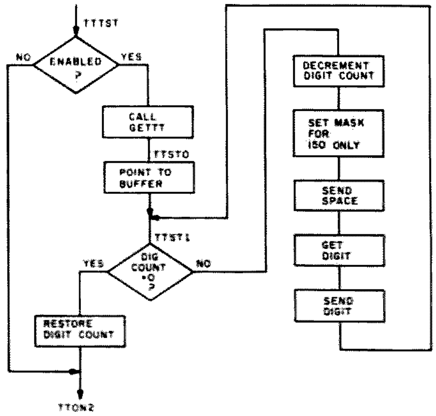

Fig. 5. Touchtone test routine.

TTON2.

At TTON2, everything that was saved upon entry of TTONE is restored and the interrupt routine returns to the foreground program.

BITS is a bit set routine used to set a bit in an output byte. The address of the byte is placed in register DE, and a 1 is placed in the desired bit in register B. BITC clears bits the same as BITS sets them.

Shown in Fig. 4, LOAD gets a three-digit code from the touchtone decoder. Upon entry, LOAD waits for SVTT. For user codes, SVTT is immediately present, since it is SVTT which caused the interrupt. For control codes, where several three-digit codes are used, LOAD waits for a code to be entered. When a digit is ready, LOAD calls DECOD. DECOD reads the input ports and decodes the digits into binary form. The digit is stored, and HURRY is called. HURRY checks VTT while counting time. If a tone occurs before three seconds elapse, HURRY returns with the carry clear. If no tone is received in three seconds, HURRY exits with the carry set. The timeout is detected in LOAD, the program is aborted, and LOAD returns. Otherwise DECOD gets the next digit, the sequence repeating. The third digit is fetched in the same manner. After exiting LOAD, either three digits are stored or an invalid code is stored because of failure to send successive digits within three seconds.

DECOD reads the decoder. Presumably, a tone is present when DECOD is called. The digits 1 through 9 are stored as those numbers, and 0, *, and # are stored as decimal 10, 11, and 12. A digit stored as 0 indicates an invalid code. LOAD presets the three digits to 0, so timing out results in one or more stored digits remaining 0

The routine WCD is used to wait for a carrier drop. It is possible to lock out the ROGER routine. If this is done, it also eliminates the need to wait for dropping carrier when controlling the repeater. Upon entry, WCD checks for this, and normally proceeds to check to see if it is in the phone control mode. If so, WCD returns. If not, it checks to see if the control receiver is being used. If so, it waits for the signal there to drop. If not, it waits for the COS signal to disappear. In this manner, WCD only waits when necessary, and waits for the proper signal. The LINK routine checks if the function is to be permitted. If so, it links the repeaters and calls ROGER.

The TAPE routine checks to see if the function is enabled, calls WCD, activates the tape, and exits.

The SELCL (selective call) routine clears BLK, calls WCD, and exits. This permits any tones after 3#3 and before the carrier drop to pass.

TTTST, the touchtone test routine, is shown in Fig. 5. If the function is enabled, GETTT (get touchtone) is called, which loads a sequence of digits. Control goes to TTST1, where the digit count is checked. For each digit, the digit is converted to CW and sent. The addresses of the CW conversions are at DIGAD. The actual CW codes are at CWD1 through CWDP. After the buffer is sent, the digit count is restored and TTTST exits.

The GETTT routine is shown in Fig. 6. Upon entry, the digit count is cleared and register pair DE is initialized to the start of the buffer. If carrier is present at GETT1, the VTT is checked. The program loops until either the carrier is dropped or a digit is received. When the latter happens, DECOD is called and the digit is placed into the buffer. The digit count is incremented, and checked to see if the buffer is full. The buffer is loaded in this manner until the carrier is dropped, when GETTT returns. If the buffer length reaches maximum, WCD is called and then GETTT returns.

When the three-digit control code is sent, the program goes to CNTRL, shown in Fig. 7. If the control mode is locked out, CNTRL exits immediately. Otherwise, WCD is called, and then LOAD. The HL registers are

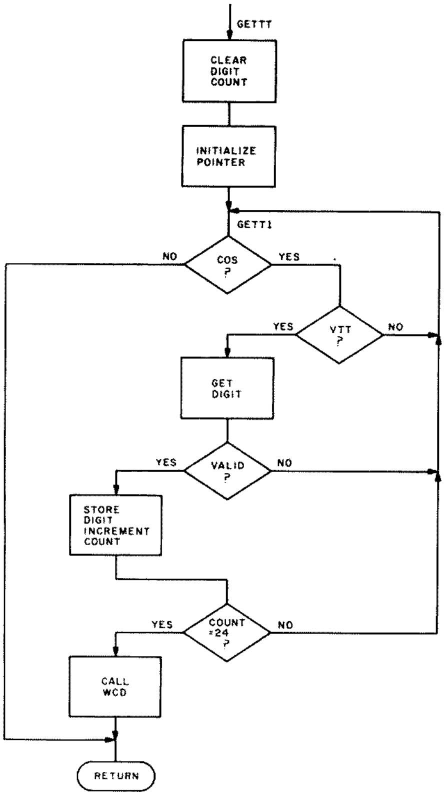

Fig. 6. Get touchtone routine.

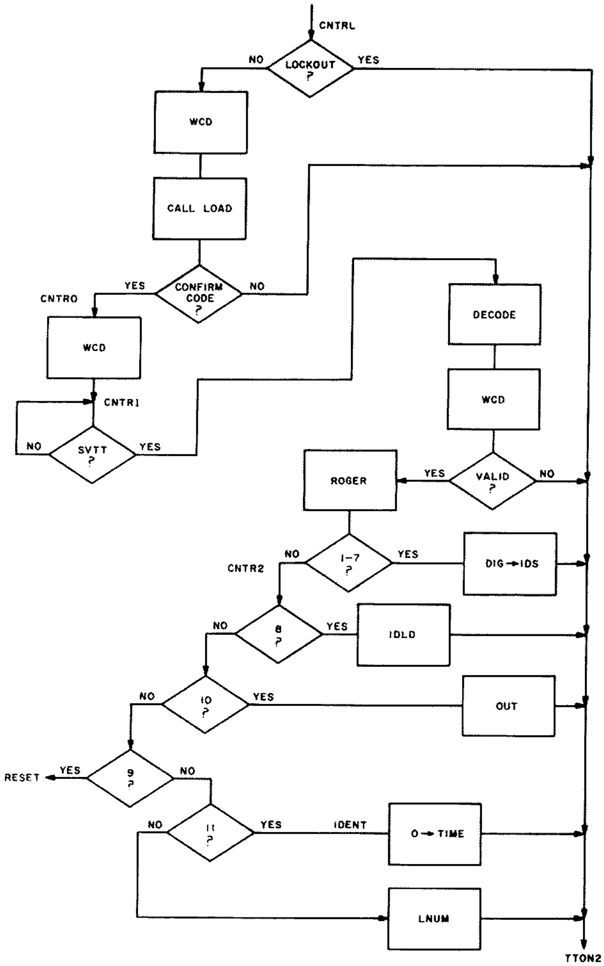

Fig. 7. Control routine.

loaded with the address of the confirm code. Jumping to TTON6 enters TTONE at a point where the code received is checked against the code table, now consisting only of the confirm code. If the received code is not in the single entry table, the interrupt is aborted as usual. If agreement is found, TTONE sends control to CNTR0, a continuation of CNTRL. WCD is called, and CNTRL then loops at CNTR1 until a tone is received. A single-digit code is expected, and DECOD is called to get it. WCD is again called, and if the received digit is invalid, control exits. Otherwise, ROGER is called and the proper program must be selected. If the received digit is between 1 and 7, IDS is loaded with that digit. The command is done, and CNTRL exits. If the digit is 8, CNTRL jumps to IDLD (ID load). A 10, which is digit 0, sends CNTRL to OUT, and 9 has the program jump to RESET, initializing the entire program with the exception of LOCK. If the digit is a *, TIME is cleared; otherwise, the digit must be a # and CNTRL jumps to LNUM (load number). Each routine, at completion, goes to TTON2 and exits.

Fig. 8 shows IDLD. The HL registers are loaded with the address of the programmable ID. The character byte in register B and element count in register C are cleared at IDLD0. IDLD1 waits for a digit to be received, and DECOD is called. If the digit is 3, the stop byte is stored, ROGER is called, and IDLD exits. Otherwise, control goes to IDNTS (ID not stop), where the digit is checked to see if it is a 2. If so, at IDDLT (ID done, left justify) register B is justified by the element count in register C. The character is stored in the message buffer at IDDL (ID done letter), HL is incremented, and control loops to IDLD0. If the digit is not a 2, it is checked to see if it is a 1. If it is, a 1 is shifted into register B and the element bit count is incremented. Otherwise, the digit is checked to see if it is a 0, where a 0 is shifted in. If the digit is not a 3, 2, 1, or a 0, then an invalid digit was sent and it is ignored.

The OUT routine, in Fig. 9, outputs selected bits to the output ports. LOAD is called to get a three-digit code. If the first digit is a *, ROGER is called and OUT exits. Otherwise, the digits are checked to see if they are 0, which is invalid. If an invalid entry is made, after carrier drop, control loops back to OUT. If port 0 is selected, the 10 is changed to a 0 for later use. Several validity checks are made, checking to see if port, bit numbers, and output levels make sense. If they do, ROGER is called. At OUT2, the binary code for the bit number is converted to a 1 in the proper bit of register E. At OPRT (output to port), a machine output instruction is set up in RAM with the required port number. The bit is either set or cleared, and the output instruction in RAM is called. Control loops to OUT, and the cycle continues until OUT is exited with a *.

LNUM (load number) is shown in Fig. 10. The digit count is zeroed, and at LNUM1 LNUM waits for a received digit. DECOD is called, and if the digit is a *, ROGER is called and the routine exits. Otherwise, the digit count is checked and the digit is stored. If more than 11 digits are attempted, the last digit keeps being overwritten.

LOCK has two functions.

```
0000                  ;REPEATER CONTROL STATUS MONITOR PROGRAM
0000                  ;
0000                  ;FOR USE WITH AN 8080 CONTROLLER
0000                  ;WITH I/O PORTS
0000                  ;AND THE DESCRIBED EXTERNAL HARDWARE
0000                  ;INCLUDING A TOUCH TONE (R) DECODER
0000                  ;
0000                  ;
0000                  ;
0000                  ;VERSION 2.0
0000                  ;
0000                  ;SERIES 2 INCORPORATED ERROR RECOVERY
0000                  ;
0000                  ;NOVEMBER 1977, ROBERT GLASER W3IC
0000                  ;MODIFIED FEBRUARY, 1979
0000                  ;COPYRIGHT ROBERT GLASER
0000                  ;
0000                  ;
0000                  ;
0000                  PSW:    EQU     6
0000                  SP:     EQU     6
0000                  PORT1:  EQU     10H
0000                  PORT2:  EQU     20H
0000                  PORT3:  EQU     30H
0000                  PORT4:  EQU     40H
0000                  PORT5:  EQU     50H
0000                  PORT6:  EQU     60H
0000                  PORT7:  EQU     70H
0000                  STSML:  EQU     0FFH
0000                  CWSPD:  EQU     5000
0000                  IDTM0:  EQU     0
0000                  IDTM1:  EQU     0
0000                  IDTM2:  EQU     26
0000                  IDTM3:  EQU     0
0000                  ;
0000                  ;
0000                  ;
0000                          ORG     0       ;FIRST ROM
0000                  ;INITIALIZATION PROCEDURE
0000                  ;
0000                  ;
0000                  ;
0000 AF               DECIN:  XRA     A
0001 32 F2 30                 STA     LCKR
0004 21 F4 30         RESET:  LXI     H,TIME-1
0007 23               RESTI:  INX     H
0008 36 00                    MVI     M,0
000A 3E FF                    MVI     A,STSML
000C BD                       CMP     L
000D C2 07 00                 JNZ     RESTI
0010 AF                       XRA     A
0011 D3 10                    OUT     PORT1
0013 D3 20                    OUT     PORT2
0015 D3 30                    OUT     PORT3
0017 D3 40                    OUT     PORT4
0019 D3 50                    OUT     PORT5
001B D3 60                    OUT     PORT6
001D 3C                       INR     A
001E 32 F3 30                 STA     IDS     ;ID STATUS
0021 32 F4 30                 STA     IDN     ;ID NUMBER
0024 3E FF                    MVI     A,0FFH
0026 32 FF 30                 STA     OUT7H
0029 D3 70                    OUT     PORT7
002B 2A 00 10                 LHLD    STCK    ;STACK LOC
002E F9                       SPHL
002F C3 38 00                 JMP     MASLP   ;BYPASS INT LOC
0032                  ;
0032                  ;
0032                  ;
0032                          ORG     38H     ;INTERRUPT LOCATION
0038 C3 86 01                 JMP     TTONE   ;INTERRUPT PROGRAM
0038                  ;
0038                  ;
0038                  ;
0038                  MASLP:  EQU     $       ;MASTER LOOP
0038 FB                       EI
003C 3A F5 30                 LDA     TIME
003F B7                       ORA     A
0040 C2 65 00                 JNZ     MAS1    ;TIMING
0043 DB 10                    IN      PORT1
0045 2F                       CMA
0046 E6 20                    ANI     20H     ;150 PTT
0048 CA 58 00                 JZ      MAS2
004B 3E C0                    MVI     A,0C0H
004D 32 F6 30         MAS3:   STA     MASK    ;50 MASK
0050 3E 01                    MVI     A,1
0052 32 F5 30                 STA     TIME    ;START TIMING
0055 C3 B3 00                 JMP     ID      ;IDENTIFY
0058 DB 10            MAS2:   IN      PORT1
005A 2F                       CMA
005B E6 10                    ANI     10H     ;450 PTT
005D CA 38 00                 JZ      MASLP   ;NO ACTIVITY
0060 3E 30                    MVI     A,30H   ;450 MASK
0062 C3 4D 00                 JMP     MAS3
0065 DB 10            MAS1:   IN      PORT1
0067 2F                       CMA
0068 F5                       PUSH    PSW
0069 E6 20                    ANI     20H     ;150 PTT
006B CA 75 00                 JZ      MAS4
006E 21 F6 30                 LXI     H,MASK
0071 3E C0                    MVI     A,0C0H
0073 B6                       ORA     M
0074 77                       MOV     M,A
0075 F1               MAS4:   POP     PSW
0076 E6 10                    ANI     10H     ;450 PTT
0078 CA 82 00                 JZ      MAS5
007B 21 F6 30                 LXI     H,MASK
007E 3E 30                    MVI     A,30H
0080 B6                       ORA     M
0081 77                       MOV     M,A
0082 21 E8 30         MAS5:   LXI     H,TIMER ;INCR 4 BYTE TIMER
0085 34                       INR     M
0086 C2 95 00                 JNZ     MAS6
0089 23                       INX     H
008A 34                       INR     M
008B C2 95 00                 JNZ     MAS6
008E 23                       INX     H
008F 34                       INR     M
0090 C2 95 00                 JNZ     MAS6
0093 23                       INX     H
0094 34                       INR     M
0095 21 E8 30         MAS6:   LXI     H,TIMER ;SEE IF TIME
0098 3E 00                    MVI     A,IDTM0 ;IS UP
009A BE                       CMP     M
009B C2 38 00                 JNZ     MASLP   ;NOPE
009E 23                       INX     H
009F 3E 00                    MVI     A,IDTM1
00A1 BE                       CMP     M
00A2 C2 38 00                 JNZ     MASLP   ;NOPE
00A5 23                       INX     H
00A6 3E 16                    MVI     A,IDTM2
00A8 BE                       CMP     M
00A9 C2 38 00                 JNZ     MASLP   ;NOPE
00AC 23                       INX     H
00AD 3E 00                    MVI     A,IDTM3
00AF BE                       CMP     M
00B0 C2 38 00                 JNZ     MASLP   ;NOPE
00B3                  ;
00B3                  ;
00B3                  ;
00B3                  ID:     EQU     $       ;TIME TO ID IF MASK NONZERO
00B3 21 00 00                 LXI     H,0
00B6 22 E8 30                 SHLD    TIMER
00B9 22 EA 30                 SHLD    TIMER+2
00BC 21 F4 30                 LXI     H,IDN
00BF 3A F6 30                 LDA     MASK
00C2 B7                       ORA     A
00C3 C2 CC 00                 JNZ     ID1
00C6 32 F5 30                 STA     TIME    ;STOP TIMING
00C9 C3 38 00                 JMP     MASLP
00CC 3A F3 30         ID1:    LDA     IDS     ;ID STATUS
00CF FE 06                    CPI     6       ;< 6?
00D1 D2 DA 00                 JNC     ID2
00D4 32 F4 30                 STA     IDN     ;ID NUMBER
00D7 C3 F3 00                 JMP     ID3
00DA 34               ID2:    INR     M
00DB 3A F3 30                 LDA     IDS
00DE FE 06                    CPI     6
00E0 CA EE 00                 JZ      ID4
00E3 3E 05                    MVI     A,5
00E5 BE               ID5:    CMP     M
00E6 D2 F3 00                 JNC     ID3
00E9 36 01                    MVI     M,1
00EB C3 F3 00                 JMP     ID3
00EE 3E 04            ID4:    MVI     A,4
00F0 C3 E5 00                 JMP     ID5
00F3 7E               ID3:    MOV     A,M
00F4 3D                       DCR     A
00F5 07                       RLC
00F6 5F                       MOV     E,A
00F7 16 00                    MVI     D,0
00F9 21 00 10                 LXI     H,IDAD
00FC 19                       DAD     D
00FD 5E                       MOV     E,M
00FE 23                       INX     H
00FF 56                       MOV     D,M
0100 EB                       XCHG
0101 CD 08 01                 CALL    CW
0104 AF                       XRA     A
0105 32 F6 30                 STA     MASK    ;CLEAR MASK
0108 C3 38 00                 JMP     MASLP
0108                  ;
0108                  ;
0108                  ;
0108                  ;CW SENDING ROUTINE
0108                  ;ROTATES DATA LEFT.
0108                  ;1 IS A DASH, 0 IS A DOT
0108                  ;UNTIL AN 80 IS LEFT.
0108                  ;AN INITIAL 20 IS A SPACE
0108                  ;AND A ZERO IS MESSAGE END
0108                  ;
0108                  ;
0108                  CW:     EQU     $       ;CW SENDING ROUTINE
0108 3A F6 30                 LDA     MASK
010B E6 C0                    ANI     0C0H
010D 47                       MOV     B,A
010E 11 F9 30                 LXI     D,OUTIM
0111 CD 0C 02                 CALL    BITS
0114 D3 10                    OUT     PORT1
0116 7E               CW0:    MOV     A,M
0117 B7                       ORA     A
0118 C2 29 01                 JNZ     CWNG
011B 11 F9 30                 LXI     D,OUTIM
011E 06 F0                    MVI     B,0F0H
0120 CD 10 02                 CALL    BITC
0123 D3 10                    OUT     PORT1
0125 C9                       RET
0126 FE 80            CWNG:   CPI     80H
0128 C2 38 01                 JNZ     CWLET
012B 3E 06                    MVI     A,6     ;SPACE
012D CD 74 01         CW1:    CALL    DELAY
0130 3D                       DCR     A
0131 C2 2D 01                 JNZ     CW1
0134 23               CW2:    INX     H
0135 C3 16 01                 JMP     CW0     ;GET NEXT CODE
0138 FE 80            CWLET:  CPI     80H     ;DONE?
013A CC 74 01                 CZ      DELAY   ;2 SPACES
013D CC 74 01                 CZ      DELAY   ;AT END
0140 CA 34 01                 JZ      CW2     ;LETTER DONE
0143 F5                       PUSH    PSW
0144 11 F9 30                 LXI     D,OUTIM
0147 3A F6 30                 LDA     MASK
014A E6 C0                    ANI     0C0H
014C 47                       MOV     B,A
014D CD 0C 02                 CALL    BITS
0150 D3 10                    OUT     PORT1   ;OUT TONE
```

Program listing.

It can block access to the control mode, and it can eliminate the ROGER routine. After the LOCK sequence is given, LOAD is called to get three digits. The second digit eliminates the ROGER routine if it is a 1, and the third digit locks the control mode out if it is a 1. ROGER is then called, and LOCK exits. If the second or third digits of a LOCK command are 0, the normal state of the appropriate function is resumed. The LOCK function is intended as a fail-safe measure, available only to the person who constructs the system. The reset instruction (9) is purposely constructed so that it does not reset LCKR, the locker

```
0155 F1                     POP     POW
0156 CD 74 01               COLL    DELAY
0159 17                     OOL
015A F5                     PUSH    P60
015B D2 64 01               JNC     CDDOT
015E CD 74 01               CALL    DELAY
0161 CD 74 01               CALL    DELAY
0164 06 AD         CUDOT:   MVI     D,DADN
0166 CD 10 02               CALL    OITC
0169 D3 10                  OUT     POOT1
016D CD 74 01               CALL    DELAY
016E F1                     POP     POW      ;GET CHOD
016F E6 FE                  ANI     OFEN
0171 C3 30 01               JNP     COLET
0174               ;
0174               ;
0174               ;
0174 D5            DELAY:   PUSH    D
0175 F5                     PUSH    POU
0176 11 88 13               LXI     D,CHSPD
0179 4F                     XOA     A
017A 1B            DEL1:    DCX     D
017B 9B                     CMP     E
017C C2 7A 01               JOZ     DEL1
017F 0A                     CMF     D
0180 C2 7A 01               JNZ     DEL1
0183 F1                     PDF     PSU
0184 D1                     PDP     D
0185 C9                     AET
0186               ;
0186               ;
0186               ;
0186               TTONE:   EDU     9
0186               ;INTEDOUPT DOUTTNE TO SEDVICE
0186               ;TOUCH TONE (O) OECODER
0186               ;
0186               ;HANNLES ALL CONTOOL OND USED FUNCTIONS
0186               ;
0186               ;
0186 F5                     PUDH    POD
0187 C5                     PUSH    O
0188 D5                     PUSH    D
0189 E5                     PUDH    H
018A 21 00 00               LXI     H,O      ;SEE IF
018D 39                     DOD     DP       ;THE DTACK
018E 7C                     MOV     O,H      ;IO DEJEED
018F FE 30                  CPI     30H      ;OP
0191 C2 00 00               JNZ     BEGIN    ;YEO, DECOVED
0194 36 FE 30               LDD     HOOS
0197 F5                     FHON    PON
0198 11 F9 30               LXI     D,DDTIN
019B 1A                     LDAX    D
019C F5                     PDDH    POU
019D 06 FD                  MVI     B,DFDN
019F CD 10 02               CALL    BITC     ;OIT CLEDD
01A2 06 01                  MVI     O,1
01A4 CD 0C 02               CALL    BITS     ;OIT EET
01A7 D3 10                  OOT     POOT1
01A9 DB 20                  IN      POOT2
01AB 2F                     CDA
01AC E6 02                  ANI     2
01AE CA D3 01               JZ      TTONI    ;NOT *
01B1 06 02                  BVI     O,2
01B3 CD 0C 02               CALL    OITD
01B6 D3 10                  DUT     POOT1    ;XNOCXOONN
01B8 CD 74 01               CALL    DELAY
01BB CD 10 02               CALL    OITC     ;DELEDDE FONCE
01BE D3 10                  DUT     POOT1
01C0 11 F8 30               LXI     O,OOT3N
01C3 1A                     LDAX    D
01C4 E6 10                  OOI     10H      ;LINXEO?
01C6 C4 D2 03               CNZ     DOGEE    ;TE3
01C9 06 10                  MVI     S,10H
01CB CD 10 02               COLL    OITC     ;DEDTODE TINEN 6
01CE D3 30                  DUT     POOT3    ;UNLINK DPTOD
01D0 C3 FC 01               JOP     TTON2
01D3 CD 19 02      TTONI:   CALL    LDAD
01D6 2A 02 10               LHLD    CDTAD    ;LOCATION OF CODTD
01D9 7E            TTON6:   MOV     O,H
01DA 07                     006     A
01DB CA FC 01               JZ      TT002    ;NOT CODE
01DE 0A                     CDP     O
01DF C2 F4 01               JOZ     TT003
01E2 23                     INX     H
01E3 7E                     MOV     A,H
01E4 0D                     COP     E
01E5 C2 F3 01               JNZ     TT004
01E8 23                     INX     H
01E9 7E                     MOV     O,H
01EA B8                     CMP     O
01EB C2 F4 01               JNZ     TTON5
01EE 23                     INX     H
01EF 5E                     MOV     E,O
01F0 23                     INX     H
01F1 56                     MOV     O,H
01F2 EB                     XCHC             ;HODO TO HL
01F3 E9                     PCHL             ;JUMP TO IT
01F4 23            TTON3:   INX     H
01F5 23            TTON4:   INX     H
01F6 23            TTON5:   INX     H
01F7 23                     INX     H
01F8 23                     INX     H
01F9 C3 D9 01               JMP     TTON6    ;TAY NEET CODE
01FC               ;
01FC F1            TTON2:   POP     PON
01FD 32 F9 30               STA     ONTIN
0200 D3 10                  OOT     PODT1
0202 F1                     PDP     PEU
0203 32 F6 30               SIA     HABK
0206 E1                     PDP     H
0207 D1                     PDP     O
0208 C1                     PDP     O
0209 F1                     PAP     PSU
020A FB                     EI
020B C9                     RET              ;000 EXIT INTEOOUPT
020C               ;
020C               ;
020C               ;
020C               ;
020C               ;
020C               ;
020C               BITS:    EDU     9
020C               ;OIT DET SETO THE OIT CORREDPONDINC
020C               ;TO TOAT OF EEG O IO MEN LOC (OE)
020C               ;
020C 1A                     LDAX    O
020D 00                     OO9     O
020E 12                     STAX    O
020F C9                     DET
0210               ;
0210               ;
0210               OITC:    EDU     6
0210               ;OIT CLEAD CLEADD THE OIT
0210 C5                     PUSH    O
0211 78                     OOV     O,O
0212 2F                     CDA
0213 47                     MOV     B,A
0214 1A                     LDDX    O
0215 A0                     ANA     B
0216 12                     STAX    D
0217 C1                     POP     B
0218 C9                     DET
0219               ;
0219               ;
0219               ;
0219               LOAD:    EDU     8
0219               ;LOAD PUTD THE OEDUENTIOL 3 DIGIT CODK
0219               ;INTD DEG'E O,E,O
0219               ;EEE'S CLEOD IF NO DIGIT
0219               ;LOAD HAITD FON O LONG FIOOT TONE
0219               ;OOO THEN FEST TOD TONES
0219               ;
0219 11 00 00               LXI     O,O
021C 01 00 00               LXI     O,O
021F DB 10         LOADI:   IN      PORT1
0221 2F                     CMN
0222 07                     60O     A
0223 F2 1F 02               JP      LOADI    ;HOIT FOD LONE TOXE
0226 CD 30 02               COLL    DECOD    ;EET DIGIT
0229 57                     MOV     D,A
022A CD 60 02               CALL    HUEEY
022D D8                     HC               ;TIMED OUT
022E CD 30 02               COLL    DECOD
0231 5F                     MOV     E,O
0232 CD 6E 02               COLL    XUOOT
0235 D8                     DC
0236 CD 30 02               CALL    DECOD
0239 47                     MOV     O,6
023A C9                     AET
023B               ;
023B               ;
023B               ;
023B               DECOD:   EOO     O
023B               ;DECOD DEDDE THE TONCH TONE (O) DECODED
023B               ;AND PUTD THE CHAD IN EEB O
023B               ;NO TONE RETDEND N ZERO
023B               ;HAIT FOD DELEDDE OF TONE HEFONE EETUDN
023B               ;
023B C5                     PUDH    O
023C DB 10                  IN      PONT1
023E 2F                     CM6
023F E6 0F                  HNI     OFH
0241 C2 50 02               JNZ     DECOI    ;IN PODT 1
0244 DB 20                  IN      POET2
0246 2F                     CMN
0247 07                     OOO     O
0248 CA 5C 02               JZ      DECOA    ;ERRONEOUE CHOK
024B 0E 04                  MVI     C,4      ;OFFDET
024D C3 56 02               JMP     DECO2
0250 17            DECOI:   SAL
0251 17                     DAL
0252 17                     DAL
0253 17                     DAL
0254 0E 00                  MVI     C,O
0256 0C            DECO2:   INE     C
0257 17                     RAL
0258 D2 56 02               JMC     DECO2
025B 79                     MOV     H,C
025C C1            DECO4:   POP     B
025D F5                     PUDH    POD
025E DB 10         DECO3:   IN      PODTI
0260 2F                     CMA
0261 E6 40                  ANI     40H
0263 C2 5E 02               JNZ     DECO3
0266 F1                     POP     PON
0267 C9                     DET
0268               ;
0268               ;
0268               ;
0268               HONOT:   EDU     O
0268               ;HUDOT DAITD POD O TONE,
0268               ;OUT EXITD DITH CODDV DET IP NONE
0268               ;EECEIVED IN PENMITTED TIOE
0268               ;
0268 AF                     XOA     A
0269 D5                     PDDH    O
026A C5                     PDDH    B
026B 11 00 00               LXI     O,O
026E 01 00 00               LXI     B,O
0271 DB 10         HOOYI:   IN      PODTI
0273 2F                     CMA
0274 E6 40                  ONI     40H      ;TONE?
```

Continued on next page

where the control mode may be inhibited.

PATCH, the autopatch routine, is one of the more complicated subprograms. Shown in Fig. 11, PATCH first checks to see if the autopatch is enabled. NOTIM (no timer) is cleared so that the timer will be present unless changed later. GETTT gets the requested telephone number. The digit count is then checked. If no number was sent, and a direct autopatch is allowed, then at PTCH1 AP is pulsed, giving the user the line to dial his own number. Otherwise, the attempt is aborted. If 7 digits were entered, control passes through PTCH2 to PTCH8. If the first digit of the number is a 1, the patch is aborted. If not, at PTCH3 AP is pulsed, bringing up the line. At PTCH5, a one-second delay is introduced to allow time for the telephone company equipment to produce the dial tone.

```
0449 0276 C2 8D 02          JNZ     HURY3   ;YES
0450 0279 0C                INR     C
0451 027A C2 86 02          JNZ     HURY2
0452 027D 04                INR     B
0453 027E C2 86 02          JNZ     HURY2
0454 0281 1C                INR     E
0455 0282 C2 86 02          JNZ     HURY2
0456 0285 14                INR     D
0457 0286 3E 01     HURY2:  MVI     A,1
0458 0288 BB                CMP     E
0459 0289 C2 71 02          JNZ     HURY1
0460 028C 37                STC             ;TIMED OUT
0461 028D C1        HURY3:  POP     B
0462 028E D1                POP     D
0463 028F C9                RET
0464 0290           ;
0465 0290           ;
0466 0290           ;
0467 0290           WCD:    EQU     $
0468 0290           ;WAIT FOR CARRIER DROP
0469 0290 F5                PUSH    PSW
0470 0291 3A F7 30          LDA     LKBOC
0471 0294 B7                ORA     A
0472 0295 C2 B5 02          JNZ     WCD2
0473 0298 DB 30             IN      PORT3
0474 029A B7                ORA     A
0475 029B FA B5 02          JM      WCD2
0476 029E E6 40             ANI     40H
0477 02A0 CA A6 02          JZ      WCD1    ;NOT CD
0478 02A3 DB 30     WCD3:   IN      PORT3
0479 02A5 E6 40             ANI     40H
0480 02A7 C2 A3 02          JNZ     WCD3
0481 02AA C3 B5 02          JMP     WCD2
0482 02AD DB 10     WCD1:   IN      PORT1
0483 02AF 2F                CMA
0484 02B0 E6 20             ANI     20H
0485 02B2 C2 AD 02          JNZ     WCD1
0486 02B5 F1        WCD2:   POP     PSW
0487 02B6 C9                RET
0488 02B7           ;
0489 02B7           ;
0490 02B7           ;
0491 02B7 3A F6 30  LINE:   LDA     OUTON   ;LINE OPTION
0492 02BA E6 01             ANI     1       ;ENABLED?
0493 02BC C2 FC 01          JNZ     TTON2   ;NO!
0494 02BF 11 F0 30          LXI     D,OUT3H
0495 02C2 06 10             MVI     B,10H
0496 02C4 CD 0C 02          CALL    BITS
0497 02C7 D3 30             OUT     PORT3
0498 02C9 CD D2 03          CALL    ROGER
0499 02CC C3 FC 01          JMP     TTON2
0500 02CF           ;
0501 02CF           ;
0502 02CF           ;
0503 02CF 3A F0 30  TAPE:   LDA     OUTON   ;TAPE LOOP
0504 02D2 E6 02             ANI     2       ;ENABLED?
0505 02D4 C2 FC 01          JNZ     TTON2   ;NO!
0506 02D7 CD 90 02  TAP1:   CALL    WCD
0507 02DA 11 F0 30          LXI     D,OUT3H
0508 02DD 06 00             MVI     B,00H
0509 02DF CD 0C 02          CALL    BITS
0510 02E2 D3 30             OUT     PORT3
0511 02E4 CD 74 01          CALL    DELAY
0512 02E7 CD 10 02          CALL    BITC    ;PULSE TAPE
0513 02EA D3 30             OUT     PORT3
0514 02EC C3 FC 01          JMP     TTON2
0515 02EF           ;
0516 02EF           ;
0517 02EF           ;
0518 02EF           ;SELECTIVE CALL DISABLED TONE BLOCKING
0519 02EF 11 F9 30  SELCL:  LXI     D,OUTIN
0520 02F2 06 01             MVI     B,1
0521 02F4 CD 10 02          CALL    BITC
0522 02F7 D3 10             OUT     PORT1
0523 02F9 CD 90 02          CALL    WCD     ;WAIT FOR CAR DROP
0524 02FC C3 FC 01          JMP     TTON2
0525 02FF           ;
0526 02FF           ;
0527 02FF           ;
0528 02FF           CNTRL:  EQU     $
0529 02FF           ;ALL CONTROL CODES ARE ENTERED
0530 02FF           ;IN THIS ROUTINE.
0531 02FF           ;
0532 02FF 3A F2 30          LDA     LCKO
0533 0302 B7                ORA     A
0534 0303 C2 FC 01          JNZ     TTON2   ;LOCKED OUT
0535 0306 CD 90 02          CALL    WCD
0536 0309 CD 19 02          CALL    LOAD
0537 030C 2A 04 10          LHLD    CPANC
0538 030F C3 D9 01          JMP     TTON6
0539 0312 CD 90 02  CNTR0:  CALL    WCD
0540 0315 DB 10     CNTR1:  IN      PORT1
0541 0317 2F                CMA
0542 0318 B7                ORA     A
0543 0319 F2 15 03          JP      CNTR1
0544 031C CD 38 02          CALL    DECOD   ;GET DIGIT
0545 031F CD 90 02          CALL    WCD
0546 0322 B7                ORA     A
0547 0323 CA FC 01          JZ      TTON2
0548 0326 FE 0D             CPI     13
0549 0328 D2 FC 01          JNC     TTON2   ;INVALID
0550 032B CD D2 03          CALL    ROGER
0551 032E FE 08             CPI     8
0552 0330 D2 39 03          JNC     CNTR2
0553 0333 32 F3 30          STA     IDD
0554 0336 C3 FC 01          JMP     TTON2   ;DONE
0555 0339 FE 08     CNTR2:  CPI     8
0556 033B CA A8 10          JZ      IDLD    ;LOAD ID
0557 033E FE 06             CPI     10
0558 0340 CA 50 03          JZ      OUT
0559 0343 FE 09             CPI     9
0560 0345 CA 04 00          JZ      RESET   ;INIT
0561 0348 FE 0B             CPI     11
0562 034A CA F8 03          JZ      IDENT
0563 034D C3 12 10          JMP     LNUMA   ;LOAD NUMBER
0564 0350           ;
0565 0350           ;
0566 0350           OUT:    EQU     $
0567 0350           ;OUT TAKES 3 DIGITS AND OUTPUTS
0568 0350           ;TO OUTPUT PORTS AS FOLLOWS:
0569 0350           ;TT CODE IS XYZ
0570 0350           ;PORT X 0,1,2,3,4,5,6,7
0571 0350           ;BIT Y          1,2,3,4,5,6,7,8
0572 0350           ;LEVEL Z        0,1
0573 0350           ;
0574 0350           ;ALL FAULTY CODES ARE IGNORED
0575 0350           ;
0576 0350           ;A * EXITS THE CONTROL-OUT MODE
0577 0350           ;
0578 0350 CD 19 02          CALL    LOAD
0579 0353 3E 0B             MVI     A,11    ;*
0580 0355 BA                CMP     D
0581 0356 C2 5F 03          JNZ     OUT1
0582 0359 CD D2 03          CALL    ROGER
0583 035C C3 FC 01          JMP     TTON2   ;EXIT
0584 035F AF        OUT1:   XRA     A
0585 0360 BA                CMP     D
0586 0361 CA CC 03          JZ      OUTE    ;NO GOOD
0587 0364 BB                CMP     E
0588 0365 CA CC 03          JZ      OUTE
0589 0368 7A                MOV     A,D
0590 0369 FE 0A             CPI     10
0591 036B C2 73 03          JNZ     OUT4
0592 036E 16 00             MVI     D,0
0593 0370 C3 79 03          JMP     OUT5
0594 0373 3E 07     OUT4:   MVI     A,7
0595 0375 BA                CMP     D
0596 0376 DA CC 03          JC      OUTE
0597 0379 3E 08     OUT5:   MVI     A,8
0598 037B BB                CMP     E
0599 037C DA CC 03          JC      OUTE
0600 037F 3E 01             MVI     A,1
0601 0381 B8                CMP     B
0602 0382 CA BE 03          JZ      OUT3
0603 0385 3E 0A             MVI     A,10
0604 0387 B8                CMP     B
0605 0388 CA BE 03          JZ      OUT3
0606 038B C3 CC 03          JMP     OUTE
0607 038E CD D2 03  OUT3:   CALL    ROGER
0608 0391 3E 80             MVI     A,80H
0609 0393 07        OUT2:   RLC
0610 0394 1D                DCR     E
0611 0395 C2 93 03          JNZ     OUT2
0612 0398 5F                MOV     E,A
0613 0399 7A        OPRT:   MOV     A,D     ;PORT D
0614 039A 07                RLC             ;TIMES 10H
0615 039B 07                RLC
0616 039C 07                RLC
0617 039D 07                RLC
0618 039E 32 E8 30          STA     OUTR2
0619 03A1 78                MOV     A,B     ;LEVEL
0620 03A2 43                MOV     B,E     ;BIT B
0621 03A3 3D                DCR     A
0622 03A4 F5                PUSH    PSW
0623 03A5 7A                MOV     A,D
0624 03A6 11 F0 30          LXI     D,OUTON
0625 03A9 83                ADD     E
0626 03AA 5F                MOV     E,A
0627 03AB 7A                MOV     A,D
0628 03AC CE 00             ACI     0
0629 03AE 57                MOV     D,A
0630 03AF 3E D3             MVI     A,0D3H
0631 03B1 32 EA 30          STA     OUTR1   ;OUT INSTR
0632 03B4 3E C9             MVI     A,0C9H
0633 03B6 32 EC 30          STA     OUTR3   ;RETURN INSTR
0634 03B9 F1                POP     PSW
0635 03BA CA C6 03          JZ      OPRT1
0636 03BD CD 10 02  OPRT0:  CALL    BITC
0637 03C0 CD EA 30  OPRT2:  CALL    OUTR1   ;OUTPUT
0638 03C3 C3 50 03          JMP     OUT     ;GET NEXT CMD
0639 03C6 CD 0C 02  OPRT1:  CALL    BITS
0640 03C9 C3 C0 03          JMP     OPRT2
0641 03CC CD 90 02  OUTE:   CALL    WCD
0642 03CF C3 50 03          JMP     OUT
0643 03D2           ;
0644 03D2           ;
0645 03D2           ;
0646 03D2           ROGER:  EQU     $
0647 03D2           ;ROGER SENDS AN 'R' IN MORSE
0648 03D2 CD 90 02          CALL    WCD
0649 03D5 F5                PUSH    PSW
0650 03D6 3A F7 30          LDA     LKBOC
0651 03D9 B7                ORA     A
0652 03DA C2 F6 03          JNZ     ROG1
0653 03DD E5                PUSH    H
0654 03DE D5                PUSH    D
0655 03DF C5                PUSH    B
0656 03E0 3A F6 30          LDA     MASK
0657 03E3 F5                PUSH    PSW
0658 03E4 3E C0             MVI     A,0C0H
0659 03E6 32 F6 30          STA     MASK
0660 03E9 2A 06 10          LHLD    RMSGA   ;LOC OF RMSG
0661 03EC CD 08 01          CALL    CW
0662 03EF F1                POP     PSW
0663 03F0 32 F6 30          STA     MASK
0664 03F3 C1                POP     B
0665 03F4 D1                POP     D
0666 03F5 E1                POP     H
0667 03F6 F1        ROG1:   POP     PSW
0668 03F7 C9                RET
0669 03F8           ;
0670 03F8           ;
0671 03F8           ;
0672 03F8           ;FORCE 6 REPEATER IDENTIFICATION
0673 03F8 AF        IDENT:  XRA     A
0674 03F9 32 F5 30          STA     TIME    ;FORCE 6N ID
```

Our exchange is an electronic switching system and is very rapid. If it commonly takes longer than one second at your exchange, change the number 15 to a larger number in line #1057. A 1 is sent to the LD output, preparing to dial the number. At PTCH6, the number is dialed. Each tone is on for 65 ms and off for 65 ms, the time DELAY waits. The binary digit numbers are converted to the proper row and column format by the TTTAB (touchtone table). When the number is completed, LD is turned off, and if NOTIM is not 0, the timer is disabled. Similarly, if 8 or 11 digits are requested and the first digit is a 0, the same procedure applies. If a single-digit number is requested, a table is searched at PCH10. The single digit table, SDTAB, has the single digit followed by the address of the corresponding telephone number. At the loca-

```
03FC C3 FC 01              JMP    TTON2
03FF                ;
03FF                ;
03FF                ;
03FF                       ORG    1000H    ;SECOND ROM
1000 EA 30          STCK:  DW     STOCK
1002 15 10          CDTAB: DD     COOTB
1004 40 10          CPRMC: DD     CFMCO
1004 9H 10          OHSGA: DV     RMOG
1006 4E 10          10AD:  DD     10AD1
100A 5F 10                 DD     10AD2
100C 75 10                 DD     10AD3
100E 84 10                 DD     10AD4
1010 25 30                 DD     10AD5
1012 C3 12 13       LNUMA: JMP    LNUM
1015                ;
1015 09             COOTB: DD     6
1016 08                    DB     7
1017 0C                    DB     12      ;0
1018 07 11                 DD     PATCH
101A 03                    DD     9
1010 0C                    DD     12      ;0
101C 0A                    DD     5
1010 AF 12                 DD     ODASE
101F 03                    DD     3
1020 0C                    DD     12      ;0
1021 03                    DD     3
1022 EF 02                 DD     SELCL
1024 01                    DD     1
1025 0C                    DD     12      ;0
1026 01                    DD     1
1027 07 02                 DD     LINK
1029 02                    DD     2
102A 0C                    DD     12      ;0
1020 02                    DD     2
102C CF 02                 DD     TAPE
102E 04                    DD     4
102F 0C                    DD     12      ;0
1030 04                    DD     4
1031 F3 10                 DD     TTTST
1033 05                    DD     5
1034 0C                    DD     12      ;0
1035 05                    DD     5
1036 C1 12                 DD     DIAL
1030 0C                    DD     6
1039 02                    DD     11      ;*
163A 00                    DD     12      ;0
1030 FF 02                 DD     CNTRL
1030 0C                    DD     12      ;0
103E 05                    DD     4
103F 00                    DD     0
1040 07 12                 DD     LOCK
1042 6C                    DD     8
1043 00                    DD     11      ;*
1044 02                    DD     2
1045 07 12                 DD     TAP2
1047 00                    DD     0
1048 00             CPOCD: DD     12      ;0
1049 02                    DD     11      ;*
1046 0C                    DD     6
1040 12 03                 DD     CNTRO
1040 00                    DD     0
104E                ;
104E                ;
104E                ;
104E 83             10AD1: DD     80H
104F 90                    DD     90H     ;D
1050 40                    DD     40H     ;0
1051 80                    DD     88H     ;SP
1052 70                    DD     70H     ;D
1053 50                    DD     80H     ;D
1054 1C                    DD     1CH     ;3
1055 60                    DD     60H     ;0
1056 28                    DD     28H     ;P
1057 E0                    DD     0E0H    ;D
1058 80                    DD     80H     ;SP
1059 89                    DD     88H     ;D
105A 60                    DS     80H     ;0
1058 50                    DD     50H     ;R
105C A8                    DD     0A6H    ;C
1058 00                    DD     80H     ;SP
105E 00                    DD     0
105F 80             IDAD2: DD     80H     ;SP
1060 90                    DD     90H     ;D
1061 40                    DD     40H     ;E
1062 80                    DD     80H     ;SP
1063 70                    DD     70H     ;D
1064 50                    DD     50H     ;D
1065 1C                    DD     1CH     ;3
1066 60                    DD     60H     ;A
1067 28                    DD     28H     ;F
1066 E0                    DD     0E0H    ;M
1069 80                    DD     80H     ;SP
106A 88                    DD     88H     ;D
1060 60                    DD     60H     ;A
106C 48                    DD     48H     ;L
1060 C0                    DD     0C0H    ;T
106E 20                    DD     20H     ;1
106F E0                    DD     0E0H    ;D
1070 F0                    DD     0F0H    ;O
1071 50                    DD     50H     ;R
1072 40                    DD     40H     ;E
1073 80                    DD     80H     ;SP
1074 00                    DD     0
1075 80             10AD3: DD     80H     ;SP
1076 C4                    DD     0C4H    ;7
1077 1C                    DD     1CH     ;3
1078 00                    DD     80H     ;SP
1079 90                    DD     90D     ;0
107A 40                    DD     40H     ;E
1070 80                    DD     80H     ;SP
107C 70                    DD     70H     ;M
1070 50                    DD     50H     ;R
107E 1C                    DD     1CH     ;3
107F 60                    DD     60H     ;A
1080 28                    DD     28H     ;F
1081 E0                    DD     0E0H    ;D
1082 80                    DD     80H     ;SP
1081 00                    DD     0
1084 80             IDAD4: DD     80H     ;SP
1085 00                    DD     90H     ;D
1086 40                    DD     40H     ;E
1087 80                    DD     80H     ;SP
1088 70                    DD     70H     ;U
1089 50                    DD     80H     ;D
108A 1C                    DD     1CH     ;3
1080 63                    DD     60H     ;D
108C 28                    DD     28H     ;F
1080 E0                    DD     0E0H    ;D
108E 80                    DD     80H     ;SP
108F 88                    DD     88H     ;D
1090 60                    DD     60H     ;A
1091 48                    DD     48H     ;L
1092 C0                    DD     0C0H    ;T
1093 F0                    DD     0F0H    ;D
1094 80                    DD     88H     ;SP
1095 69                    DD     68H     ;A
1096 50                    DD     50H     ;D
1097 A8                    DD     0A8H    ;C
1098 80                    DD     80H     ;SP
1099 00                    DD     0
109A 80             RMSG:  DD     80H     ;SP
1098 80                    DD     80H     ;SP
109C 80                    DD     80H     ;SP
1090 50                    DD     50H     ;D
109E 80                    DD     80H     ;SP
109F 00                    DD     0
10A0                ;
10A0                ;
10A0                ;
10A0                IDLO:  EDD    0
10A0                ;IO LOOP LOADS 8 CV ID INTO ROM
10A0                ;THIS CORRESPONDS TO ID 03
10A0                ;
10A0                ;0 IS BIT, 1 IS 88H
10A0                ;2 IS END CHARACTER
10A0                ;3 IS END ID
10A0                ;
10A0 21 25 30              LXI    H,IDBD5
10A3 06 08          IDLOD: MVI    B,0
10A5 0E 08                 MVI    C,8      ;ELEMENT COUNT
10A7 DB 10          IDLD1: IN     PORTI
10A9 2F                    CMA
10AA E6 45                 ANI    40H
10AC CA A7 10              JZ     IDLD1
10AF C0 30 02              CALL   DECOD
10B2 FE 03                 CPI    3
10B4 C2 BF 10              JNZ    IDNTD
10B7 36 00                 MVI    M,0
10B9 C0 B2 03              CALL   OOGED
10BC C3 FC 01              JMP    TTON2
10BF FE 02          IONTD: CPI    2
10C1 C2 D9 10              JNZ    IDCH
10C4 78                    MOV    B,B
10C5 37                    STC              ;LEFT JUSTIFY
10C6 17             IDOLT: RAL
10C7 47                    MOV    B,A
10C8 0C                    INR    C
10C9 3E 07                 MVI    A,7
10CB B9                    CMP    C
10CC DA 04 10              JC     IDOL
10CF AF                    XRA    A
10D0 78                    MOV    A,B
10D1 C3 C6 10              JMP    IDOLT
10D4 70             IDOL:  MOV    M,B
10D5 23                    INX    H
10D4 C3 A3 10              JMP    IDLOD
10D9 FE 01          IDCH:  CPI    1
10DB C2 E6 10              JNZ    IDCHD
10DE 78                    MOV    A,B
10DF 37                    STC
10E0 17                    RAL
10E1 47                    MOV    B,A
10E2 0C                    INR    C
10E3 C3 A7 10              JMP    IDLD1
10E6 FE 0A          IDCHD: CPI    10
10E8 C2 A7 10              JNZ    IDLD1   ;INVALID
10EB AF                    XRA    A
10EC 78                    MOV    A,B
10ED 17                    RAL
10EE 47                    MOV    B,A
10EF 0C                    INR    C
10F0 C3 A7 10              JMP    IDLD1
10F3                ;
10F3                ;
10F3                ;
10F3                TTTST: EDD    0
10F3                ;TOUCH TONE (R) TEST ROUTINE
10F3                ;THIS FUNCTION PLACES UP TO 24 DIGITS
10F3                ;INTO A BUFFER AND REPEATS WHAT IT RECEIVED
10F3                ;IN CD AFTER CARRIER DROP
10F3                ;
10F3 3A F8 30              LDA    OUTON   ;ENABLED?
10F6 E6 08                 ANI    8
10F8 C2 FC 01              JNZ    TTON2   ;NO
10FB C0 69 11              CALL   GETTT   ;GET TOUCH TONE (R)
10FE 11 01 30       TTSTO: LXI    D,TTDIG+1
1101 3A 00 30              LDA    TTDIG
1104 F5                    PUSH   PSW     ;SAVE IT
1105 3A 00 30       TTST1: LDA    TTDIG
1108 B7                    ORA    A
1109 C2 13 11              JNZ    TTST3
```

Continued on next page

tion of the number, the number of digits precedes the actual number, permitting any digit length. A 0 must be stored as a decimal 10. If the number is not found, PATCH exits. If found, the digit count is checked, primarily for the programmable number. If the number is valid, the telephone number is copied into the GETTT buffer, NOTIM is set, and control goes to PTCH3, where the rest is normal.

The remote base routine, RBASE, merely pulses RB. TAP2, the secondary tape access, jumps to the appropriate point in TAPE. DIAL, the 5#5 function, makes various checks and jumps to TTTST at a point where the existing buffer is sent.

The two ROMs are set up in a fashion to permit as many changes as possible in the second ROM without requiring a replacement of the first ROM as well. Most

```
110C F1                   POP     PSW
110D 32 00 30             STA     TTDIG   ;RESTORE IT
1110 C3 FC 01             JMP     TTON2   ;DONE
1113 3D          TTST2:   DCR     A
1114 32 00 30             STA     TTDIG
1117 D5                   PUSH    D
1118 21 87 11             LXI     H,CW9SP ;SPACE
1119 3A F6 3D             LDA     MASK
111E F5                   PUSH    PSW
111F 3E C0                MVI     A,0C0H  ;150 ONLY
1121 32 F6 30             STA     MASK
1124 CD 0B 01             CALL    CW
1127 F1                   POP     PSW
1129 32 F6 30             STA     MASK
1129 D1                   POP     D
112C D5                   PUSH    D
112D 1A                   LDAX    D               ;GET DIGIT
112E 3D                   DCR     A
112F 07                   RLC                     ;TIMES 2
1130 5F                   MOV     E,A
1131 16 00                MVI     D,0
1133 21 50 11             LXI     H,DIGAD
1136 19                   DAD     D
1137 5E                   MOV     E,M
1138 23                   INX     H
1139 56                   MOV     D,M
113A EB                   XCHG                    ;ADDR TO HL
113B 3A F6 3D             LDA     MASK
113E F5                   PUSH    PSW
113F 3E C0                MVI     A,0C0H
1141 32 F6 30             STA     MASK
1144 CD 09 01             CALL    CW
1147 F1                   POP     PSW
1148 32 F6 30             STA     MASK
114B D1                   POP     D
114C 13                   INX     D
114D C3 05 11             JMP     TTST1
1150             ;
1150             ;
1150             ;
1150 63 11       DIGAD:   DW      CWD1
1152 6A 11                DW      CWD2
1154 6C 11                DW      CWD3
1156 6E 11                DW      CWD4
1159 70 11                DW      CWD5
115A 72 11                DW      CWD6
115C 74 11                DW      CWD7
115E 76 11                DW      CWD8
1160 78 11                DW      CWD9
1162 7A 11                DW      CWD0
1164 7C 11                DW      CWDS
1166 91 11                DW      CWDP
1168             ;
1169             ;
1169             ;
1169 7C          CWD1:    DB      7CH
1169 00                   DB      0
116A 3C          CWD2:    DB      3CH
1169 00                   DB      0
116C 1C          CWD3:    DB      1CH
116D 00                   DB      0
116E 0C          CW94:    DB      0CH
116F 00                   DB      0
1170 04          CW95:    DB      6
1171 00                   DB      0
1172 84          CW96:    DB      84H
1173 00                   DB      0
1174 C4          CW97:    DB      0C4H
1175 00                   DB      0
1176 E4          CWD0:    DB      0E4H
1177 00                   DB      0
1178 F4          CWD9:    DB      0F4H
1179 00                   DB      0
117A FC          CWD0:    DB      0FCH
117B 00                   DB      0
117C 10          CWDS:    DB      10H     ;S
117D C0                   DB      0C0H    ;T
117E 60                   DB      60H     ;A
117F 90                   DB      90H     ;R
1180 00                   DB      0
1181 68          CWDP:    DB      68H     ;P
1182 F0                   DB      0F0H    ;O
1183 30                   DB      30H     ;U
1184 40                   DB      0A0H    ;N
1185 90                   DB      90H     ;D
1186 00                   DB      0
1187 80          CW9SP:   DB      80H
1188 00                   DB      0
1189             ;
1189             ;
1189             ;
1189             GETTT:   EQU     $
1189             ;GET TOUCH TONE (R) ROUTINE
1189             ;PLACES UP TO 24 DIGITS IN BUFFER
1189             ;AT TTDIG+1. DIGIT COUNT AT TTDIG
1189 11 00 30             LXI     D,TTDIG
118C AF                   XRA     A
118D 12                   STAX    D
118E 13                   INX     D
118F DB 10       GETTI:   IN      PORT1
1191 E6 20                ANI     20H
1193 C0                   RNZ                     ;CARRIER GONE
1194 DB 10                IN      PORT1
1196 E6 40                ANI     40H
1198 C2 8F 11             JNZ     GETTI   ;NO TONE
119B CD 30 02             CALL    DECOD
119E B7                   ORA     A
119F CA 8F 11             JZ      GETTI
11A2 12                   STAX    D               ;STORE DIGIT
11A3 13                   INX     D
11A4 3A 00 30             LDA     TTDIC
11A7 3C                   INR     A
1169 32 0030              STA     TTDIG
11AD FE 19                CPI     24
11AD C2 8F 11             JNZ     GETTI
1190 C3 90 02             JMP     BCD
1183             ;
1183             ;
1183             ;
1183             ;AUTOPATCH ROUTINE - CHECKS REQUESTED
1181             ;NUMBER FOR VALIDITY. IF OK IT
1183             ;BRINGS UP LINE AND REDIALS THE NUMBER
1193 3A FA 30    PATCH:   LDA     OUT2H
1186 E6 20                ANI     20H
1188 C2 FC 01             JNZ     TTON2
118B AF                   XRA     A
118C 32 F1 30             STA     HOTIN
118F CD 89 11             CALL    GETTT   ;GET NUMBER
11C2 3A 00 30             LDA     TTDIG
11C5 B7                   ORA     A
11C6 C2 E6 11             JNZ     PTCH2
11C9 3A F0 30             LDA     OUTON   ;DIRECT
11CC E6 04                ANI     6       ;ENABLED?
11CE CA FC 01             JZ      TTON2   ;NO!
11D1 11 F9 30             LXI     D,OUTIN
11D4 06 08                MVI     B,8
11D6 CD 0C 02    PTCH1:   CALL    BITS
11D9 D3 10                OUT     PORT1
11DB CD 74 01             CALL    DELAY
11DE CD 10 D2             CALL    BITC
11E1 D3 10                OUT     PORT1
11E3 C3 FC D1             JMP     TTON2
11E6 FE 01       PTCH2:   CPI     1
11E8 CA 79 12             JZ      PTCH9
11E9 FE 07                CPI     7
11ED CA 6A 12             JZ      PTCH8
11F0 FE 08                CPI     11
11F2 CA FA 11             JZ      PTCH4
11F5 FE 09                CPI     9
11F7 C2 FC 01             JNZ     TTON2
11FA 3A 01 30    PTCH4:   LDA     TTDIG+1
11FD FE 0A                CPI     10      ;ZERO
11FF C2 FC 01             JNZ     TTON2   ;NOT COLLECT
1202 11 F9 30    PTCH3:   LXI     D,OUTIN
1205 06 09                MVI     B,8
1207 CD 0C 02             CALL    BITS
120A D3 10                OUT     PORT1
120C CD 74 01             CALL    DELAY
120F CD 10 02             CALL    BITC
1212 D3 10                OUT     PORT1
1214 3E 0F                MVI     A,15
1216 CD 74 01    PTCH5:   CALL    DELAY
1219 3D                   DCR     A
121A C2 16 12             JNZ     PTCH5   ;1 SEC WAIT
121D 11 F0 30             LXI     D,OUT3H
1220 06 40                MVI     B,40H
1222 CD 0C 02             CALL    BITS    ;TURN LINE ON
1229 D3 30                OUT     PORT3
1227 11 00 30             LXI     D,TTDIG
122A 1A                   LDAX    D       ;SAVE
1229 F5                   PUSH    PSW     ;IT
122C 3A 00 30    PTCH6:   LDA     TTDIG
122F B7                   ORA     A
1230 CA 54 12             JZ      PTCH7
1233 CD 74 01             CALL    DELAY
1234 3D                   DCR     A
1237 32 00 30             STA     TTDIG
123A 13                   INX     D
1238 1A                   LDAX    D       ;GET DIGIT
123C 3D                   DCR     A
123D 21 06 13             LXI     H,TTTAD
1240 65                   ADD     L
1241 6F                   MOV     L,A
1242 7C                   MOV     A,H
1243 CE 00                ACI     0
1245 67                   MOV     H,A
1246 7E                   MOV     A,M     ;TTCODE
1247 2F                   CMA
1248 D3 70                OUT     PORT7   ;SEND TONE
124A CD 74 01             CALL    DELAY
124D 3E FF                MVI     A,0FFH
124F D3 70                OUT     PORT7   ;TONE OFF
1251 C3 2C 12             JMP     PTCH6   ;NEXT
1254 11 F8 30    PTCH7:   LXI     D,OUT3H
1257 06 40                MVI     B,40H
1259 CD 10 02             CALL    BITC    ;LINE NORMAL
125C 47                   MOV     B,A
125D 3A F1 3D             LDA     HOTIN
1260 B0                   ORA     B
1261 D3 30                OUT     PORT3
1263 F1                   POP     PSW
1264 32 00 3D             STA     TTDIG   ;RESTORE IT
1267 C3 FC 01             JMP     TTON2   ;BGNS
126A 3A 01 30    PTCH8:   LDA     TTDIC+1
126D FE 01                CPI     1
126F CA FC 01             JZ      TTON2
1272 C3 02 12             JMP     PTCH3
1275 21 3F 13    PTCH9:   LXI     H,SDTAD
1278 3A 01 3D             LDA     TTDIG+1
127B 47                   MOV     B,A
127C 7E          PCN10:   MOV     A,M
127D B7                   ORA     A
127E CA FC 01             JZ      TTON2
1281 B8                   CMP     B
1282 CA 8B 12             JZ      PCN11
1285 23                   INX     H
1286 23                   INX     H
1287 23                   INX     H
1288 C3 7C 12             JMP     PCN10
128B 23          PCN11:   INX     H
128C 5E                   MOV     E,M
128D 23                   INX     H
128E 56                   MOV     D,M
128F EB                   XCHG
1290 7E                   MOV     A,M
1291 B7                   ORA     A
```

forward references from the lower ROM go to the beginning of the second ROM, which will not change if a routine in the second ROM is modified. Frequent use is made of reading an address from a fixed location rather than reading an address directly.

The code table is organized with a three-digit code preceding the address of the program to service that code. The end of the table is marked with a 0. Naturally, the published codes are not the ones in use. The CW ID messages are set up with leading and trailing spaces to clean up the ID.

The RAM has the bottom 25 bytes reserved for the digit buffer, including one for the buffer length. 12 bytes are reserved above that for the digit #1 telephone number. Above that, space is left for the programmable ID. 22 bytes at the top are variables, and

```
1292 CA FC 01            JZ      TTON2
1295 FE 0C               CPI     12
1297 D2 FC 01            JNC     TTON2
129A 11 00 30            LXI     D,TTDIG
129D 46                  MOV     B,M
129E 04                  INR     B
129F 7E         PCH12:   MOV     A,M
12A0 12                  STAX    D
12A1 23                  INX     H
12A2 13                  INX     D
12A3 05                  DCR     B
12A4 C2 9F 12            JNZ     PCH12
12A7 3E 20               MVI     A,20H    ;DISABLE
12A9 32 F1 30            STA     MOTIM    ;TIMER
12AC C3 02 12            JMP     PTCH3
12AF            ;
12AF            ;
12AF            ;
12AF            ;REMOTE BASE CONNECTS RPT TO PHONE LINE
12AF            ;BUT DOES NOT SEIZE THE LINE
12AF 11 F9 30   RBASE:   LXI     D,OUT1M
12B2 06 04               MVI     B,4
12B4 C3 E6 11            JMP     PTCH1
12B7            ;
12B7            ;
12B7            ;
12B7 3A F8 30   TAP2:    LDA     OUTOM    ;TAPE ACCESS
12BA B7                  ORA     A        ;VIA CONTROL
12BB FA FC 01            JM      TTON2    ;STATION
12BE C3 D7 02            JMP     TAP1
12C1            ;
12C1            ;
12C1            ;
12C1            ;DIAL SENDS IN CW WHATEVER WAS LAST
12C1            ;ENTERED VIA THE TTT ROUTINE
12C1            ;OR THE AUTOPATCH
12C1 3A F6 30   DIAL:    LDA     OUTOM    ;WHAT DID I DIAL?
12C4 E6 10               ANI     10H      ;ENABLED?
12C6 C2 FC 01            JNZ     TTON2    ;NO
12C9 3A 00 30            LDA     TTDIG
12CC FE 19               CPI     25       ;VALID?
12CE D2 FC 01            JNC     TTON2    ;NO
12D1 CD 90 02            CALL    WCD
12D4 C3 FE 10            JMP     TTSTO
12D7            ;
12D7            ;
12D7            ;
12D7            ;LOCK PERMITS A LOCKOUT OF CONTROL
12D7            ;AND DISABLING OF THE ROGER ROUTINE
12D7            ;LOCK WAITS FOR 3 DIGITS:
12D7            ;THE SECOND ELIMINATES (1) OR CLEARS (0)
12D7            ;THE ROGER ROUTINE.
12D7            ;THE THIRD LOCKS OR UNLOCKS ENTRY
12D7            ;TO THE CONTROL MODE
12D7 CD 19 02   LOCK:    CALL    LOAD
12DA 3E 01               MVI     A,1
12DC BB                  CMP     E
12DD C2 E3 12            JNZ     LOCK3
12E0 C3 EA 12            JMP     LOCK4
12E3 3E 0A      LOCK3:   MVI     A,10
12E5 BB                  CMP     E
12E6 C2 ED 12            JNZ     LOCK5
12E9 AF                  XRA     A
12EA 32 F7 30   LOCK4:   STA     LKROG
12ED 3E 01      LOCK5:   MVI     A,1
12EF B8                  CMP     B
12F0 C2 F6 12            JNZ     LOCK1
12F3 C3 FD 12            JMP     LOCK2
12F6 3E 0A      LOCK1:   MVI     A,10
12F8 B8                  CMP     B
12F9 C2 FC 01            JNZ     TTON2    ;INVALID
12FC AF                  XRA     A
12FD 32 F2 30   LOCK2:   STA     LCKR
1300 CD D2 03            CALL    ROGER
1303 C3 FC 01            JMP     TTON2
1306            ;
1306            ;
1306            ;
1306            ;TABLE FOR REGENERATING TOUCH TONES (R)
1306 88         TTTAB:   DB      88H      ;1
1307 84                  DB      84H      ;2
1308 82                  DB      82H      ;3
1309 48                  DB      48H      ;4
130A 44                  DB      44H      ;5
130B 42                  DB      42H      ;6
130C 28                  DB      28H      ;7
130D 24                  DB      24H      ;8
130E 22                  DB      22H      ;9
130F 14                  DB      14H      ;0
1310 18                  DB      18H      ;*
1311 12                  DB      12H      ;D
1312            ;
1312            ;
1312            ;
1312            ;LOAD NUMBER FOR SINGLE DIGIT DI
1312 21 19 30   LNUM:    LXI     H,NUMBR
1315 36 00               MVI     M,0
1317 DB 10      LNUM1:   IN      PORT1
1319 2F                  CMA
131A E6 40               ANI     40H
131C CA 17 13            JZ      LNUM1
131F CD 38 02            CALL    DECOD
1322 FE 0B               CPI     11       ;*
1324 C2 2D 13            JNZ     LNUM2
1327 CD D2 03            CALL    ROGER
132A C3 FC 01            JMP     TTON2
132D 47         LNUM2:   MOV     B,A
132E 3A 19 30            LDA     NUMBR
1331 FE 0B               CPI     11       ;MAX DIGITS
1333 CA 17 13            JZ      LNUM1
1336 3C                  INR     A
1337 32 19 30            STA     NUMBR
133A 23                  INX     H
133B 70                  MOV     M,B
133C C3 17 13            JMP     LNUM1
133F            ;
133F            ;
133F            ;
133F 01         SDTAB:   DB      1
1340 19 30               DW      NUMBR    ;D1
1342 02                  DB      2
1343 5B 13               DW      THUM2
1345 03                  DB      3
1346 63 13               DW      THUM3
1348 04                  DB      4
1349 6B 13               DW      THUM4
134B 05                  DB      5
134C 73 13               DW      THUM5
134E 06                  DB      6
134F 7B 13               DW      THUM6
1351 07                  DB      7
1352 83 13               DW      THUM7
1354 08                  DB      8
1355 8B 13               DW      THUM8
1357 09                  DB      9
1358 93 13               DW      THUM9
135A 00                  DB      0
135B            ;
135B 07         THUM2:   DB      7        ;BALTO CITY
135C 02                  DB      2
135D 02                  DB      2
135E 02                  DB      2
135F 03                  DB      3
1360 03                  DB      3
1361 03                  DB      3
1362 03                  DB      3
1363 07         THUM3:   DB      7        ;TRANSIT & TPC
1364 03                  DB      3
1365 09                  DB      9
1366 06                  DB      6
1367 03                  DB      3
1368 0A                  DB      10
1369 05                  DB      5
136A 0A                  DB      10
136B 07         THUM4:   DB      7        ;MD STATE POL
136C 04                  DB      4
136D 08                  DB      8
136E 06                  DB      6
136F 03                  DB      3
1370 01                  DB      1
1371 0A                  DB      10
1372 01                  DB      1
1373 07         THUM5:   DB      7        ;HARBOR TUNNEL
1374 03                  DB      3
1375 05                  DB      5
1376 05                  DB      5
1377 03                  DB      3
1378 05                  DB      8
1379 0A                  DB      10
137A 0A                  DB      10
137B 07         THUM6:   DB      7        ;ANNE ARUNDEL
137C 04                  DB      9
137D 08                  DB      8
137E 07                  DB      7
137F 04                  DB      4
1380 0A                  DB      10
1381 05                  DB      5
1382 0A                  DB      10
1383 07         THUM7:   DB      7        ;COAST GUARD
1384 07                  DB      7
1385 08                  DB      8
1386 09                  DB      9
1387 08                  DB      8
1388 0A                  DB      10
1389 05                  DB      5
138A 0A                  DB      10
138B 07         THUM8:   DB      7        ;BALTO CO
138C 04                  DB      4
138D 09                  DB      9
138E 04                  DB      4
138F 02                  DB      2
1390 01                  DB      1
1391 01                  DB      1
1392 01                  DB      1
1393 07         THUM9:   DB      7        ;HOWARD CO
1394 04                  DB      4
1395 06                  DB      6
1396 05                  DB      5
1397 01                  DB      1
1398 06                  DB      6
1399 01                  DB      1
139A 01                  DB      1
139B            ;
139B            ;
139B            ;
139B                     ORG     3000H    ;RAM BOTTOM
3000            ;
3000            TTDIG:   EQU     $
3000                     DS      25       ;SPACE FOR DIGITS
3019            NUMBR:   DS      12       ;TEL #1
3025            IDADS:   EQU     $
3025                     DS      197      ;SPACE FOR STOCK, ID DS
30EA            STOCK:   EQU     $
30EA            OUTR1:   DS      1
30EB            OUTR2:   DS      1
30EC            OUTR3:   DS      1
30ED            TIMER:   DS      4
30F1            MOTIM:   DS      1
30F2            LCKR:    DS      1
30F3            IDS:     DS      1
30F4            IDR:     DS      1
30F5            TIME:    DS      1
30F6            MASK:    DS      1
30F7            LKROG:   DS      1
30F8            OUTOM:   DS      1
30F9            OUT1M:   DS      1
30FA            OUT2M:   DS      1
30FB            OUT3M:   DS      1
30FC            OUT4M:   DS      1
30FD            OUT5M:   DS      1
30FE            OUT6M:   DS      1
30FF            OUT7M:   DS      1
```

the stack starts below them. The stack works down, and the programmable ID works up. No safeguards are set up to eliminate the two clashing. The amount of space is so large for the required functions that for even the longest imaginable ID message there will be plenty of room left for the stack. I do not suggest testing the system by loading an ID of 197 characters! Up to 150 should be safe. OUT0M is a dummy output port. Although it is set up as an output port, there is no physical port. This is convenient for both programming and operation.

Design Philosophy

As previously mentioned, several years ago I had constructed a microprocessor system to perform a similar

function. At that time, I built the hardware first. After completing this project, I have no doubt that the proper procedure is the other way around. A general idea of the hardware should be in mind, but the program should be written first. Writing the program defines the parameters of the system. By doing so, I found that some hardware modifications were needed that otherwise I would have had to go back and redo.

The program was written and debugged on the development system described. I configured the I/O ports so that the program could be executed on my large system. The program was in operation on it before a single wire was cut to construct the hardware. Clip leads and external oscillators were used to test the system. Did you ever try to simulate touchtones with clip leads, trying not to be caught by a three-second timer?

The program was modularized as much as possible. If any routine is longer than about two or three pages, it is too long and should be broken down into smaller routines. Not only is it easier to write that way, but it is also easier to understand how it works a few months later. For routines with many conditionals, flowcharts are a must. Originally, a skeleton program was written—just enough so that the entire program was self-consistent. Gradually the individual routines can be added to the code table and debugged. The throughput using these techniques can be quite high. I wrote the skeleton program in one day, and debugged it the next. Once an operational program was ready, the hardware was constructed. In the week or so it took to build the thing, the program was beefed up. By the time the hardware was ready, the software was refined. I cannot overemphasize the fact that a 100% operational program is necessary before building the hardware. When the ROMs are plugged in, if the program is in any doubt, and the system does not work, you do not know if the problem is hardware or software, resulting in an exercise in futility.

The hardware/software tradeoffs previously mentioned are important. A lot of thought is necessary before plunging ahead with design. The total software and hardware development time/cost must be considered. Even though the individual pays nothing for his own software, thinking like the businessman who must pay for his software will give a more balanced design.

When building hardware, it is advantageous to freely add LEDs on signal lines. You may not need them after the circuitry is in operation, but they are invaluable when debugging and testing the system. Design a system that not only works properly, but also can be made to operate properly in a reasonable amount of time.

Fault tolerance is an area at the frontier of theoretical knowledge. The discipline is about a decade old, and much remains to be worked out satisfactorily. Semiconductor technology is increasing at a rate which is hard to keep up with. Writing programs which merely function, and programs which both function and are error-tolerant, are two different things. Instead of making equivalence tests, it is better to make relational tests. Otherwise, if an error occurs, a test may fall through. Subprograms are usually expected to be entered with certain initial conditions. They should be constructed so that if those conditions are erroneous, the subprogram will exit soon. The worst thing that can happen is an erroneous input condition resulting in an endless loop. In a controller, it may not be as easy to push the reset button when something goes awry as it is on a general-purpose computer. I certainly did not follow all of these tenets in writing the software; however, I attempted to keep them in mind as much as possible.

The original program, somehow, did manage to crash twice. After that, I added the error recovery portion. It is a very simple, first-order attack, but it covers more errors than a first glance shows. If the program gets into a false state, it will often go to a faulty address. Since the hardware uses a small amount of the address space, it is quite likely that the program will be sent to

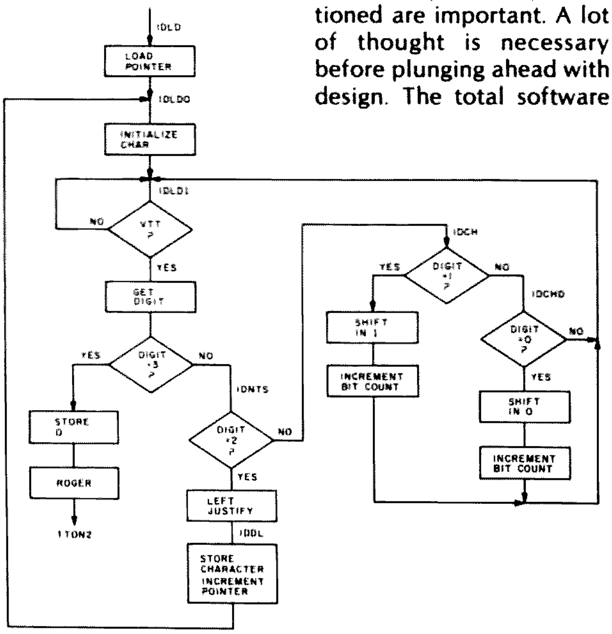

Fig. 8. ID load routine.

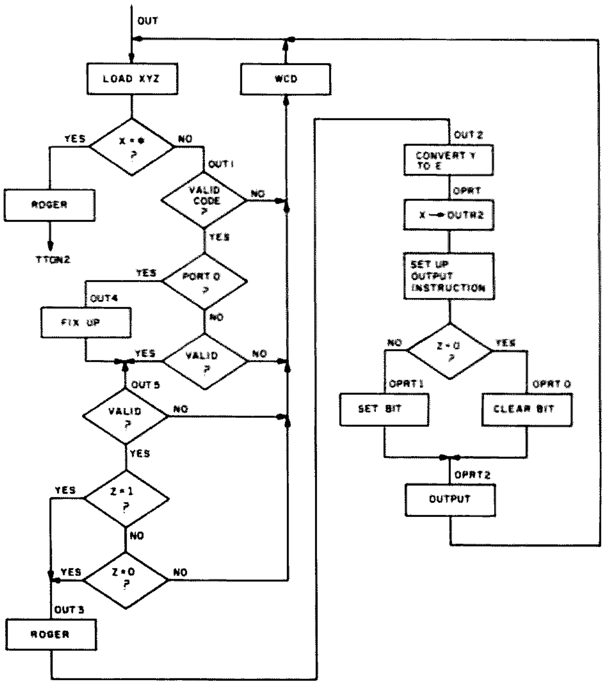

Fig. 9. Out routine.

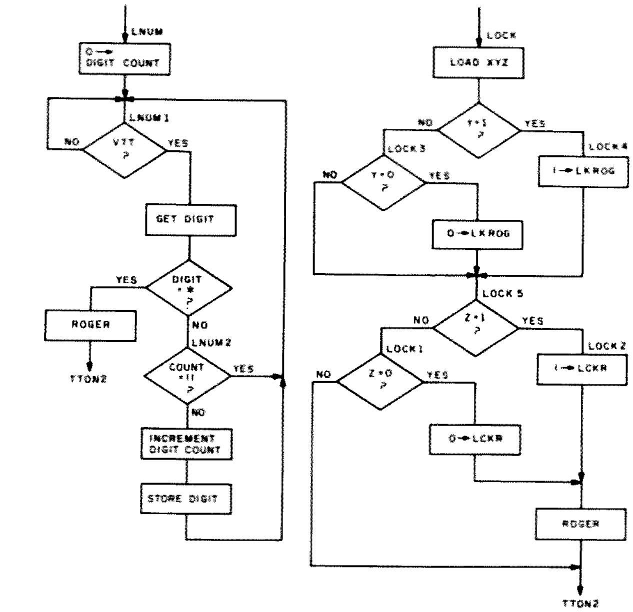

Fig. 10. Load number and lock routines.

a place where there is no memory. This results in reading all highs; the instruction FF is the interrupt instruction, so effectively an invalid memory address interrupts the program. That is why I placed the recovery routine at the interrupt location. The processor is not being interrupted, but it interprets the error as an interrupt. A second different thing about the fault-tolerant program is that the enable interrupt instruction was placed into the master loop. Otherwise, if the interrupt were ever disabled when in the foreground program, there would be no way to communicate with it.

I am not claiming that the system is totally fault-tolerant, but by the addition of some very simple checks, the fault tolerance can be increased tremendously. This entire project has been a good education.

Expansion

There are many additions and improvements which can be made. The advantage of the whole arrangement is that for many changes, hardware need not be touched. Many functions can be added by software changes only. It is more pleasant to sit in an easy chair at home rewriting the program than to sit on the cold, hard floor at the repeater site to effect changes. If changes don't work, all that has to be done is to put the original ROMs back in.

Additional hardware can be added to mate with the existing circuitry, and it is not necessary to worry about the additional control functions, as plenty of spares are already provided. A possible improvement to the software would allow interrogation of the status bits. This is a simple addition which is not required but might be useful. A planned hardware addition to the system will provide downlink telemetry from the site. Lights on the voting selector indicate which receivers are being accessed, and which receiver the voter selects. The telemetry will transmit the voter lights in real-time. Incorporated in the telemetry package will be an analog-to-digital converter. Upon command from the control system, the telemetry will switch from the voter lights to

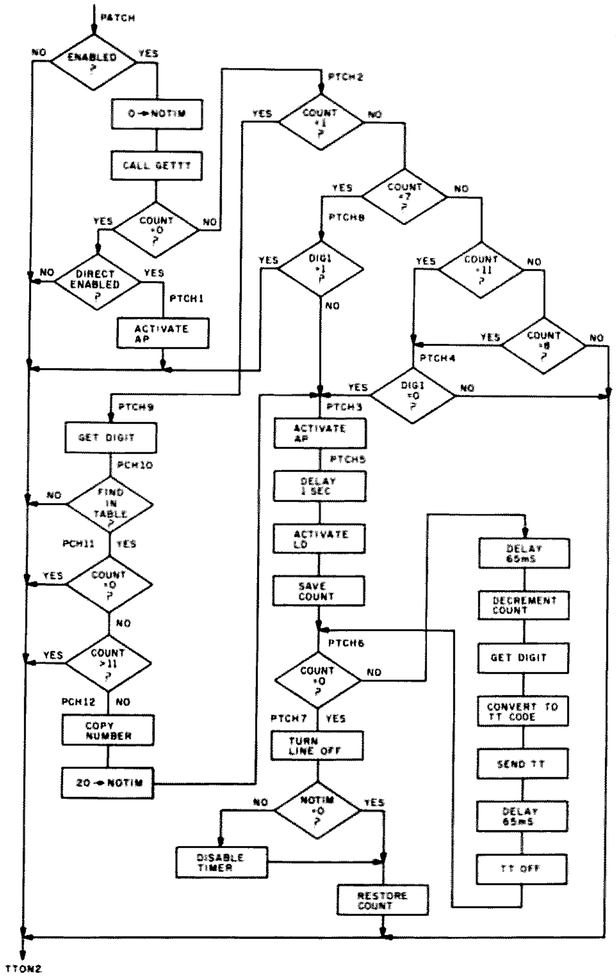

Fig. 11. Autopatch routine.

meter readings read by the A/D; plate voltage, plate and grid current for each repeater, and cabinet temperature could be read. With the existing central control system, the possibilities for expansion are straightforward and exciting.

Acknowledgements

I would like to thank Carroll Van Ness K3HZU for his able assistance in designing the autopatch circuitry. Until this time, Carroll has been the father of the control circuitry and the autopatch. His equipment always functioned fine, but there is only so much that can be done with relays. Carroll is now a microcomputer convert.

I received help from Vern Chapin K3VC with the metalwork. Despite broken saw blades and bruised fingers, he finished the panels.

I thank Frank Ayd WA3ILR, who stayed with me over 13 hours at the site on the day of installation. We were both dirty, tired, cold, and hungry, but he remained with me while making frantic pleas that we quit.

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The Micro Duper

—for small contests

The January VHF Sweepstakes is a very popular contest. It brings out operation on the VHF frequencies that usually does not exist at other times. In fact, anyone with a modest setup capable of 100 Watts on CW and SSB with a beam of 11 elements or better can make hundreds of contacts during this weekend on one band alone. Since I am equipped with just a TS-700A and 16 elements at 50 feet, I decided to try my luck on two meters.

A few glasses of wine later, my wife, Chris WA2KOU, and Bill WA2RZR became more interested in coming up with a computer dupe sheet for the contest than operating the contest itself. The computer system is the Heath H8/H9. The program calls for the operator to enter the call of the station. The computer will then ask if you have entered the call correctly in order to prevent typing mistakes. Upon answering with a "Y" for "yes," the computer will then ask if you wish to have the station logged into memory. This was placed into the program to allow the contest operator the opportunity to work (or try to work) that particular station. If you work that station and answer "Y" to the last computer question, the program logs that call and returns to the beginning.

If you answer "N" for "no" to the computer question "Do you have the call correct?", the computer will return again to the begnning and ask for another call to check.

In the event that you enter a call that has already been worked and logged, the computer will respond with "DUPE - DUPE - DUPE - DUPE - DUPE" or any other obscenity you wish to include and then return with a question for the next call. A sample of the program is shown in Fig. 1.

As can be seen, Fig. 1 is a rather simple program and can be expanded to include such things as different bands, etc. But the main purpose was to have an easy dupe sheet for the minimum amount of time and energy, and the maximum amount of glasses of wine. It works well, and it does not take much time to run in between contacts. If you make it too complex, it may take time away from hunting down the points. The program listing for this little gem is shown in Fig. 2. Good luck, and I'd like to hear about any changes.■

```
DUPE SEARCH FOR CALL? ------ WB3MIC
DO YOU HAVE CALL CORRECT ------ N
DUPE SEARCH FOR CALL ? ------ WB2MIC
DO YOU HAVE CALL CORRECT ------ Y
STATION NOT WORKED - CALL IT ------
SHOULD STATION BE LOGGED ? ------ Y
DUPE SEARCH FOR CALL ? ------ WB2MIC
DO YOU HAVE CALL CORRECT ? ------ Y
DUPE - DUPE - DUPE - DUPE - DUPE - DUPE - DUPE
DUPE SEARCH FOR CALL ? ------
```

Fig. 1. Sample run.

```
10 REM VHF S/S LOG WB2MIC and WA2RZR
15 DIM C$(250)
20 PRINT :PRINT :LINE INPUT "DUPE SHEET FOR CALL ? ------ ";A$
30 LINE INPUT "DO YOU HAVE CALL CORRECT ? ------ ";B$
40 IF B$ = "Y" THEN GOTO 60
50 GOTO 20
60 LET X = 0
70 X = X + 1
80 IF C$(X) = "" THEN GOTO 150
90 IF C$(X) = A$ THEN GOTO 200
100 GOTO 70
150 PRINT :PRINT "STATION NOT WORKED - CALL IT ----- "
160 LINE INPUT "SHOULD STATION BE LOGGED ? ------ ";B$
170 IF B$ = "Y" THEN GOTO 190
180 GOTO 20
190 LET C$(X) = A$
195 GOTO 20
200 PRINT "DUPE - DUPE - DUPE - DUPE - DUPE - DUPE - DUPE"
210 GOTO 20
```

Fig. 2. Program listing. Please note that, in statement 15, the number of contacts that the program will keep track of is 250, but can be changed by altering the number within the parentheses.

An 8080 Disassembler

—written in BASIC, yet!

Convenience plus.

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This program was written for a Poly-88 microcomputer. However, since it is in BASIC, it is easily modified for other 8080-based computers that have a BASIC interpreter or compiler available.

A disassembler's task is very difficult. It must be able to jump into the middle of the computer's memory, help the user to read the mixture of ASCII and numerical data stored there, and change the numerical instruction codes into mnemonic assembler code. Instructions on the 8080 are of variable length, and if the disassembler happens to start ih the middle of an instruction rather than at its beginning, what comes out is garbage.

To help cure these problems, this disassembler displays the contents of each location in hexadecimal, in ASCII, and in assembler code. It takes into account the variable length of the instructions. The misalignment problem is quite difficult, and if the disassembler is started in the middle of an instruction, it usually takes a few instructions before it is back on the track. However, this program incorporates a heuristic method for obtaining correct alignment. A special code "P", for "Previous instruction," attempts to find the nearest previous instruction that seems reasonable. What it actually does is this: first it jumps back in memory twelve bytes, then it disassembles its way forward to the last instruction that does not overlap the one you started in. The odds are very good that, during this process, the disassembler will find the proper alignment. This feature is, perhaps, the most interesting advance this disassembler exhibits. The other features that make it very convenient to use are explained in the operating instructions.

The disassembler was written by Douglas Wyatt, with a little bit of the code (and probably most of the bugs) supplied by me. A few comments on changing Poly BASIC to your BASIC might help. The exclamation point (!) means "PRINT." Anything shown in lowercase may be changed to uppercase. We think that it is nicer for the computer to talk in standard English if it can, so we use lowercase where appropriate. The function INP(1) grabs a character from the keyboard. Thus, lines 110 and 120 take a character, C, and ask if it is a RETURN (ASCII-13). If it is, the computer does a RETURN and a LINE FEED. The slash (/) allows two instructions to appear on the same line. You can modify this so that they are on separate lines if your BASIC doesn't support this feature.

Knowing the symbol equivalent of various ASCII codes is useful in understanding the program. Your BASIC must have the PEEK function, of course. On some, this is called EXAM. We also use TAB. If you don't have the multiway branch (the ON instruction) you will have to use a list of IFs. It's not all that hard.

Operating Instructions

When the program is running, a press on the space bar disassembles the next instruction. Any key

Program listing.

```
90 GOSUB 9000\REM INITIALIZE
100 !"*",
110 C=INP(1)
120 IF C=13 THEN !\GOTO 100
130 IF (C<32) OR (C>122) THEH 110
140 GOSUB 200
145 GOSUB 1000
150 GOTO 100
200 IF C>96 THEN C=C-32\REM MAKE UPPER-CASE
205 C$=CHR$(C)
210 IF C$=" " THEN RETURN
220 IF C$="A" THEN 2000
230 IF C$="J" THEN 400
240 IF C$="B" THEN 500
250 IF C$="C" THEN 450
260 IF C$="R" THEN 600
270 IF C$="P" THEN 700
300 A=A0
310 RETURN
400 IF J0=0 THEN 300
410 !"Jump",
420 A=E
430 RETURN
450 IF J0=0 THEN 300
460 !"Call",
465 S(S0)=A
470 S0=S0+1
475 A=E
480 RETURN
500 !"Back"
510 A=A0-1
520 RETURN
600 IF S0=0 THEN 300
610 !"Return",
620 S0=S0-1
630 A=S(S0)
640 RETURN
700 !"Previous instr."
710 T=A0-12
720 A=T\GOSUB 1200
730 I=B(PEEK(A))
740 T=T+I
750 IF T<A0 THEN 720
760 RETURN
1000 !\REM MAIN LOOP
1005 GOSUB 1200
1010 H2=A\GOSUB 4000\REM PRINT ADDRESS
1020 !":",TAB(T1),
1025 A0=A\REM REMEMBER ADDRESS
1030 X=PEEK(A)
1040 FOR I=0 TO B(X)-1
1050 H=PEEK(A+I)
1055 GOSUB 4200
1060 NEXT I
1065 !TAB(T2),
1070 FOR I=0 TO B(X)-1
1075 H=PEEK(A+I)
1080 IF(H<32)OR(H>126) THEN !"_", ELSE !CHR$(H),
1085 NEXT I
1090 !TAB(T3),
1100 GOSUB 5000\REM DISASSEMBLE INSTRUCTION
1110 !TAB(T4),
1120 RETURN
1195 REM NORMALIZE A
1200 IF A<0 THEN A=A+W\GOTO 1200
1210 IF A<W THEN RETURN
1220 A=A-W*INT(A/W)
1230 RETURN
2000 !"Address: "
2010 GOSUB 2200
2020 A=H2
2030 RETURN
2195 REM GET A HEX NUMBER FROM THE KEYBOARD
2200 H2=0
2210 I=0
2220 C=INP(1)
2225 C$=CHR$(C)
2230 C=C-48\REM ASCII 0
2240 IF C<0 THEH 2220
2250 IF C<10 THEN 2300
2260 C=C-7\REM MAGIC!
2270 IF (C<10)OR(C>15) THEN 2220
2300 !C$,
2310 I=I+1
2320 H2=16*H2+C
2330 GOTO 2220
2350 IF I=0 THEN 2220
2360 I=I-1
2370 H2=INT(H2/16)
2380 !CHR$(127),
2390 GOTO 2220
2400 IF I=0 THEN !"0",
2410 RETURN
3995 REM PRINT H2 AS 4 HEX DIGITS
4000 H=INT(H2/256)
4010 GOSUB 4200
4020 H=H2-256*H
4030 GOTO 4200
4195 REM PRINT H AS 2 HEX DIGITS
4200 N=INT(H/16)
4210 !H$(N+1,N+1),
4220 N=H-16*N
4230 !H$(N+1,N+1),
4240 RETURN
5000 REM GIVEN ADDRESS IN A, DISASSEMBLE 1 INSTRUCTION
5005 J0=0\REM ZERO JUMP FLAG
5010 X=PEEK(A)\REM OPCODE IN X
5015 A=A+1
5020 L=INT(X/64)\REM BITS 6-7
5030 ON L+1 GOTO 5100,7000,6000,8000
5100 REM 00XXXXXX
5120 ON J+1 GOTO 5130,5200,5400,5600,5700,5710,5800,5900
5130 IF X>0 THEN 7200
5140 !"NOP",
5150 RETURN
5200 REM 00XXX001
5210 J=INT(I/2)\REM BITS 4-5
5215 K=I-2*J\REM BIT 3
5220 IF K=0 THEN 5300
5230 !"DAD",
5240 GOTO 6600
5300 !"LXI"
5310 GOSUB 6600
5320 !",",
5330 GOTO 7500
5400 REM 00XXX010
5410 K=INT(I/4)\REM BIT 5
5420 I=I-4*K\REM BITS 3-4
5430 IF K=1 THEN 5500
5440 J=INT(I/2)\REM BIT 4
5450 K=I-2*J\REM BIT 3
5460 ON K+1 GOTO 5470,5480
5470 !"STAX",\GOTO 6600
5480 !"LDAX",\GOTO 6600
5500 ON I+1 GOTO 5510,5520,5530,5540
5510 !"SHLD",\GOTO 7450
5520 !"LHLD",\GOTO 7450
5530 !"STA",\GOTO 7450
5540 !"LDA",\GOTO 7450
5600 REM 00XXX011
5610 J=INT(I/2)\REM BITS 4-5
5620 K=I-2*J\REM BIT 3
5630 OH K+1 GOTO 5640,5650
5640 !"INX",\GOTO 6600
5650 !"DCX",\GOTO 6600
5700 !"INR",\J=I\GOTO 6400
5710 !"DCR",\J=I\GOTO 6400
5800 REM 00XXX110
5810 !"MVI",
5815 J=I
5820 GOSUB 6400
5830 !",",
5840 GOTO 7700
5900 REM 00XXX111
5910 ON I+1 GOTO 5920,5930,5940,5950,5960,5970,5980,5990
5920 !"RLC",\RETURN
5930 !"RRC",\RETURN
5940 !"RAL",\RETURN
5950 !"RAR",\RETURN
5960 !"DAA",\RETURN
5970 !"CMA" \RETURN
5980 !"STC",\RETURN
5990 !"CMC",\RETURN
6000 REM 10XXXXXX
6030 ON I+1 GOTO 6100,6110,6120,6130,6140,6150,6160,6170
6100 !"ADD",\GOTO 6200
6110 !"ADC",\GOTO 6200
6120 !"SUB",\GOTO 6200
6130 !"SBB",\GOTO 6200
6140 !"AHA",\GOTO 6200
6150 !"XRA",\GOTO 6200
6160 !"ORA",\GOTO 6200
6170 !"CMP",\GOTO 6200
6200 !" ",
6210 GOTO 6500
6400 REM PRINT BLANK, THEN REG. NAME
6410 !" ",
6500 REM GIVEN J, PRINT REGISTER NAME
6510 N=J+1
6520 !R$(N,N),
6530 RETURN
6600 !" ",
6700 REM GIVEN J, PRINT RP NAME
6710 N=J+1
6720 C$=D$(N,N)
6730 !C$,
6740 IF C$="S" THEH !"P",
6750 RETURN
7000 REM 01XXXXXX
7010 IF X=118 THEN !"HLT",\RETURN
7020 !"MOV ",
7040 K=J\REM SAVE J
7050 J=I\GOSUB 6500
7060 !",",
7070 J=K\GOSUB 6500
```

```
7080 RETURN
7200 REM UNDEFINED INSTRUCTION
7210 !"--",
7220 RETURN
7400 REM JUMP OR CALL
7410 REM SET JUMP FLAG
7420 J0=1
7450 !" ",
7500 REM FETCH NEXT 2 BYTES, INTERPRET AS ADDRESS,
7510 REM AND PRINT IN HEX
7520 Y=PEEK(A)\A=A+1
7530 Z=PEEK(A)\A=A+1
7540 E=Y+256*Z\REM E IS EFFECTIVE ADDRESS
7550 H=Z\GOSUB 4200
7560 H=Y\GOSUB 4200
7570 RETURN
7700 REM FETCH AND PRINT NEXT BYTE
7710 Y=PEEK(A)\A=A+1
7720 H=Y
7730 GOTO 4200
7800 REM PRINT RST ADDRESS
7810 ! I,
7820 RETURN
8000 REM 11XXXXXX
8040 ON J+1 GOTO 8050,8100,8200,8300,8400,8500,8600,8700
8050 !"R",\REM RETURN ON CONDITION
8060 GOTO 8800
8100 REM 11XXX001
8105 J=INT(I/2)\REM BITS 4-5
8110 K=I-2*J\REM BIT 3
8115 IF K=1 THEN 8150
8120 !"POP ",
8130 GOTO 8900
8150 ON J+1 GOTO 8160,7200,8170,8180
8160 !"RET",\RETURN
8170 !"PCHL",\RETURN
8180 !"SPHL",\RETURN
8200 REM 11XXX010
8210 !"J",\REM JUMP ON CONDITION
8220 GOSUB 8800
8230 GOTO 7400
8300 REM 11XXX011
8310 ON I+1 GOTO 8320,7200,8330,8340,8350,8360,8370,8380
8320 !"JMP",\GOTO 7400
8330 !"OUT ",\GOTO 7700
8340 !"IN ".\GOTO 7700
8350 !"XTHL".\RETURN
8360 !"XCHG".\RETURN
8370 !"DI",\RETURN
8380 !"EI".\RETURN
8400 REM 11XXX100
8410 !"C",\REM CALL ON CONDITION
8420 GOSUB 8800
8430 GOTO 7400
8500 REM 11XXX101
8510 J=INT(I/2)\REM BITS 4-5
8520 K=I-2*J\REM BIT 3
8530 IF K=1 THEN 8550
8540 !"PUSH ".\GOTO 8900
8550 ON J+1 GOTO 8560,7200,7200,7200
8560 !"CALL",
8570 GOTO 7400
8600 REM 11XXX110
8605 ON I+1 GOTO 8610.8615,8620,8625,8630,8635,8640,8645
8610 !"AD",\GOTO 8650
8615 !"AC",\GOTO 8650
8620 !"SU".\GOTO 8650
8625 !"SB",\GOTO 8650
8630 !"AN".\GOTO 8650
8635 !"XR",\GOTO 8650
8640 !"OR",\GOTO 8650
8645 !"CP",
8650 !"I ",
8660 GOTO 7700
8700 REM 11XXX111
8710 !"RST",
8720 H=I\GOSUB 7800
8730 RETURN
8800 REM GIVEN I, PRINT RET, CALL, OR JMP CONDITION
8810 ON I+1 GOTO 8820 8830,8840,8850,8860,8870,8880,8890
8820 !"NZ",\RETURN
8830 !"Z",\RETURN
8840 !"NC",\RETURN
8850 !"C",\RETURN
8860 !"PO",\RETURN
8870 !"PE".\RETURN
8880 !"P",\RETURN
8890 !"M",\RETURN
8900 REM GIVEN J, PRINT RP NAME FOR PUSH OR POP
8910 I=J+1
8920 C$=D$(I,I)
8930 IF C$="S" THEN !"PSW",\RETURN
8940 !C$,\RETURN
9000 REM INITIALIZATION
9010 DIM R$(8)
9020 R$="BCDEHLMA"\REM REGISTER NAMES
9030 DIM D$(4)
9040 D$="BDHS"\REM REGISTER PAIR NAMES
9050 DIM H$(16)
9060 H$="0123456789ABCDEF"
9100 DIM B(255)\REM # OF BYTES FOR INSTRUCTION
9105 FOR I=0 TO 63
9110 READ B(I)
9115 NEXT I
9120 FOR I=64 TO 191
9125 B(I)=1
9130 NEXT I
9135 FOR I=192 TO 255
9140 READ B(I)
9145 NEXT I
9150 DATA 1 3,1,1.1,1,2,1,1,1,1,1,1.1,2,1
9160 DATA 1,3,1,1,1,1,2,1,1,1,1,1,1,1,2,1
9170 DATA 1,3,3,1,1,1,2,1,1,1,3,1,1,1,2,1
9180 DATA 1,3,3,1,1,1,2,1,1,1,3,1,1,1,2,1
9200 DATA 1,1.3.3,3,1,2,1,1,1,3,1,3,3,2,1
9210 DATA 1,1,3,2,3,1,2,1,1,1,3,2,3,1,2,1
9220 DATA 1,1,3,1,3,1,2,1,1,1,3,1,3,1,2,1
9230 DATA 1,1,3,1,3,1,2,1,1,1.3,1,3,1,2,1
9300 A=0
9305 A0=0
9310 J0=0
9350 W=65536
9400 REM TAB STOPS
9410 T1=7
9420 T2=15
9430 T3=24
9440 T4=40
9500 DIM S(20)\REM ADDRESS STACK
9510 S0=0
9900 RETURN
```

other than a command just repeats the previous instruction. The following six commands form the entire assembler. When they are pressed, no RETURN is required if you use the INP function or its equivalent.

A(ddress)

When this command is given, you have to supply a hex address. Disassembly proceeds from that address.

J(ump)

If the instruction just disassembled was any kind of jump, this command causes disassembly to proceed at the jump's destination address. Thus, you can use the disassembler to trace through a program.

B(ack)

This causes disassembly of the previous instruction.

C(all)

If the instruction just disassembled was a CALL, then this instruction causes the first line of the called subroutine to be disassembled. Disassembly proceeds through the subroutine until you give the instruction.

R(eturn)

Disassembly proceeds with the statement following the CALL. Subroutines may be nested. Use of the R(eturn) instruction is not limited to when you find the subroutine's RTN instruction; it can be used at any time to return to disassembling the calling program.

P(revious instruction)

This command has the disassembler go back twelve bytes, then scan forward to the last instruction before the one you started in, trying to align itself to the correct instruction boundaries. If the code you are disassembling isn't making sense, try this instruction. There is a good chance (although it is not certain) the disassembler will now be properly aligned with the program. Of course, if you are in a region of memory that is full of data, then a glance at the ASCII or the hexadecimal columns should show the structure of the data.

Output Format

The address appears at the left edge, followed by the contents of the location (and the next one or two locations if the disassembler thinks that a multi-byte instruction lives there) in hexadecimal. Next is the ASCII representation of those contents (or underlines if they are not printing characters). This is followed by the assembler mnemonic, and then an asterisk.■

Antenna Bonanza for 10

—CB is good for something

Modifying your antenna is easy.

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Most CB equipment can be modified, tuned, or used as is to operate on 10 meters. Many excellent articles have been published on the modification of transceivers. I am working on a vfo to work with these modified units. Each CB modification results in the necessity of a good 10 meter antenna.

The CB industry is manufacturing an array of excellent economical antennas that can be easily modified to 10 meters with a near perfect match. If you are looking for a real bargain, don't overlook your local swap meets.

Here is how to modify several types of antennas. The tuning will be covered later. The actual length will vary with each type of antenna.

Mobile—Base-Loaded Steel Whip, 47 Inches

It was necessary to reduce the whip length to 41 inches. The original whip was retained for 11 meters and another whip was cut for 10 meter operation: swr, 1.2 to 1—29 MHz.

Fixed Station—Vertical Half Wave

No modification: swr, 1.8 to 1—29 MHz. This antenna is known as a Starduster. If you don't mind a little swr, use it as is. Cutting it to length would be difficult since the coax is inside the bottom element.

Fixed Station—Quarter-wave Ground Plane

This antenna had three 106-inch radials and one 106-inch vertical driven element. The vertical element was shortened from 106 to 96 inches. The three radials were not modified: swr 1.2 to 1—29MHz.

The above antennas are being used on 10 meters. The measurements are actual. The following is theoretical.

Mobile—Quarter-wave Whip

Reduce length in accordance with the pruning procedure.

Mobile—Fiberglass Wire-wound

These antennas are made by winding wire around a fiberglass rod and then applying shrink tubing over the entire length. The tuning consists of removing turns of wire from the top end. The frequency is determined by the number of turns rather than the overall length of the glass rod. The size of wire determines the power handling capability. 18-gauge wire will handle 200 Watts.

Fixed Station—5/8-wave Vertical

These antennas normally have a loading coil to obtain electrical length without extending the mechanical length. Tuning would consist of reducing the mechanical length. The loading coil is located in the bottom end of the antenna assembly, and is not readily available for modification. If the loading coil is wound with small wire, it will not handle power. This is a good antenna to stay away from!

CB Beam Antennas

For the modification of beams, refer to antenna handbooks. Check swr and, if it is not more than 2 to 1 and it has a front-to-back ratio on receive, try using it as is.

A contact was made with a ham in Michigan who was using a vertical three-element CB Super Scanner beam as is. S9 reports were received on both ends of the contact.

Mobile—Center-Loading Coil

Tuning is accomplished by shortening the whip on the top end of the coil. The actual length will be critical and the bandwidth narrow.

Loading Coils

Antenna loading coils are sealed against moisture. This is normally accomplished by injection molding or potting the coil in epoxy. Do not attempt to remove coil turns unless you have determined a satisfactory method of resealing.

Power Handling Capability

Antennas without

loading coils are usually good for a kW. RG-58 coax is satisfactory up to 200 Watts input. Above this level, use RG-8/U.

Antennas with loading coils have power limitations. The larger the wire in the loading coil, the more power it will handle. Visual inspection of wire size is usually impossible due to moisture seals.

A clue to power capabilities is the outside diameter of the loading coil housing. If it's ½ inch or less, the power handling capability will be low, not more than 25 Watts. Excess power will cause the coil to heat and possible coil destruction. If there is a gradual increase in swr when the transmitter is turned on, the chances are that the loading coil is working up a fever.

Antenna Tuners

Antenna tuners are not required. Do not have one in the line when changing the length of the driven element. There is nothing wrong with trying a tuner with a CB antenna as is.

Pruning Procedure

Regardless of antenna type, the tuning from 27 MHz to 29 MHz requires the reduction of the electrical length of the driven element.

An swr bridge is required. The function switch is first placed in the forward position and adjusted for set level. The switch is then placed in the reflected position and the swr recorded.

Let's assume your modified transceiver has the following transmit frequencies: channel 1—28,965 kHz, channel 13—29,115 kHz, and channel 23—29,255 kHz. The center frequency is 29,115 kHz, so this is where you should adjust for minimum swr.

Minimum swr will not necessarily be a perfect match—1 to 1. It could be 1.3 to 1 or even 1.5 to 1. Do not settle for more than 1.5 to 1. This would indicate there is a problem somewhere.

A base-loaded mobile CB antenna, when operated on 10 meters, will show an swr reading of approximately 4 to 1. A quarter-wave base antenna will show an swr reading of approximately 2.5 to 1. A loading coil narrows antenna bandwidth.

While pruning a mobile antenna whip, cut off 1 inch at a time until the swr drops below 2 to 1. From this point on, cut only ½ inch at a time. The best way to cut a stainless steel whip is to use the edge of a file to notch the whip and then break off the notched piece with pliers. All mobile antennas have an adjustment screw which allows at least a ½-inch adjustment. With this adjustment, it is possible to obtain minimum swr at the center of your operating frequencies.

Pruning Fixed Station Antennas

The procedure is the same but not as critical. Cut off 2 inches at a time until the swr drops below 2 to 1, and then cut only 1 inch at a time until you obtain minimum swr at the center of your operating frequencies.

In the pruning of any antenna, all swr measurements must be made with the antenna in its permanent position. If it's going to be mounted on the roof, that's where you adjust it. If it's a mobile installation on the trunk lid, close the lid and position the car in the clear, away from all obstructions such as trees, buildings, and other automobiles. Close the car doors during swr measurements. ■

Lightning!

—a case history

If you're not careful, it's one strike and you're out.

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This is the story of what happened to Bernie Witherspoon W8GKM during the storm of July 14, 1978. It will show you what can happen even without a direct lightning strike to your antenna. Very few amateurs realize that a distant strike on a power line can cause more damage than a direct strike on your antenna. This is Bernie's story:

"At 4:30 am on July 14th, there was a sudden double click, together with a flash of lightning, in the radio room which is just off the kitchen where I was standing.

"I went into the radio room to check and saw that the pilot light on the two meter rig was out. It is left on all of the time so that the memory will hold the channels on which it is set.

"When I saw that the light was out, I knew that something was amiss. The antenna was switched off for storm protection, and it was free. Otherwise, the damage to the equipment (about $5000 worth), if connected to the antenna, would have been extensive.

"The lightning surge apparently came through the entrance panel and knocked out the fuse for the radio room. It then went through the NCR 12-volt regulated power supply, which originally sold for about $200, and now runs between $50 and $60 as NCR surplus. The inside of the power supply showed extensive damage. It was completely useless.

"The surge then travelled through the equipment via a common ground. It knocked out several transistors and a diode in the Yaesu FT-227R, knocked out a keying circuit in the TR-4CW, and burn-damaged the low voltage circuit in the L4B amplifier.

"It knocked out the power circuits in the R4C receiver. It went through the control box of the Ham III rotator and through one of the screws holding a rubber foot on the control box. The box was sitting on top of a transmatch. It jumped about one-half inch to the case of the transmatch and made a punched hole the size of a ten-penny nail. The surge burned a spot on the transmatch about the size of a silver dollar. It went through the transmatch to the outside, doing a little damage to the inside of the transmatch by burning some of the wiring.

"The amazing thing about this whole bit is that it went through the L4B low voltage panel and R4C control box, and then jumped to the chassis through the transformers without damage to the transformers. It went through several other transformers and did not damage them, although it did knock out two other transformers.

"The ground braid on the coax was welded to the Cantenna dummy load. Although the switch was off on the L4B, the filaments on the 3-500Zs were lit, but not at full brilliance. There were carbon deposits on the switch contacts making a high resistance connection.

"The fuse on the wiring for the rest of the house was not blown. However, it did burn out the transformer on the furnace and the doorbell transformer, plus various small items around the house.

"Since there were two cracks of thunder, I went out to see if the antenna showed any damage. I found half of an insulator on the ground. A neighbor who had been watching said that it looked as if little fireballs were dancing all over the antenna.

"I found that one of the insulating blocks, which hold the center conductor, was broken in two and showed burns. On the metal inserts, which hold the insulators, one of the screws was burned and badly melted. Also, there was some melting where the insulator block was burned in two.

"That strike went down the coaxial line, and each one of the wires in the RG-8 showed signs of being burned. It was not charred, but discolored. When I took the jacket off some of the coax and looked at the clear insulation, it looked like a dark streak inside. Stripping that off, I found that on the inside of the cable each stranded wire was burned.

"Where the coax entered the house under the porch there was a 15-foot length of RG-8, and in that, a PL-259 and a PL-258 were fused together. I was finally able to pry them apart. It short circuited three other PL-259s, badly burned a PL-258, and melted metal on the outside so that it was not usable. There were short circuits in three places in the 15-foot length of RG-8 under the house.

"The estimate of total damage was most fortunate—$332.67. However, I did much of the repair work myself. I replaced the bell transformer and the cable to the dum-

my load.

"The coax switch to the antenna was burned but usable.

"The transmatch was homemade, and a replacement cabinet and panel would cost from $55 to $60. I listed it as $15. I fixed the rotator and L4B myself, and sent the R4B to Drake.

"I also fixed the TR-4CW myself and the VTVM. If all that had been sent out, the cost would have been much more.

"I sent the Yaesu FT-227R to Columbus to be fixed, and they had to send for parts. It took me one month to get it back.

"Except for the Yaesu, I was on the air in a few hours. I have had this setup, and it has always been connected through storms, since 1959, and nothing ever happened, but after 28 years it finally did. I guess if you wait long enough, something will happen.

"Some years ago my father was in the yard holding a steel rim off a buggy, and a cat. Lightning struck the steel rim and went through him, struck the cat, and then hit a boy standing nearby. It killed the cat and the boy, but did not kill my father.

"I have seen lightning strike the ground in an open field less than forty feet from a tree which was thirty or forty feet tall, so it isn't always the highest point that gets hit.

"I have seen it strike water. Once, when I was in the army, I saw it hit a telephone pole. The top third of the pole disintegrated.

"A man on a farm was once hit by lightning and killed. The nails in his shoes were formed into little balls which were rammed up into his feet all the way to his ankles."

Some years ago, W8MPJ, a friend of mine in Dayton, Ohio, had his antenna hit by lightning and it went through the wiring in the house. It burned a pattern on the wall all the way through the house, wherever there was wiring. Strangest of all, in the bathroom, it stripped all the mercury coating off the mirror. On the little side lights by that mirror, there were little knurled nuts that held the lights to the brackets. Those little nuts were unscrewed by the strike and were found on the floor.

The light fixtures were hanging by the wires, still connected. The total damage to the house, for replacing the wiring and fixtures, was over $2000.

Some years ago I had an NCL-2000 amplifier, which was on, and at the same time I was seeing in the distance what we usually call heat lightning. It was a clear day, and there were no clouds in the local sky. But in the distance, miles away, these little flashes could be seen, but no thunder was heard. I noticed that every time I saw these little distant flashes, my NCL-2000 tank would flash over. I disconnected it and stayed off the air until the storm passed.

There is only one word for lightning—unpredictable.

I now have across my 220 line in the radio room a General Electric, 2-pole valve-type secondary lightning arrestor. It should be connected at the input box to the house. It would then protect every appliance in the house. I have it connected across the line to my radio room for the protection of my equipment, since putting it across the input fuse panel would require extensive wiring. GE says that it would completely protect one against these lightning surges. ■

Build a CW Memory

—fun!

Try another one of our $10 projects.

Larry Kasevich WA1ZFW
78 Jackson Road
Enfield CT 06082

Probably the most useful of electronic components today is the solid-state memory. This device comes in all sizes, packages, and families. There are RAMs, ROMs, PROMs, EROMs, static and dynamic, and even something called "bubble" memory. These devices are used in so many applications that the list is endless. Even with the latest and greatest microprocessors, the memory is as important as the microprocessor itself.

With the availability and low cost of solid-state memory, I put it to use for the amateur radio operator. Since CW only consists of two states, carrier on or off, this type of memory suits this application quite well. My goal was to design a unit that would be a useful tool for the CW operator. It consists of a

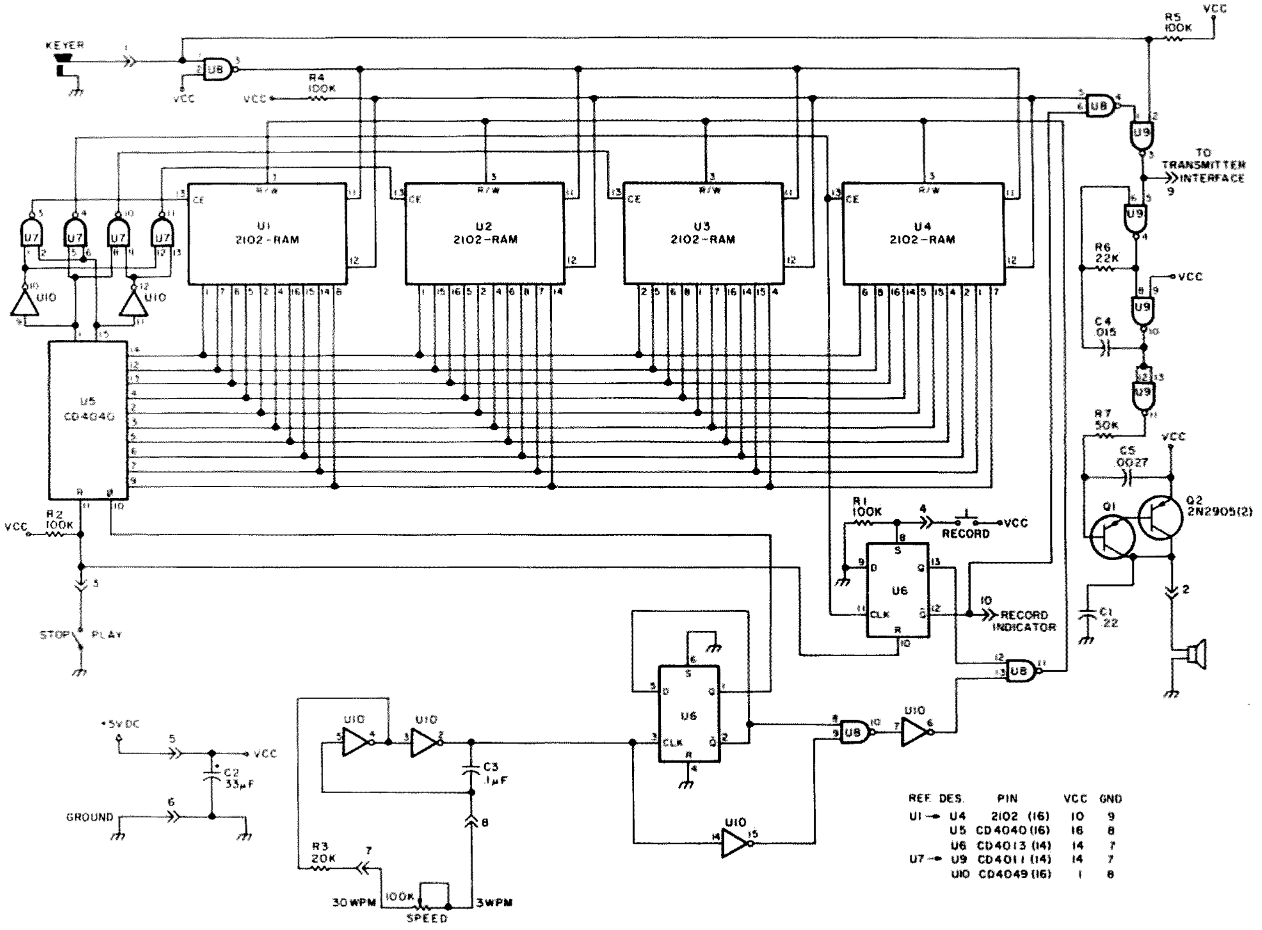

Fig. 1. Code Memory schematic diagram.

memory to store a coded message. The unit actually records what an operator sends with his key. In order to make this recorder more versatile, the rate of speed of the code can be varied without changing the output tone. This makes the unit useful for the beginner when learning the code because he could increase the speed slowly. (This unit could also be valuable in contests for repetitive information such as name, QTH, etc.—ed.)

The schematic and parts identification are shown in Fig. 1. There are ten connections to the circuit. The keyer is connected between pin 1 and ground. This could be a straight key or an electronic keyer as long as the signal is open or ground. An 8-Ohm speaker is connected between pin 2 and ground. The speaker will produce a tone whenever the key is depressed or whenever code is being played back from memory. This tone can be adjusted using either C4 or R6. A volume control can be added by simply putting a pot in series with the speaker. Two switches control the operation of the unit. The play/stop switch, connected to pin 3, when in the open position, applies a reset to U5, the memory address register. This puts the unit in a mode where the memory is idle and the unit can be used as a code-practice oscillator. With ground applied to pin 3, the unit will play back the code that is in the memory. The other switch, the record button, is connected to pin 4 and, upon momentary depression, sets the U6 flip-flop and puts memory ICs U1 through U4 in the record or memory-write mode. The play/stop switch must be in the play position during recording.

Power is applied to pins 5 and 6. A positive 5 V dc is required at about 500 mA. A normal transformer, rectifier, and filter with a voltage regulator, like an LM309, works just fine. To control the speed, a 100k pot is connected between pins 7 and 8. This controls the clock which is used to advance the address of the memory. This pot can be set in any position to record, and any position for playback. With the 4096 bits of memory, good resolution can be obtained from 3 wpm to 30 wpm. Don't try to record 30 wpm code with the pot set for 3 wpm. It won't work. Message times will vary from about 1 minute for a speed setting of 30 wpm to about 6 minutes for a speed setting of 3 wpm.

The Code Memory can drive a transmitter, if desired, provided an interface circuit is used. Pin 9 is available for this, but, note that the signal is CMOS, which is extremely limited in its drive capability. Consult the data sheet for the CD4011 NAND gate before you design an interface. Pin 10 can drive a buffer which, in turn, can be used to drive an indicator to tell the operator that the unit is in the record mode. It should be noted that when in the record mode, the unit will stop recording once the memory is full. The operator can instantly start from the beginning at any time by cycling the play/stop switch.

This Code Memory should be a useful tool for any CW operator, contester, or person learning the code. The cost of the components is less than $10.00, so not only is this a practical project, but also an inexpensive one. To make the construction easier, a two-sided printed circuit board is available for $10.25 from Larry Kasevich WA1ZFW, 78 Jackson Road, Enfield CT 06082. ■

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Wire-Wrap on a Budget

—home-brew your tools

For building many integrated circuit projects, a printed circuit board is considered essential. The alternative is to make many connections in very limited space, and point-to-point soldering techniques are most tedious. One alternative to these wire techniques is wire-wrapping, where each connection is made by wrapping a square post with no. 28 to 30 wire—no solder is required. One limitation to starting wire-wrap construction is the cost of the tool—$6.00 (minimum)—and many people are reluctant to get the starting tools. If your budget is limited and you want to experiment with wire-wrap, here is a no-cost way to begin.

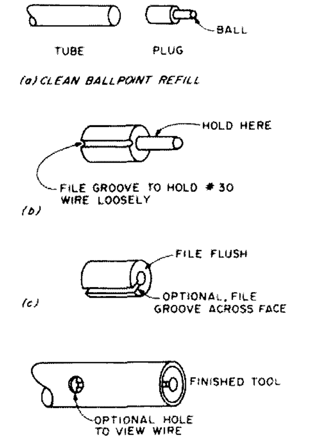

Fig. 1. Wire-wrap tool construction.

Almost all of us have a few dozen ballpoint pens that refuse to write. Inside many, the refill is a metal tube. These are the type you need; get at least two of them. Some of the more expensive refills have larger upper reservoirs which also make good handles, but any metal ones will suffice. First, clean the remaining ink out of each one. The metal plug containing the ball point should be carefully removed to clean it. Be sure to save the end piece! Cleaning is the hard part and is a little messy. Soapy water and a few pipe cleaners help.

Next, look at Fig. 1 and see how to file the notch in the side of the plug. This is the groove in which the wire will be placed, so make the V-shaped groove large enough for a #30 wire or a little larger so the insulation can also slide in if you prefer the first turn to be of insulated wire. Do not cut the pen end off before you file the groove. It is easier to hold it by that end while you file, and it's small enough anyway. (I lost the first one somewhere in my shop.)

After you have finished the groove, carefully cut off the small end of the plug flush with the large diameter. You may insert this almost all the way into the refill tube now and check to see if a wire will pass through the groove satisfactorily. The center hole should be just the right size to fit over a standard .025 x .025 pin. You may wish to file a groove across the diameter end of the plug, connecting the groove and center hole. This aids in causing the very end of the wire to be wrapped against the pin, but is not essential.

Another optional feature is a small hole, just above the groove in the plug, in the wall of the refill tube. This allows you to see the wire pass through the groove. If you look into the hole and cannot see the wire, it went into the center hole, which is wrong. Again, this is an option—drill as small a hole as possible. A no. 80 is large enough, but few of us have that small a drill. A hand grinder with a no. ½ dental burr will cut a nice groove and also drill a small hole, if you have access to one.

This completes the wire-wrap tool. Try it out. With a little practice, you can do as well with it as with any professional model. You will find that more time is spent cutting and stripping wire (if you do not buy the prestripped lengths) and inserting the wire than is spent in wrapping, so that manual tools are only a slight bit slower than motor-driven ones.

Now for the eraser for your mistakes! You need an unwrap tool, too, because you will want to remove wires to make tests, make changes, and correct errors. Since you may wrap a wire in either a clockwise or a counterclockwise direction, you want a tool that works in both directions. Look at Fig. 2. This time, the plug is put into the tube, the small end cut off and filed flush, and the plug is filed back to form a sharp edge which will pick up the end of the wire and unwind it. A triangular file or jeweler's file will help here to get the undercut edge. The edge should be beveled somewhat, as shown in Fig. 2(c). Grooving below the outside edge of the tool is optional. This makes it pick up the wire a little more easily sometimes. Try it on a few of your wraps to see how it works.

Now you are all set to wire-wrap your next IC project. All you need is wire, sockets, and a stripper. A cheap stripper which works well on no. 30 Kynar insulated wire-wrap wire is hard to find. Try using a good double-V stripper set carefully to not nick the wire. ■

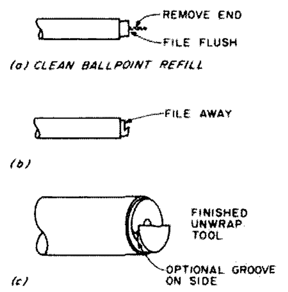

Fig. 2. Unwrap tool construction.

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Compact Continuity Tester

Fastened to a piece of asbestos paper, hard asbestos, or hardwood, the few parts are as shown in the schematic. They're fastened to the backing by means of their own pigtail wire ends.

Tie a knot in the cord where it leaves the box to eliminate strain on the components. ■

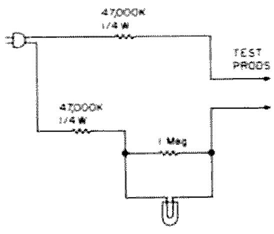
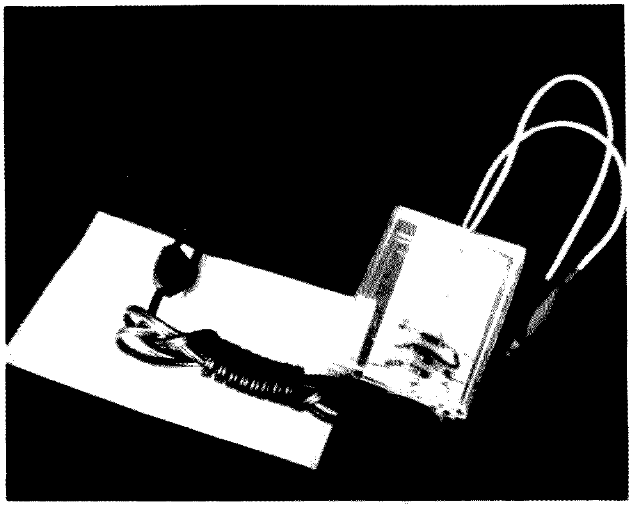


Fig. 1.



✓ Reader Service—see page 195

12 Volts, 5 Amps, 3 Terminals

—what could be simpler?

Protect yourself from shorts and headaches.

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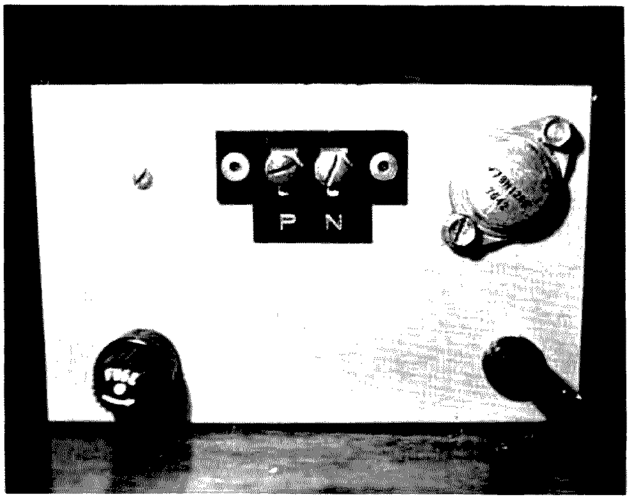
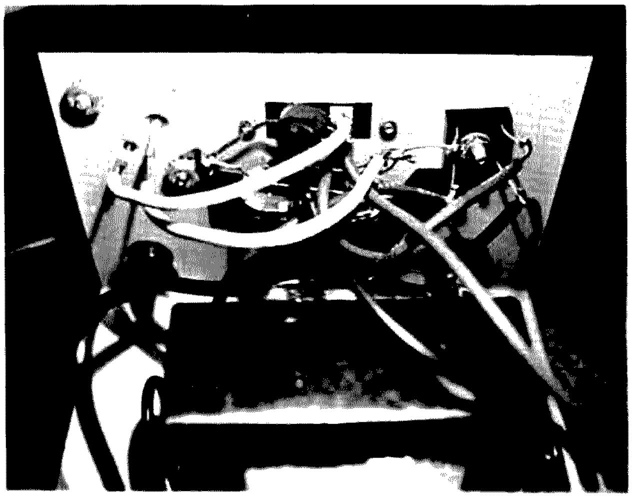
It seems that in the last several months, *73* has carried more than its share of regulated power supply articles. I started to build one of them for use with my TR-22 and my Heathkit® amplifier. Sure, for three bucks or so, anyone can build a regulator for his power supply using a 2N3055 pass transistor, a zener diode, and a few resistors. The only problem is that such a circuit has no protection against short circuits and excessive current draw. To add the extra circuitry for protection can increase the cost considerably.

The solution to my problem was found in a new regulator subsystem by Fairchild. The device, a Fairchild 78H12, is a complete regulator with internal current limiting and thermal-shutdown circuitry in a TO-3-type case. It will handle 5 Amps at 12 V dc before current limiting begins. In other words, the device is indestructible. The price is about $9.00, which is expensive in this day and age, but not for complete protection in a TO-3 case. Other than the power supply capacitors and an output bypass capacitor, no other external parts are needed.

Fig. 1 shows a schematic of my supply. I added the regulator to an already-assembled power supply. Because the device is complete in itself, modification of the power supply was minimal. Also, the company that built the power supply was thoughtful enough to have drilled the holes for a TO-3 pass transistor. So, I simply mounted the regulator in the holes provided, and used a little heat-sink compound. If you plan to draw more than a few Amps, I would recommend using a heat sink—the bigger, the better. Two more steps completed the addition of the regulator. First, I had to break the positive lead between the filter capacitor and the output terminal strip. I then ran a wire from the capacitor to the input (pin 1) of the regulator, and a wire from the output (pin 2) of the regulator to the



The rear of the power supply shown with the 78H12 regulator installed in the holes that were provided by the manufacturer for a pass transistor. The white area around the regulator is not an insulator (the regulator case should be grounded to the chassis), it is common heat-sink compound which helps transfer the heat to the chassis from the regulator.



Inside view of the power supply. The two white wires connect the positive side of capacitors C1 to the input (pin 1) of the regulator, and the other is the output to the terminal strip on the rear. The capacitor on the terminal strip is C2, which bypasses any noise at the output of the regulator to ground.

terminal strip. It was also necessary to ground the negative lead to the chassis, since the case of the regulator must be at ground potential. Don't insulate the regulator from the chassis.

If you are building a supply from scratch, I would recommend the use of a 15- or 18-volt transformer. My power supply uses a 12-volt transformer which develops about 18 volts of unregulated dc output. But, after the current passes through the regulator, the output is only a regulated 11.5 volts dc. Although I haven't tried, I don't think that the full 5-Amp capacity could be reached. Keep in mind, though, that the peak input voltage to the regulator cannot exceed 25 volts.

I've used the regulator with my 2 meter amp and my TR-22. Under key-down conditions, the regulator will become warm to the touch after about one minute. Again, a larger size heat sink would allow more current to be drawn while keeping the regulator cool.

Two other versions are available: the 78H05 for 5 V dc, and the 78H15 for 15 V dc. Both will handle 5 Amps, and are priced the same as the 78H12.■

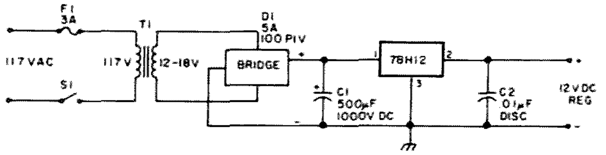


Fig. 1. Power supply schematic.

Has Anyone Seen OSCAR 7?

—find it with your SR-56

An off-the-wall program for on-the-air fun.

Cebrun Mayse
1916 Crosby Park Blvd. N.W.
Lawton OK 74505

Recently, I became a proud owner of a PC-100A printer. Now I'm swamped with printing tape, with every program imaginable all over the kitchen bar. There's even a program strip for how to figure wall paneling with prices and even how many panels per wall. It's amazing how a fellow can come up with off-the-wall programs, especially with the PC-100A.

00	54	20	03	40	84	60	34
01	03	21	06	41	02	61	01
02	06	22	00	42	04	62	97
03	00	23	00	43	94	63	84
04	00	24	94	44	35	64	34
05	94	25	33	45	02	65	04
06	33	26	02	46	34	66	94
07	01	27	41	47	02	67	12
08	41	28	54	48	74	68	27
09	54	29	06	49	34	69	07
10	06	30	00	50	01	70	05
11	00	31	94	51	94	71	97
12	94	32	35	52	33	72	22
13	35	33	02	53	03	73	06
14	01	34	01	54	54	74	03
15	41	35	03	55	01	75	41
16	35	36	33	56	03	76	42
17	01	37	00	57	94		
18	41	38	15	58	33		
19	54	39	41	59	04		

Fig. 1.

There was one problem that had been bugging me ever since I heard QSOs on ten meters about a year ago. The problem was how to use the orbit times supplied in *73 Magazine*. I've used the standard 115 minutes added to each orbit, but, when it comes down to the next initial orbit data given, it doesn't figure precisely. Once I got my new toy, it only took 40 feet of paper and an hour to figure out the math of it. The calculator I use is the Texas Instruments SR-56.

Now, here's how I figure orbits. After loading the program (Fig. 1) in the calculator, the next step is to load the initial time inversely into the calculator. For example, 0056:56 goes in as 56(sec.)R/S, 56(min.)R/S, 0(hrs.)R/S. At this point, the

00	33	19	03
01	01	20	29
02	29	21	35
03	64	22	02
04	01	23	34
05	00	24	03
06	00	25	12
07	94	26	29
08	33	27	64
09	02	28	92
10	34	29	06
11	01	30	94
12	17	31	35
13	29	32	02
14	64	33	34
15	06	34	02
16	00	35	97
17	94	36	41
18	33	37	42

Fig. 2.

program is awaiting the next day's initial time crossing, 0134:24, and this will be loaded as the previous time was, inversely: 24(sec.)R/S, 34(min.)R/S, 1(hour)R/S. The printout will be in decimal hours, such as 1.573333333. To change the decimal hours into hour-min.-decimal-sec., refer to Fig. 2. Use this program or subtract the hour and multiply the fraction by 60, which will give the minutes. Then subtract the minutes (the integers to the left of the decimal) and multiply the fraction by 60. This will produce the seconds. Fig. 3 shows the process via the PC-100A for 1 hour, 34 minutes, 24 seconds. Should your times start to run over the 23rd hour, remember to subtract 24 from the hours portion to be in the right frame. This is noticeable whenever you're figuring out orbit times in your locale. In reality,

```
1.573333333    -
         1.    =
0.573333333
0.573333333    ×
        60.    =
34.39999998
34.39999998    -
        34.    =
 0.39999998
 0.39999998    ×
        60.    =
 23.9999988
```

Fig. 3.

27.23989316 is 3.23989316 hours. When figuring for your time area, add one of the integers, 4(PST), 5(MST), 6(CST), or 7(EST), to the first initial orbit time and the next day's initial orbit time.

Now for the longitudinal crossings—Fig. 4 shows the program and Fig. 5 shows the results of two days. The positive initial crossings are between longitudes 0 degrees and 180 degrees on the Americas side, and the negative values are on the

```
00 33   20 06
01 01   21 01
02 97   22 05
03 49   23 04
04 01   24 94
05 01   25 97
06 05   26 47
07 01   27 03
08 32   28 02
09 15   29 22
10 34   30 01
11 01   31 02
12 84   32 74
13 02   33 03
14 08   34 06
15 92   35 00
16 07   36 94
17 03   37 22
18 08   38 01
19 04   39 02
```

Fig. 4.

Asiatic and European side of 180-0 degrees. On the initial orbit of Jan. 28, 1978, it was a positive number (58.4); the next orbit crossing will be heading for the international date line at 180 degrees. After the OSCAR crosses the date line, its orbits will take on a negative number; there-

```
  58.4    PRT
  87.1    PRT
 115.9    PRT
 144.6    PRT
 173.4    PRT
-157.9    PRT
-129.2    PRT
-100.4    PRT
 -71.7    PRT
 -43.0    PRT
 -14.2    PRT
  14.5    PRT
  43.3    PRT
  72.0    PRT
 100.7    PRT
 129.5    PRT
 158.2    PRT
-173.0    PRT
-144.3    PRT
-115.6    PRT
 -86.8    PRT
 -58.1    PRT
 -29.4    PRT
  -0.6    PRT
  28.1    PRT
  56.9    PRT
```

Fig. 5.

fore, the first orbit longitude after the date line crossing will be −157.9, and so on and so on.■

Tricky QSK

—a treat for CW

Dick Blasco
991 42nd Street
Sarasota FL 33580

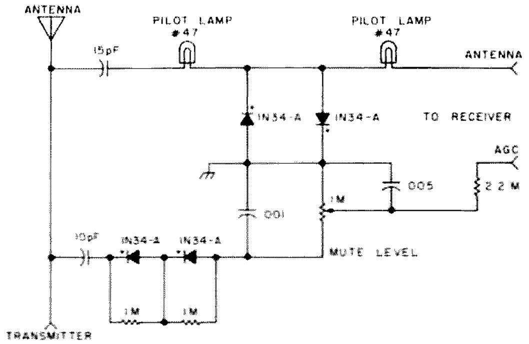


Fig. 1. Poor man's T-R switch schematic diagram.

Here's a dandy little evening project that will delight any CW-man's heart. This circuit (Fig. 1) is a refinement of a design which is simple and effective. The pilot lamps have a characteristic low resistance when not lit and a relatively high resistance as more current is passed through them. A high-level signal (from the transmitter) will exceed the contact potential of the 1N34A diodes and cause them to conduct, drawing current through the bulb. The bulb glows and acts to isolate the receiver from the antenna line. The circuit shown includes an additional lamp in the receiver lead for additional protection of the antenna coils.

Some of the rf energy is also sampled and rectified to provide a muting voltage. Simply connect this output to the agc line of any modern receiver and adjust the mute level for the desired signal level. This circuit works with the agc only when it's fully active, of course.

The circuit shown will work well at powers up to 100 Watts. Additional power may be handled by inserting additional pilot lamps in series with the 15 pF capacitor. This unit causes some loss of received signal strength, but its simplicity and effectiveness will far outweigh this in all receivers. If you aren't fully QSK by now, spend an evening and join in the fun! ■

✓ Reader Service—see page 195

Make Life Easier

—with a workbench speed control

Don Smith W4CQQ
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Jacksonville FL 32207

Drilling holes in different metals often requires the use of a variable speed drill. If you don't own a multi-speed drill, the addition of this little circuit makes your hand drill a variable speed tool.

The bridge rectifier provides the full-wave pulsating direct current for the SCR switch and controls the angle of fire of the SCR. Diode D5 is used to counter the back voltage developed by the drill motor. Speed of the drill is varied by the 10k potentiometer.

Diodes D2-D4 should be rated at 200 volts piv and have a current rating of at least 12 Amps. The SCR should have a piv of about 300 volts and a current rating of 25 Amps. ■

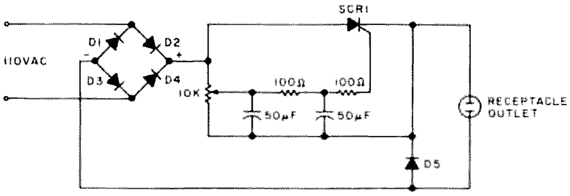


Fig. 1.

Reader Service—see page 195

The Heath/Kenwood Connection

—RIT for the 104

Robert B. Lunsford, Jr. WB5QGI
1405 Stephen
Killeen TX 76541

How many times have I heard someone say, "I sure like Heathkits, but I don't know why they don't have RIT," or something similar? RIT, by the way, stands for receiver incremental tuning. (Sometimes it is called receiver-only tuning, or receiver offset, or simply offset.) This feature is found on many transceivers on the market today, and is a means of fine-tuning the receiver without affecting the frequency of the transmitter.

I am the proud owner of a Heathkit HW-104 and have in the past built and used SB-102s, HW-101s, and HW-7s and -8s. For the price, in my opinion, there is no better way to get on the air with state-of-the-art equipment. But no RIT!

Need for RIT

One of the main problems of not having RIT is what happens, for example, when I am talking with another ham who doesn't have RIT, and each of us is busy trying to improve reception of the other's voice. I will retune my transceiver to get a more "natural-sounding" voice; then he will retune his—and we both end up jumping around in frequency. This could end us up close to another station, causing some interference or being interfered with. Since the majority of hams on the air today appear to be using a transceiver, jumping around in frequency or being slightly off frequency are all too common events.

For a time, I used a Ten-Tec Argonaut for a bit of QRP work and became attached to using its offset feature. Upon completion of my HW-104, the first thing I considered doing was incorporating RIT and regaining some of the versatility of the Argonaut's offset control. After the "lids" were on the 104, however, and looking with some affection at my handiwork, I began to have second thoughts.

I've seen additions to equipment by others. Sometimes there is very professional work which doesn't detract from appearances, and in other cases you have to pretend you don't notice the additional switch, jack, meter, or whatever to keep from offending the obviously proud installer. (All the while you're fighting off an impulse to ask what brand of chewing gum was used to stick the little goodie on with.)

An Outboard Vfo

After weighing the pros and cons, I came to the conclusion that, if at all possible, RIT would have to be obtained without any modification to my new 104. Another factor is the ability of the 104 to go from one end of the band to the other without any peaking, tweaking, or anything save changing the vfo frequency (providing you did your antenna impedance design homework). Therefore, to be able to take full advantage of the broadband characteristics of the 104, it dawned on me that an outboard vfo would act as an RIT if proper switching or relay action were provided. In this case, not only would I get RIT, but I would be able also to make use of split operation—perfect for contests and DXing.

Once the decision was made to go to outboard or remote vfo, I began to look around for the best available remote vfo for the price, with ruggedness, durability, and stability, coupled with good eye-appeal. After using the 104, I knew the vfo in the rig was capable of meeting my ideals, but at the time, the engineers at Benton Harbor were on the verge of coming out with the SB-

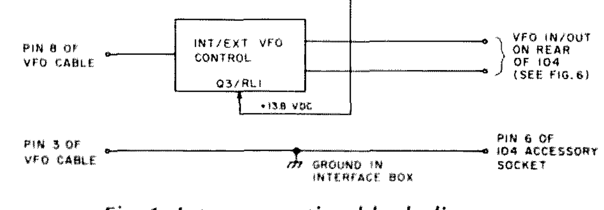


Fig. 1. Interconnection block diagram.

Pin No.	Function
1	Vfo signal
2	Shield for vfo signal
3	Ground
4	12.6 V ac (for lamps) (13.8 V dc used in this project)
5	Relay signal input (goes positive on transmit)
6	Calibrator supply source, 9 V dc (not used)
7	No connection
8	9 V dc for internal vfo
9	9 V dc for external vfo

Table 1.

104A. The remote vfo for the 104 wasn't listed in the catalog, and it would not have had RIT had I obtained one.

Looking around and considering what was still available on the market, I discovered that I could get a remote vfo and RIT in the same box for about the same price as the Heath remote vfo, had it been available. The only problem would be with the controls necessary to obtain selection of internal or external vfo and the push-to-talk (PTT) control for selecting the desired vfo on transmit.

My selection was Kenwood's model VFO-520 remote vfo, since it was readily obtainable and promised to do everything I needed. According to the stated specifications, it was compatible with the requirements of the 104.

The plan from the beginning was to utilize an outboard vfo with no modification either to the vfo or to the 104. This was accomplished by placing all interfacing components inside a miniature aluminum box which I placed out of sight behind the 104. Interconnection between the 104 and outboard vfo was neatly tucked away, and the interfacing was done silently and effectively.

A small cable from the interfacing box connects to the remote vfo. Two short pieces of RG-58 or RG-174 extend from the interfacing box to the rear of the 104, where Heath has provided convenient jacks for the vfo output from the internal vfo and for vfo signal input. Normally, if no external vfo is used, a simple jumper is installed between the two jacks. Only three other wires are necessary: 13.8 V dc, ground, and the PTT signal line. Two-conductor mike cable, with shield, may be used for these last three wires.

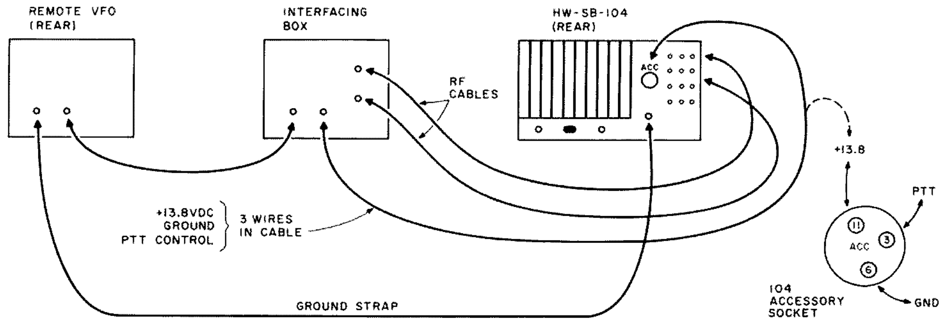


Fig. 2. Interfacing cable layout.

Kenwood has come out with a new design level since I purchased my VFO-520, but I imagine the new remote vfo and the old one are electrically equivalent. However, before buying the new one, in case the old one is hard to find, verification with a Kenwood dealer is recommended. Used equipment dealers should be eager to sell remote vfos if they have them in stock, because most hams don't need a remote vfo immediately when buying a new station, and this may leave the dealer with some extras.

The interfacing detailed in this article is what makes the combination work, so parts of the circuitry may be adaptable to other transceiver-to-remote hookups. Before planning to use combinations other than Kenwood to Heathkit, remember the two primary considerations: vfo frequency and which way the vfo is designed to tune. In this case, the Heathkit requires (a) that the vfo tunes from 5 to 5.5 MHz, and (b) that the vfo must tune backwards—which means that for a higher frequency of operation, the vfo will be producing a lower frequency, and vice versa.

The Circuit

A look at Table 1 will give an idea what the requirements of the vfo are and will aid in explaining what the interfacing connections accomplish. Block diagrams in Figs. 1 and 2 show how connections are made and demonstrate just how simple the project is. Figs. 3, 5, and 6 show the builder how few parts are required and may be followed as wiring diagrams. I will briefly discuss the various sections of the circuit, without details of the action of each electron, so that a better understanding of the circuit design and function can be achieved.

The power supply is the most complicated part of the interfacing box, but is actually a very basic circuit. For purposes of explanation, refer to Fig. 4 and notice that current flow is through zener diode D1 by way of resistor R1. Since a zener diode is designed to pass a large amount of current in the reverse direction when voltage across the diode reaches a certain level, it performs as a voltage reference device. In other words, as the voltage is raised across the diode, more current is passed by the diode at a certain voltage level, increasing the voltage drop across R1. In turn, this tends to stabilize the voltage across D1. The value of R1 is chosen to provide enough current for stable zener diode operation and to limit current through the diode to a safe value.

You may recognize transistor Q1 as operating in a standard emitter-follower amplifier circuit, but it is enough to remember that when Q1 is operating, a nearly constant voltage difference of a specific value is maintained between the base and emitter, mainly determined by the physical properties of the type of material used in making the transistor. For

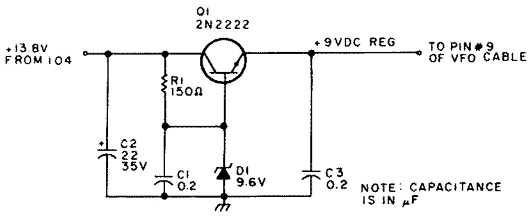


Fig. 3. 9 V dc regulated power supply.

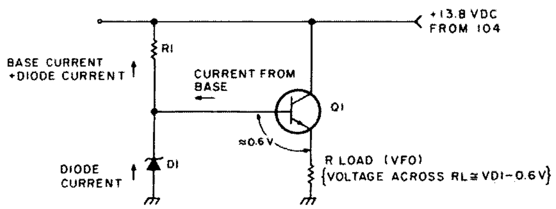


Fig. 4. Power supply simplified circuit.

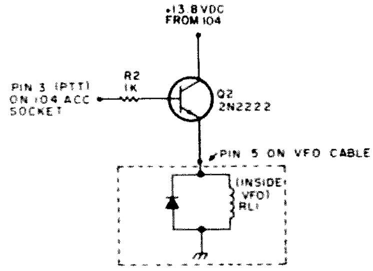


Fig. 5. Vfo relay switching circuit.

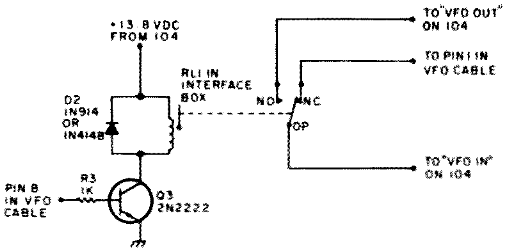


Fig. 6. Interface relay switching circuit.

silicon, which is used in the 2N2222, the voltage difference is about 0.6 V dc between base and emitter, and due to the clamping action of D1 on the base, the emitter circuit will supply current at a constant voltage. Capacitor C1 is used for insurance against the possible generation of white noise in the zener diode, due to random current paths in the silicon permitting "bumping," or friction, between groups of electrons, and resulting in a hissing sound.

Transistors Q2 and Q3 are used to operate relays, acting as current switches. R2 and R3 limit current in the base circuits to a safe value in the transistors and provide some isolation between the circuits. Diode D2 is used to limit to a safe value the "flyback" voltage generated as the relay winding is de-energized, since the inductive kickback voltage is usually high enough to jeopardize the switching transistor. Without this diode, the transistor could be "punctured" and destroyed.

Construction

All parts are common parts which either I had on hand or I bought at the local Radio Shack store. Table 2 gives a list of parts, and, while some substitution is possible, I recommend going with a winner and sticking with the circuit given, unless you like to experiment.

Silicone rubber compound, such as General Electric's RTV, would make mounting the relay a snap if you have it around. Perforated experimenter board can be used to mount the parts, but I soldered the parts to the pins on the 9-pin socket and rf connectors and experienced no mounting problems. Sockets for the rf cables between the interfacing box and transceiver may be considered unnecessary, but are recommended in order to keep everything grounded and shielded.

The VFO-520 comes with an interconnecting cable which has a 9-pin plug on each end. This cable is straight-through—that is, pin 1 goes to pin 1, etc., on each end of the cable. Also, pin numbering is standard, counting clockwise, starting from the large space between pins while looking at the bottom.

Remember to use the ground wire provided to strap the transceiver and vfo together, since depending on signal wire shields for grounding is poor practice. If the ground wire provided isn't long enough, one should be made up, since noise could be experienced later as connectors become dirty or oxidized.

Operation

Since placing the remote vfo in service, I have not had any problems whatsoever. Stability is as good as the 104 vfo, and that's pretty good. In fact, for almost all general operating, the Kenwood vfo is used exclusively. At first, one might think the price is pretty high just to get RIT, but not only do I now have RIT and the capability of comparing vfo operation, I also have the ability to set up operation on another band by verifying frequency availability and then moving with just a flick of the bandswitch. Actually, I now have the same capabilities as if I were using a separate receiver and transmitter, except for crossbanding.

I thought at one time I had a stability problem, but it turned out to be an oxidized bandswitch in the 104, and cleaning with a pencil eraser did the trick. (Take note, 104 owners.)

The function switch on the remote vfo gives total control over operating frequency. The four positions of the function switch are as follows, along with operating mode if the indicated position is selected:

OFF—Remote vfo is off. Transmit and receive frequencies are controlled by vfo in rig.

REC—Remote vfo controls receiver; rig's vfo controls transmitter.

REC/XMIT—Remote vfo has total control.

XMIT—Remote vfo controls transmitter; rig's vfo controls the receiver.

Summary

I don't expect any trouble from my vfo in the future because, upon inspection of the interior of the VFO-520 (I have a thing about looking inside every new thing I buy), I found good construction techniques were used, both electrical and mechanical. There was shielding where I didn't expect it, in fact. There is no reason why the VFO-520 cannot be used with other rigs with a little bit of homework, and I hope I've made it clear enough so others can duplicate the project without too much trouble. I also hope that those who do will get as much enjoyment out of the expanded operating capabilities as I have—all without modification to the rig or the vfo. ■

Component or Part	Quantity	
Transistor, 2N2222, silicon NPN	3	Q1, 2, 3
Resistor, 150 Ohms, ½ Watt, carbon, 10%	1	R1
Resistor, 1 kilohm, ¼ Watt, carbon, 10%	2	R2, 3
Capacitor, 0.2 uF 50 V dc min., disc ceramic	2	C1, 3
Diode, 9.6 V dc zener, 1 Watt*	1 (or two 4 V dc zen)	D1
Diode, 1N914, or 1N4148 switching diode	1	D2
Relay, Radio Shack No. 275-004 at $2.89	1	RL1
Capacitor, 22 uF, 35 V dc; RS No. 272-1014 at $.49	1	C2

*Two 4-volt zeners in series were used, but verify 9 V dc from power supply.

Table 2.

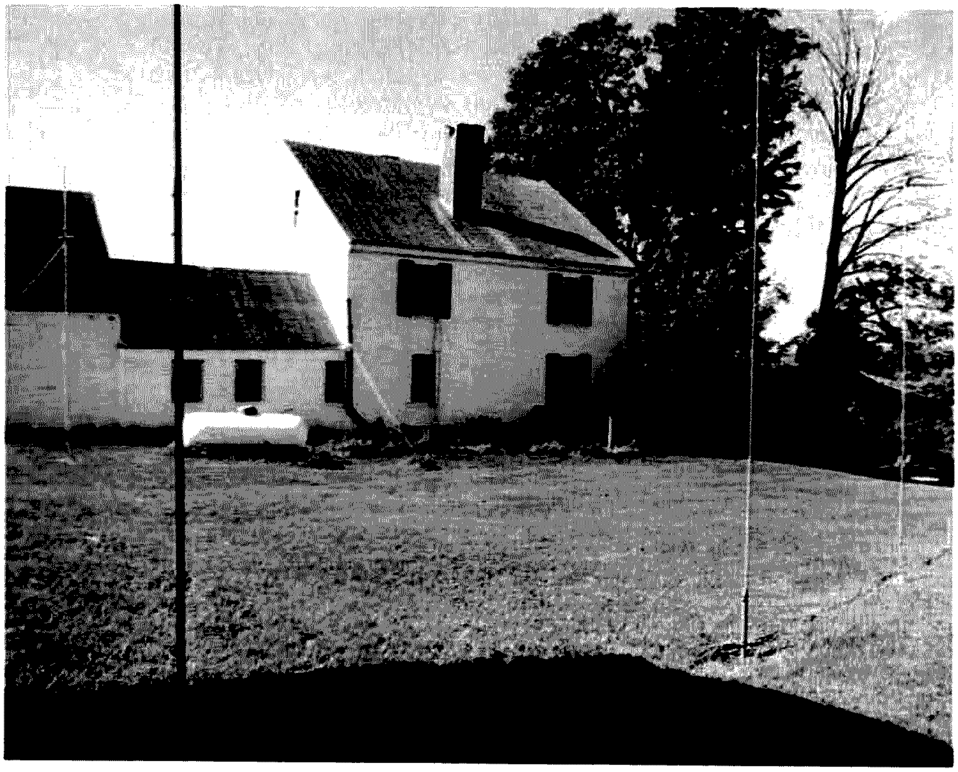
Philip S. Rand W1DBM
PO Box 8
Haverhill NH 03765

An 8-Element, All-Driven Vertical Beam

—super array for DX

Good news from New Hampshire.

The most popular 20 meter beam antenna in use today is the yagi mounted horizontally on top of a tall tower. A "package" price on such an antenna, a three-element triband beam, a rotator, a 51-foot crank-up tower, and 100 feet of coax and rotator cable was recently advertised in ham magazines at $1,095. In addition, you will have to pay for shipping and cost of erection (including concrete, guy wires, anchors, etc.), to say nothing of the legal fees to defend yourself against the local zoning board because you erected a 51-foot structure on your property without a building permit. To avoid the above expenses, I designed and built a vertical array over a ground plane with a maximum height of only 16.4 feet and a total erected cost of only $60, plus a few bucks for the extra RG-58/U needed, thus saving well over $1000.
well over $1000.



A general view of the array in relation to the shack which is in the upper rear room of the old farmhouse.

Vertical beams described in the literature are generally either two- or four-element ground-mounted phased arrays for 3.5 or 7 MHz.[1] The directivity of these beams can be changed by various switching arrangements. The usual method is to switch in coils of coax cable cut to the required length for the number of degrees lag required. This is relatively simple for two elements. However, the gain from such a two-element beam is also relatively low. To increase the gain, it is necessary to increase the number of elements in the beam. Four is usually the

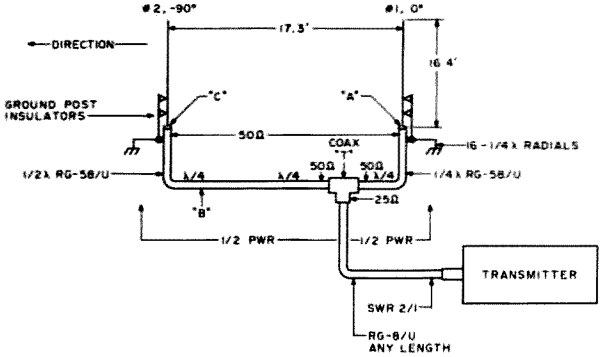


Fig. 1. Method of feed for the 2-element phased array.

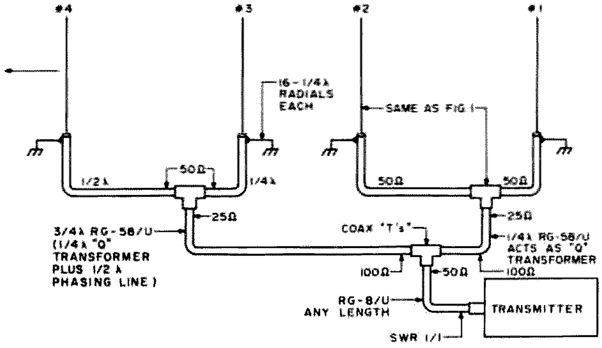


Fig. 2. Method of phasing and power division for the 4-element array.

maximum number of elements used. These may be arranged in a straight line, a square, or a triangle, with the fourth element in the center.[2] The complexity of the switching and phasing increases at a faster rate than the gain from such an array. Although the gain is low from such an array, it is more than adequate on 3.5 and 7 MHz, where rotatable beams are very expensive and difficult to construct.

To get enough gain on 14 MHz from such an array to be competitive with yagis and quads on towers, at least eight elements are necessary. Therefore, I sketched up an eight-element phased array with switchable directivity, but gave up the idea after calculating the number of relays and the feet of coax cable that would be needed.

Parasitic Array

One-half of an eight-element yagi (split down the middle) mounted vertically over a ground plane looked really interesting[3] since it only required a single length of RG-8/U for a feeder and could possibly be made into a tribander for 20/15/10. An eight-element parasitic beam could not have its directivity switched, but since I had already given up that idea, I decided to go ahead with a large high-gain unidirectional beam fixed on Oceania. It was decided to start with four elements, a reflector, a driven element, and two directors, later expanding it to eight or more elements by adding more directors. With this in mind, I reviewed the literature on yagi antennas. A 20 meter beam is generally limited to three elements only because of the difficulty in supporting a long boom 50 to 60 feet up in the air. Imagine the wind and ice load of an eight-element beam with an 80- to 100-foot boom! This is no problem on VHF where high-gain 10- to 16-element yagis are common. Neither is it a problem on HF when the beam is vertical with each element mounted on its own ground post.

Since I wanted my beam to point to Australia, which is 270 degrees true from central New Hampshire, I drove a 5-foot ground stake of 1-inch diameter pipe into the ground and attached the driven element to it. At precisely noon sun time, a stake was driven at the end of the shadow of the driven element.[4] This established true north. Next, I measured off 90 degrees and drove another stake, marking the true east/west axis of my new beam. The three ground posts for the reflector and two directors were installed next, together with their elements, along this east/west line. A length of RG-8/U was hurriedly run from the shack to the driven element just before dark. There was no time to install radials, but I did have a good (?) ground, four pipes driven into the moist soil to a depth of 3 feet.

At 6:00 am the next morning, I called CQ and was elated that VK3AKK ,answered and gave a report of strength 5 on a rather poor band. I was delighted that the first QSO on my new Australian beam was with a VK station. Anxious to see how much better it was than my other antennas, I switched in turn to a Hustler 4BTV, a dipole, and an eight-wavelength longwire. Ken came back saying: "Don't slash your wrists or cut your throat with this report, but although your new beam is a good S-5, the 4BTV ground plane is an S-7 and the dipole is an S-9. The longwire (pointing at South America) is an S-6."

So, back to the drawing board! It seems I have read somewhere that a pipe driven into the ground makes a good lightning arrester but not an rf ground! An swr check showed an extremely high swr ratio, so a 50-Ohm dummy load was placed at the far end of the coax. The swr came down to 1 to 1, showing the cable to be OK. Realizing that the trouble was probably due to the lack of a ground plane, four radials, each ¼ of a wavelength long, were installed at the base of each element. The swr immediately came down to 3 to 1.

A field-strength meter was set up about 60 feet in front of the beam, and the lengths of each element were varied in steps of 2 to 3 percent both ways with no very conclusive results. The elements did not want to tune. It appeared that I was trying to adjust the length of an element an inch or so at a time against some unknown random length of a ground system. Four more radials were added, making a total of eight radials per element. I reset the lengths of each element to 5 and 10 percent shorter for the directors and 5 percent longer for the reflector and ran another swr check. The swr was now down to 2 to 1, a worthwhile improvement.

The next morning, another CQ raised VK4AGL. The new beam was beginning to work. Joe gave me the following comparative report: new beam S-9, dipole S-8, 4BTV S-7, longwire S-5. It appeared I was now in business, so I started adding more elements, more radials, and a 4-to-1 step-down transformer. After each change, I would collect comparison reports for about a week. The greatest improvement in reports resulted from increasing the radials to 16 per element. The final 8-element

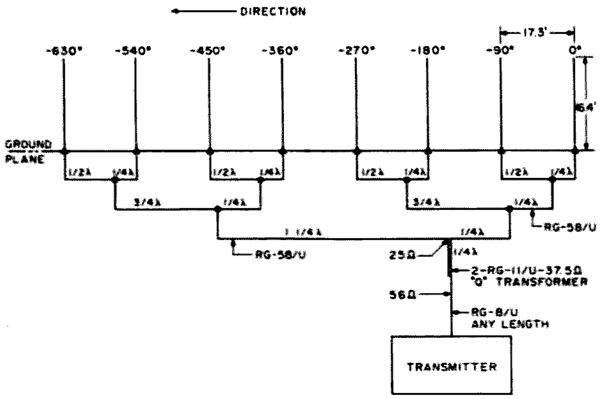


Fig. 3. Feeding and phasing an 8-element array. Note the 37.5-Ohm Q transformer. Refer to Fig. 5.

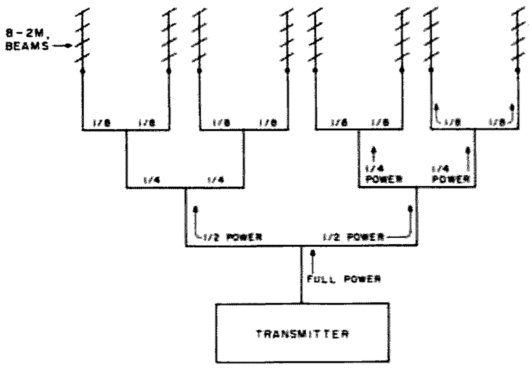


Fig. 4. Feeding eight 2 meter beams in phase with equal power. Feedlines to all beams are of equal length for in-phase operation. This is the type of phasing harness to use for broadside directivity of the 8-element array.

yagi beam gave a consistent two S-unit increase in signal strength (about 12 dB) over the best of my reference antennas. I still was not happy with the beam because I could not see any definite results from trying to tune it. Adjusting the lengths of each of the eight elements became very tedious and time-consuming. It was decided, therefore, to try an all-driven 8-element phased array, starting with two elements, then going to four, and then to all eight.

Phased Array

In a phased array, there are two things to watch out for: First, if ¼-wavelength spacing between elements is used for end fire, then there must be a 90-degree lag between elements, and second, the power must be divided equally among all elements.[5] The first problem is solved by feeding the first element directly from the coax from the transmitter and then feeding the second element through an extra ¼ wavelength of coax. Now, obviously, an electrical ¼ wave of coax, 11.4 feet, will not reach between two ¼-wave spaced elements, 17.3 feet; therefore, we must lengthen the coax to each element by an equal amount. For ease in grid-dipping each length of coax, I chose to lengthen each coax by ¼ of a wave. Refer to Fig. 1 for the power division and phasing of the first two elements. The formula for the electrical length of a quarter wavelength of coax is: L in feet = 246 × V/f = 11.39 feet when f (frequency in MHz) = 14.25 MHz and V (velocity factor) = .66.

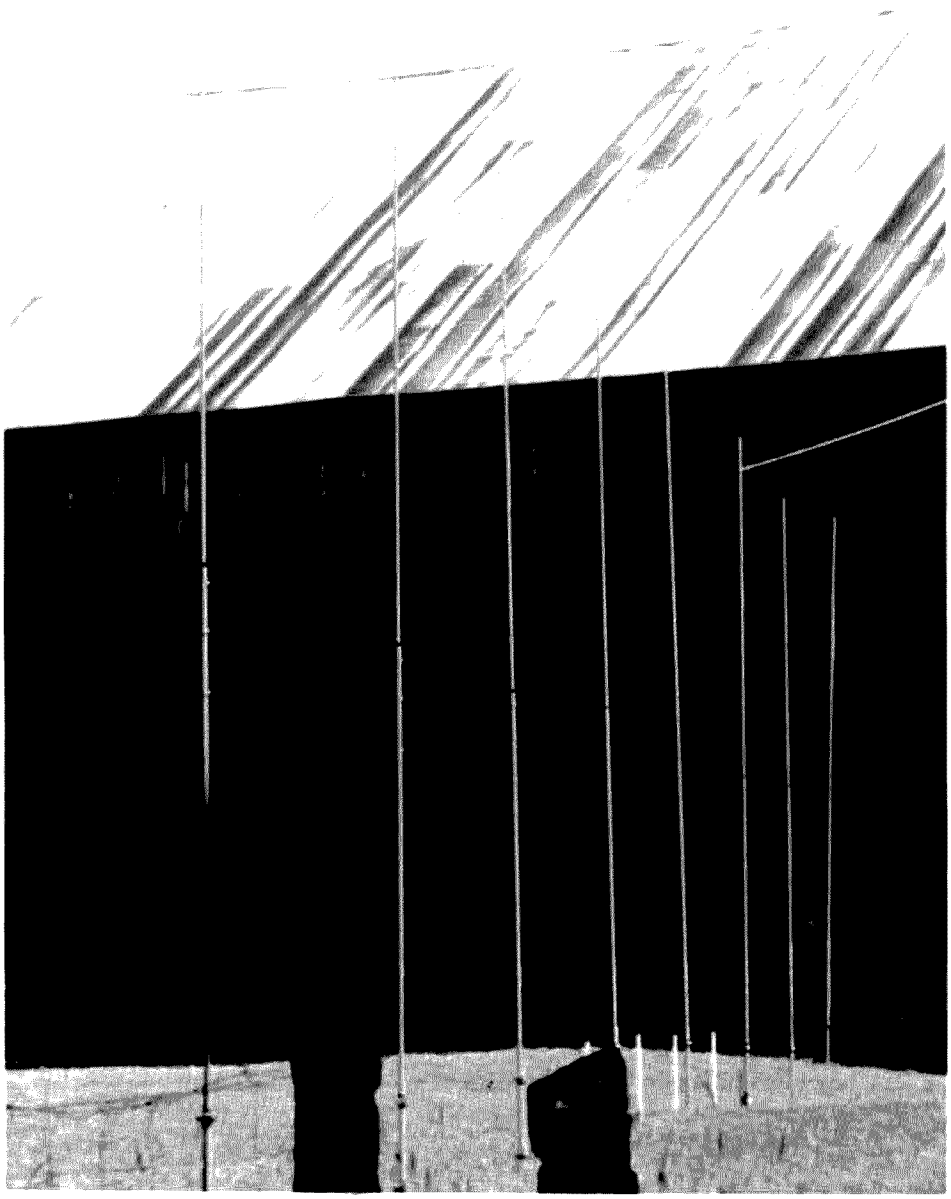
Handbooks say that V equals .8 for foam dielectric RG-8/U and .66 for solid dielectric. This makes a good starting point. Be sure to grid-dip your particular coax to 14.250 MHz, each time checking the grid-dip frequency on your receiver. Solder a 1-inch diameter loop onto a coax chassis fitting and then screw on the length of coax to be checked. If it is solid dielectric cable, then it should be cut to a few inches longer than .66 times ¼, ½, ¾, or 1¼ wavelengths and then pruned to length with the grid-dipper. When dipping the ½-wave coax, set the dipper at 7.125 MHz and read its second harmonic at 14.250 MHz. For all odd quarter wavelengths of coax, set the dipper at 14.250 MHz. The end of the cable you are pruning must be open-circuited. It was interesting to note that none of my coax had a velocity factor, V, of .66; it varied from .59 to .62.

Referring again to Fig. 1, you will note that the power from the transmitter is hopefully divided in half by the coax "T", one half going to element #1 and the other half going to element #2. Also note that points A and B are equidistant from the coax "T"; therefore, there is no phase difference between them. There is, however, an additional ¼ wavelength of coax between points B and C; therefore, it takes the signal that much longer to reach point C. Since there are 360 degrees in a wavelength, ¼ of a wave equals 90 degrees, and the signal in element #2 is said to "lag" that in element #1 by 90 degrees. This same method of feed will be used for each pair of elements.

This 2-element phased array was used for a week working VKs and ZLs, with results equal to the 4-element parasitic beam. Of course, by now I had a better ground plane than earlier. Next, two more driven elements with ¼-wave spacing were added. In each case, the division of power was hopefully accomplished by simply installing a coaxial "T" in the line as shown in Fig. 2. Phasing was accomplished by feeding the two pairs of elements through a ¼-wave and a ¾-wave section of coax as shown. The reason for doing this was to avail myself of a pair of ¼-wave matching transformers. If each of the driven elements had feedpoint resistances of 50 Ohms, they would be in parallel at the first "T", producing 25 Ohms of output. Now, if we connect in a 50-Ohm coaxial transformer an odd number of quarter waves in length, we can raise this 25 Ohms to 100 Ohms. $Zo = \sqrt{Zr \times Zs}$, where Zo is the line impedance (in our case, for RG-8/U, 50 Ohms), Zr is the impedance at one end, and Zs is the impedance at the other end, 25 Ohms. $Zr = Zo^2/Zs = 50 \times 50/25 = 100$ Ohms.

Now, at the next "T", we have two 100-Ohm resistances in parallel, giving us the desired 50 Ohms for the RG-8/U. An swr check bears this out. The swr with two elements was a little over 1.5 to 1. With the four elements and the transformers, it dropped to almost 1 to 1. The element lengths and the spacing had been calculated from the following formulas: All ¼-wave elements, length in feet = 246 × .95/14.250 = 16.4 feet. All element spacing, in feet = 246/14.250 = 17.26 feet.

A week of operation proved that the four phased elements equaled the 8-element parasitic beam. Many VKs and ZLs were worked, as well as some long-path contacts to



A view of the array from the highway with our old cattle barn in the background. This view is looking to the east off the back of the array and causes considerable comment among passing CBers. I often notice truck drivers looking out their windows with mike in hand . . . "Got your ears on, good buddy?"

the Indian Ocean, South Africa, and the South Atlantic. Another set of four elements was installed, one at a time, in line and phased, the same as shown in Fig. 3. The second group of four elements was delayed the proper number of degrees each by feeding them off another "T" with a 1¼-wavelength coax line.

The method of power division into eight equal parts is patterned after the way you would divide the power to eight two meter beams. I used this method very successfully in the 1950s on a 32-element beam for 144 MHz. Fig. 4 shows how it is done. No measurements have been made to find out exactly what the power division actually is between elements; however, judging by the array's performance, it must be fairly correct.

Swr measurements with various numbers of elements are as follows: 1 element, 1:1; 2 elements, 1.5:1; 3 elements, 3:1; 4 elements, 1:1; 5 elements, 2:1; 6 elements, 3:1; 7 elements, 2:1; 8 elements, 1.5:1. The addition of a ¼-wave Q transformer, Fig. 5, made up of 2 parallel lengths of 75-Ohm coax, as shown, raised the 25-Ohm output of the last "T" to 56 Ohms, close enough to 50 Ohms to give an swr of 1:1 for the transmitter to look into. Several weeks of tests on the completed 8-element phased array show that it tops the parasitic beam by a good S-unit. This is perhaps because I was never able to get all six directors and the reflector properly tuned for maximum gain. It appears that a parasitic element requires a much more perfect ground plane for tuning than does a driven element. At any rate, the all-driven array was much easier to get going than was the parasitic array. I suspect that an all-driven 4-element rotary beam would outperform a conventional yagi.

Construction

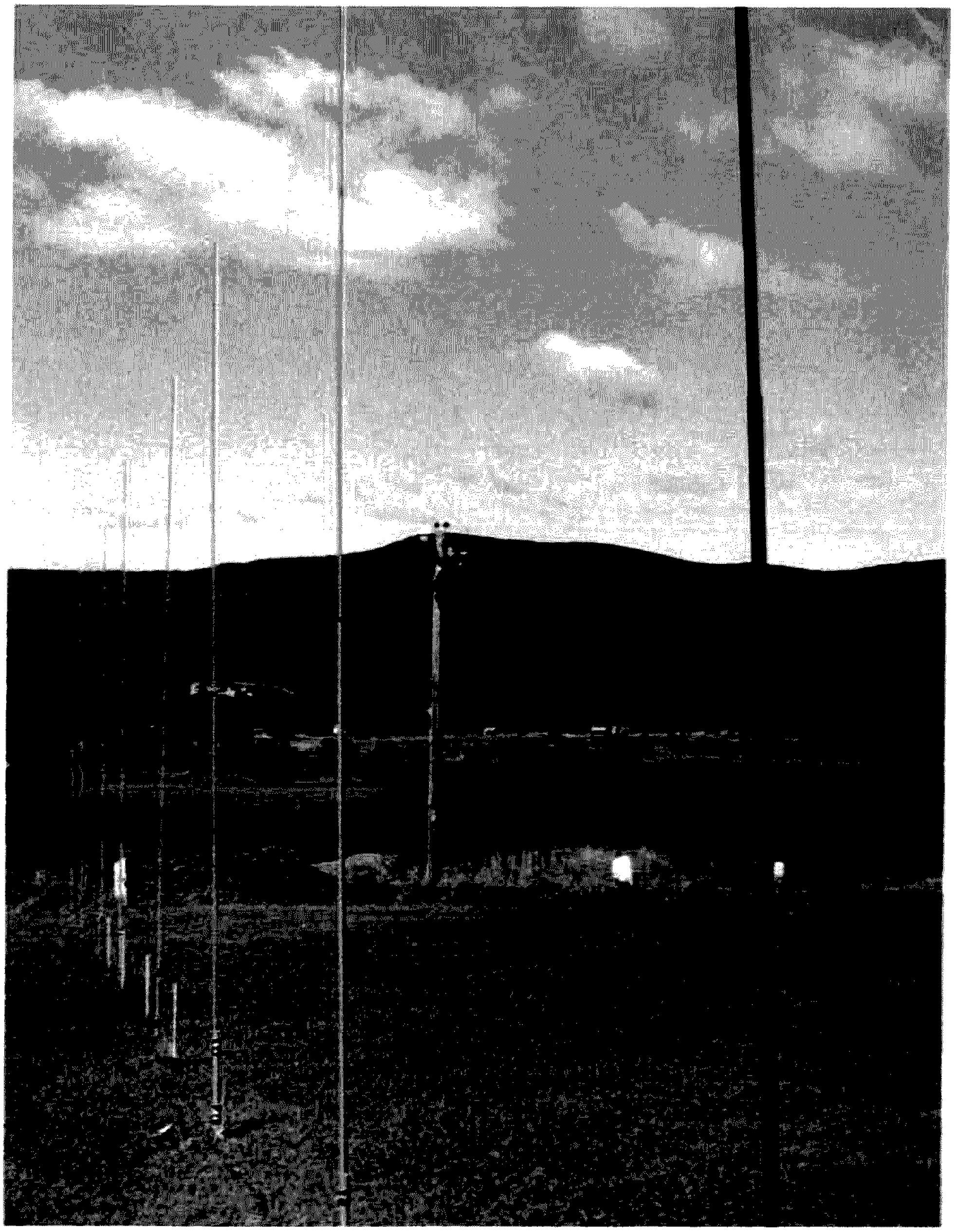
A readily available source of inexpensive tubing for this array is thin-walled galvanized steel electrical conduit, found at most electrical supply houses or discount stores. Each element is made up of a 10-foot top section of ½-inch diameter tubing telescoped into an 8-foot bottom section of ¾-inch diameter tubing. The two sections are accurately measured to 16.4 feet and then fastened together with three 10/32 machine screws tapped into the outside tube.

The ground post is a 5-foot section of 1-inch-diameter tubing driven 3 feet into the ground with a sledgehammer. Be careful to get it exactly vertical using a carpenter's level so that all your elements will line up nicely. Cut off the top 2 inches to get rid of the deformed part caused by the pounding.

The driven elements are each insulated from the ground posts with thick-walled plastic conduit or rigid plastic water pipe.

This is cut into 3-inch lengths and split lengthwise, one size to fit the ¾-inch conduit and one size to fit the 1-inch ground post. See Fig. 6. The RG-58/U is attached to the bottom of the element with a 10/32 machine screw, while the braid, after tinning, is clamped to the ground post along with 16 radials by using a stainless steel hose clamp right at ground level. The plastic insulators are squeezed into place with a C-clamp about 18 inches apart and held there with black vinyl electrical tape until the elements are secured with TV U-clamps.

Remember that the element length is from the top of the element to the point where the radials are clamped to the ground post. Fig. 7 shows the right and wrong way of attaching the radials. Keep the leads on the end of the coax as short as possible, as these add to the length of the driven element. It would be wise to give all the pieces of conduit a couple of coats of rust-proof paint before erection. Also, put corks in the top of each element and ground post to keep out water which will freeze and split the tubing in the winter. Tape the joint of the ½- and ¾-inch tubes with vinyl tape for the same reason.

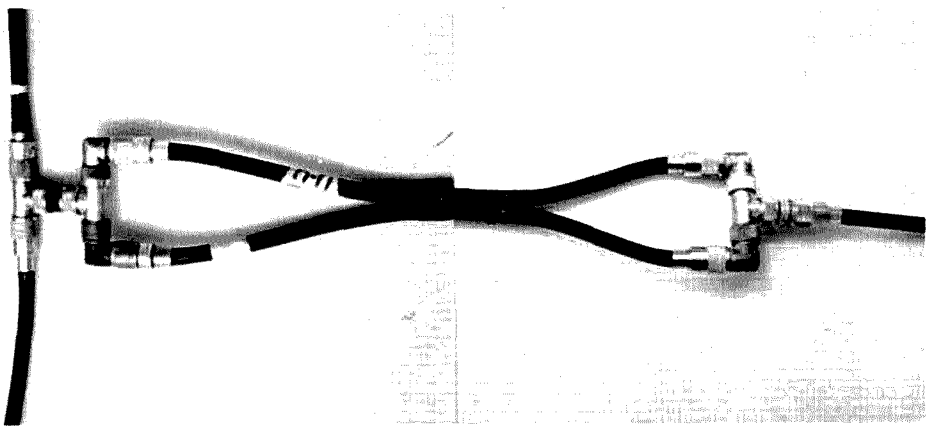


Looking west along the line of the array: The Connecticut River flows in the valley and the hills in the distance are in Vermont. Note that the top of the 7th element is just even with the horizon. A little trig with a pocket calculator tells us that our minimum angle of radiation is about 6 degrees.

Ground Plane

There have been a number of papers published recently[6] on the importance of ground radials or ground planes for vertical radiators. Most of these have been for single-element verticals or for shortened verticals. They have compared the efficiencies of several different ground planes using various numbers and various lengths of radials. A broadcast band station normally uses 120 radials, each 0.4 wavelengths long. If you plan to do this at 14 MHz for each of 8 elements, you will have to bury about 5 miles of wire in your yard, and if you do not want any TVI, you had better solder each place that the wires might touch each other or insulate them well. See Fig. 8. A poor joint will rectify your signal and generate harmonics.

Since I had found no information on the number of radials needed for an 8-element array, I decided to start with none and add them a few at a time until there was no longer any noticeable improvement. You have already read of the disastrous results with no radials and of the improvement as radials were added. If you decide to stop at 16 radials as I did, you will need 16 × 8 × 17 or about 2176 feet of wire, just under ½ of a mile. I bought two ¼-mile spools of #17 galvanized electric fence wire from the local farm supply store for $12. To solder the crossover points before burying the wire, I used acid core solder and then brushed the joint with baking soda to neutralize the acid. The radials were buried a maximum of 1 inch in the sod so that they would not get



This photo shows the use of coaxial fittings in construction of the 37.5-Ohm quarter-wave matching transformer. Refer to Fig. 5 for dimensions. RG-8/U from the transmitter connects at the bottom. The coax leaving the "T" at the top of the picture drives the right-hand and left-hand halves of the array, respectively.

tangled up in the lawn mower. The less "lossy" the dirt over the radials, the better. Fig. 8 shows the layout of the radial system. The dots indicate soldered crossover points.

Coaxial Cable

RG-8/U solid dielectric coax was used for the feedline from the transmitter to the first "T". RG-59/U, 75-Ohm, was used for the 37.5-Ohm ¼-wave transformer, and RG-58/U was used for the phasing harness. Of course, you could use the larger coax throughout if you have it available.

Results

How do you report on the merit of a new beam? The usual method is to set up a field-strength meter and rotate the beam, noting how the field strength varies with different headings. You could calculate the theoretical gain[7] or perhaps program a computer to do it for you. In this way, you could find out what the beam should do under certain conditions. What I wanted to know was what *would* the beam do under *actual* conditions. The only way to find this out is to call CQ DX and see from what direction your answers come. Then instantly switch back and forth between the beam and a fixed reference dipole and a reference ¼-wave ground plane antenna and request the DX station to give you comparative reports on the three antennas.

As a general rule of thumb, the gain of a beam increases by about 3 dB when you double its size. *The ARRL Antenna Handbook*[8] states that a 3-element phased endfire beam has an average gain of 5 dB depending on several variables, while a 6-element beam has a gain of 8 dB. In an attempt to measure the gain of our new array with a homemade field-strength meter with a remote indicating meter, we got a gain figure of 12 dB.[9] In a test with W1PFB/mobile on a hill 20 miles away in Vermont on a bearing of 270 degrees, Glen reported the array was S-9, the Hustler 4BTV was S-4, and the dipole was S-2. At six dB per S-unit, this looks like a 30 dB gain, 1,000 times in power; well, you know how S-meters are. The average VK and ZL station, however, also reports the array 3 to 5 S-units better than the two reference antennas. The proof of the pudding is in the high percentage (about 95%) of answers to CQ DX that come from VK, ZL, and other southwest Pacific Ocean areas.

A possible explanation for the reports of 20- to 30-dB gain at a distance of 10,000 miles from an antenna that should only have a gain of 9 dB is that perhaps its angle of radiation exactly matches the angle of propagation for that distance and that the angles of radiation of the 4BTV and the dipole do not. *The Handbook*[10] states in Table 1, p. 18, that at 14 MHz, signals arrive 99% of the time at between 6 degrees and 17 degrees and

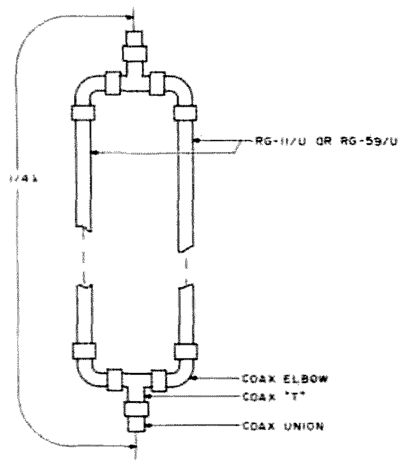


Fig. 5. 37.5-Ohm Q transformer—converts 25 Ohms to 56 Ohms.

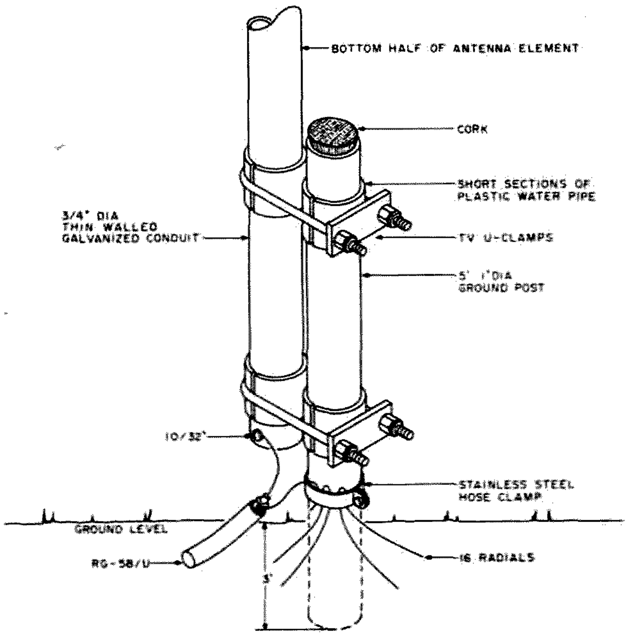
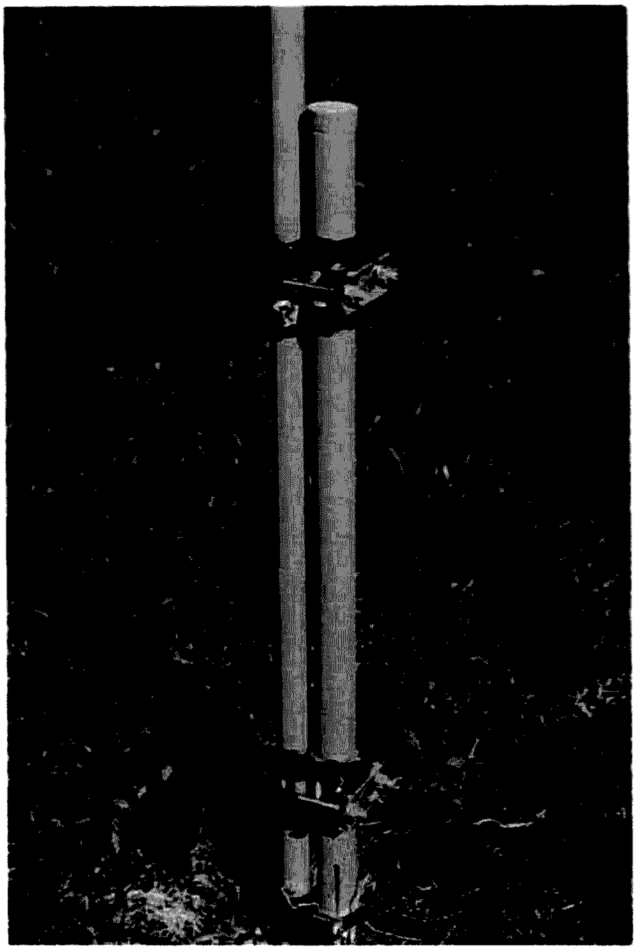


Fig. 6.



Each of the eight elements is attached to its ground post as shown, using split sections of plastic water pipe for insulators held in place with mylar™ electrical tape and clamped together with TV U-clamps. Refer to Fig. 6.

arrive 50% of the time between 6 and 11 degrees. It is also pointed out that since the maximum single hop via the F2 layer is 2500 miles,[11] a signal traveling from New Hampshire to Australia, 10,000 miles, would require a minimum of four hops. A signal radiated from a dipole ½ of a wave high would have a pattern like that in Fig. 9, with most of its power being radiated at an angle of 28 degrees. It would, therefore, require more hops to reach Australia, and since each hop attenuates the signal, it might be several S-units weaker than the array, thus accounting for the discrepancy in the gain figures between the array and the dipole.

Fig. 10 shows the vertical radiation of a vertical dipole with its center ¼ of a wave above ground. It is believed that a ¼-wave ground plane would have a similar pattern. Note that the effect of ground attenuation absorbs most of the radiation below 10 degrees. My 4BTV has 16 ¼-wave radials, more than usually used, but far less than the recommended 40 radials, each 0.4 of a wavelength long. Therefore, it may have a higher angle of radiation than the array and take one or two extra hops to reach Australia. Thus, with the ground attenuation and the extra hops, it might be even weaker than the dipole, and it appears to be. This same phenomenon, of course, also applies to rotary beams. For example, three identical beams with a gain of 8 dB will each exhibit completely different gains at a point 10,000 miles away, depending on the height at which they are mounted. The one exactly ½ of a wave above ground will be the weakest, the one 1 wave above ground will be an S-unit or so stronger, while the one 1½ waves high will be by far the strongest. At 2500 miles, however, they may be all equal.

Over a three-month period, more than 150 VKs and ZLs were worked, many of whom could not even be heard on the 4BTV or the dipole. QRM from the west is louder, of course, because the array points that way; however, most of these stations are still asleep at 6:00 am Eastern Time. The side-to-front and front-to-back ratios must be fairly good because QRM from Europe and South America is rarely a problem.

If you already have a quad at 60 to 100 feet, this array will not help you. If, on the other hand, you only have a tribander at 35 feet, you may do better in one direction with this phased array, saving the cost of a taller tower. If you are considering spending a bundle for a 60-foot tower and rotatable beam, you may do well to consider two or three of these arrays, each pointing toward needed new countries. Your ability to instantly switch direction with several of these arrays without waiting for a cumbersome rotary beam to turn is indeed a new experience in DXing.

This array, with its method of phasing and power division, may be scaled to other amateur bands. It is possible that top-hat loaded elements could be used on 80 and 40 to keep the height down to 16 feet.[12]

The directional characteristics, both horizontal

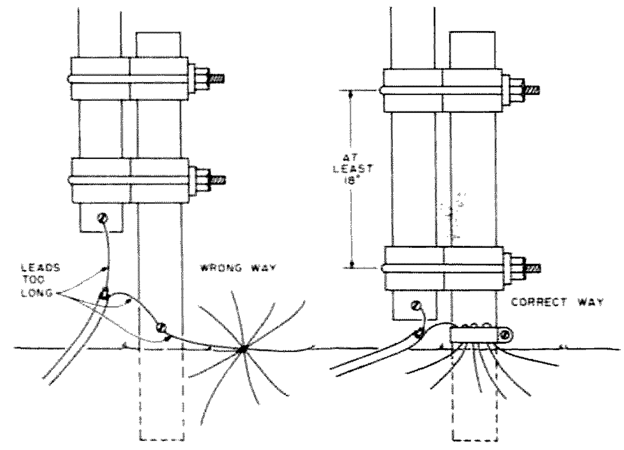


Fig. 7. Right and wrong ways of connecting radial system.

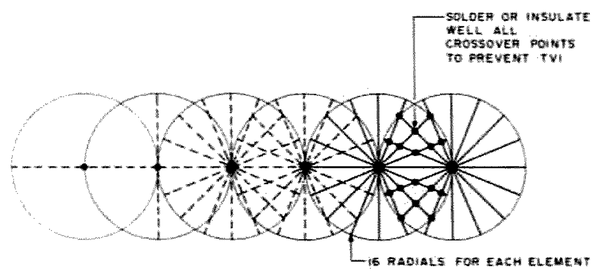
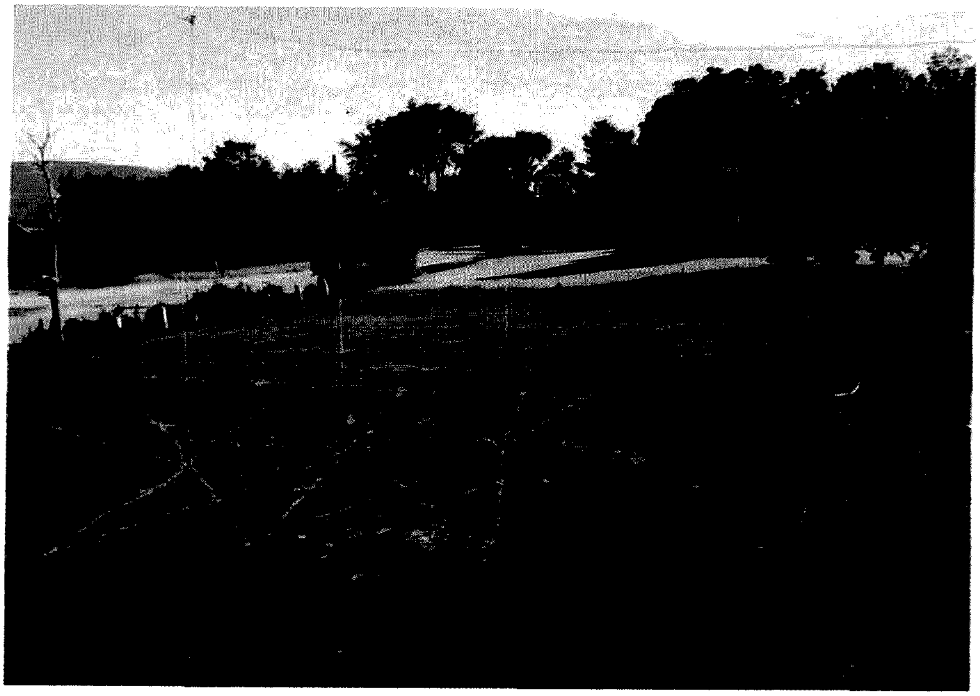


Fig. 8. Radial system shown in full for first two elements on the right. The other six are identical.

and vertical, of antenna arrays similar to the one discussed in this article may be found in various handbooks.[13]

The direction of radiation of this array may be switched end-for-end or broadside by bringing equal lengths of RG-58/U from each element into the shack to eight single-pole, three-position coaxial switches. Three different phasing harnesses would be switched into circuit.



Four more radials were added after this picture was taken, making a total of sixteen; all were from 16 to 20 feet in length. The author employed a trained mole; however, any sharp-pointed garden-weeding or cultivating tool may be used to scratch the shallow trench needed to bury the radial about 1 inch. Refer to Fig. 8.

Operation of the Array on 21 and 28 MHz

Recently, during a 10 meter band opening, I decided to check the swr of the 4BTV vertical on 28 MHz, and, to my surprise, it was 1:1. I was more surprised to find that the coaxial switch was in the 20 meter array position, not the 4BTV position. Further measurements showed the swr of the array on 10 meters to be as shown in Fig. 11. Next, the swr was measured on 21 MHz. These figures indicate that the array should work on both 10 and 15 meters, and indeed it does. On 10 meters, the swr is 1:1 around 28.5 MHz and is below 1.5:1 from 28.1 to 28.8 MHz as shown. On 15 meters, the swr is 1.3:1 at 21.150 and is below 1.7:1 from 21 to 21.450 MHz. Listening and transmitting tests confirmed that on the ten meter band the directivity was essentially the same as that on the 20 meter band. Signals from the west peaked up a couple of S-units, while signals from the south and northeast fell off a couple of S-units compared to the 4BTV and the dipole. On 21 MHz, the directivity was less pronounced, but the array proved to be effective, equal to or better than the 4BTV or dipole in the westerly direction.

Why does a 20 meter array work on 15 and 10 meters? Terman[7] states that an endfire array consists of identical antennas arranged along a line carrying equal currents excited so that there is a progressive phase difference between adjacent antennas equal in cycles to the spacing between these antennas in wavelength. He further states that the gain of the array is proportional to the length of the array, but is independent of the spacing of the elements provided that the spacing does not exceed a critical value of about 3/8 wavelength. Greater spacing is permissible under certain conditions. The array being described fulfills the above conditions on 14 MHz with a 90-degree phase lag and ¼-wave element spacing. On 21 MHz, using the same phasing harness, the phase lag becomes 135 degrees with the 3/8-wave spacing between elements. On 28 MHz, we have a 180-degree phase lag with ½-wave spacing. In other words, the phase lag between elements is correct for the element spacing on each of the three bands. The element lengths, however, are incorrect on 21 and 28 MHz. On 21 MHz, the elements are 3/8 of a wave long, as are the ¼-wave Q transformers. It is not quite clear why it works as well as it does on 15 meters. On

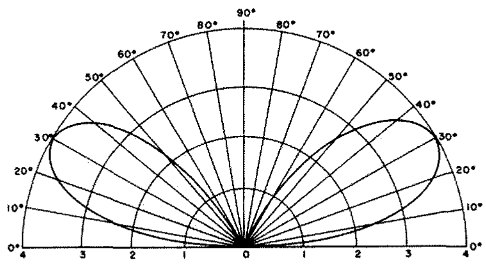


Fig. 9. Vertical angle of radiation of a half-wave dipole at a height of ½-wave above a perfectly conducting ground.

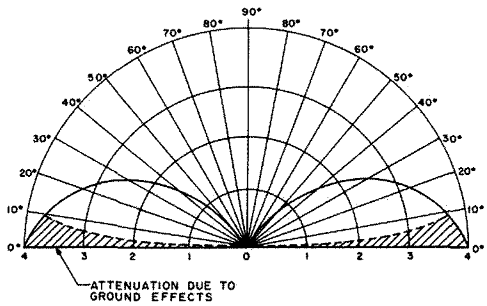


Fig. 10. Vertical angle of radiation from a half-wave vertical antenna whose center is ¼-wave above a perfectly conducting ground.

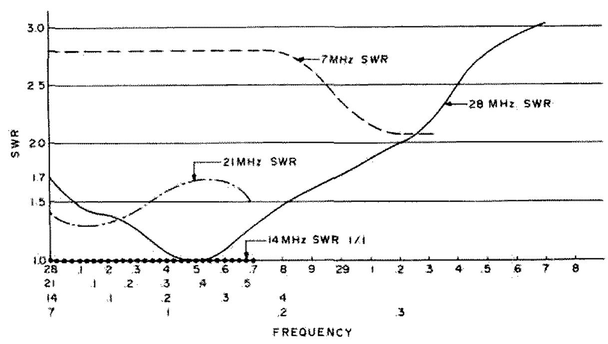


Fig. 11. Swr curves for 7 MHz through 28 MHz for the array.

28 MHz, where the elements are ½ of a wave long, it would appear that we are trying to feed a high impedance point with a low impedance feeder. There is undoubtedly a very high swr on the coax nearest to the elements. The losses will be low since the coax is short. Since our ¼-wave Q transformers are now ½ of a wave long, they no longer act as Q transformers but simply repeat the impedance from one end to the other. At each "T", we parallel these impedances and cut them in half, thus reducing the swr as we get nearer to the transmitter. Terman shows that the gain with ½-wave spacing is only about ½ that of ¼-wave spacing; however, since the array on 10 meters is twice as long as it is on 20 meters, the gain doubles and therefore is about the same as on 14 MHz.

P.S. It works like a bomb on CB. ■

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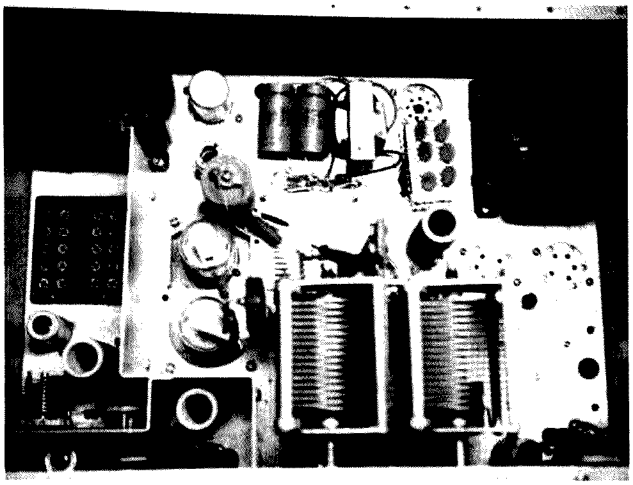
CW with a Nordic Flair

—new life for the Viking I

Butcher your boat anchor.

For the CW op who is looking for a respectable signal with minimum cash outlay, here's a chance to put a quarter kilo on the bands for about two bits per Watt.

The recipe for this treat has, as its main ingredient, one of the old boat anchors that were "in" before the advent of the filamentless tube. We refer to rigs in the Viking class which can be acquired at hamfests for anywhere from \$30 to \$100. Prices generally are inversely proportional to the algae accumulation, that is, the more shine outside, the higher and bigger the ticket. I can only encourage prospective buyers not to worry about outside rust, dents, and scratches, but rather to get a close evaluation of the innards, mainly the power transformers and rf section.



When I acquired a Viking I, the cost of the rig was less than the follow-up chiropractic costs from hefting this unmobile monster. So, numero uno for the mod squad was a requirement to trim, slim, and debulk the critter. If you have a Viking, compare it with the photograph which shows a lot of gaping space left when we retired from surgery.

I don't have any "remove the third bolt and cut the green and white wire three inches from the end" type of description for these mods. But take heart and use judgment and a certain amount of caution. It's your rig to butcher as you bloody well please, so you're the only judge of what you do. An old friend used to assay his home jobs in two categories—for fun or for sell. You won't have much of a shot at selling it, except on performance, so have fun like I did.

Check the circuit of the unmodified power supply. There are really a powerful lot of iron components floating around, iron that means good design but is not really needed in a strictly CW machine.

Transformers T1 and T2 are needed, of course. But chokes L1 and L2 were promptly relegated to the junk box (which is one way to build up one of those junk boxes that builders always seem to have). These chokes serve to smooth out the ripple in the outputs of their respective power supplies. You learned about them studying for the General exam without getting involved with more complicated stuff like $E = L\,(di/dt)$, which has to do with the notion that a changing cur-

rent through an inductor causes a back electromotive force (emf). The back emf tends to oppose the change in voltage trying to take place, with the net effect that one tends to cancel the other, particularly when load demands change, as in modulation. So, instead of a changing voltage at the rectifier output (a ripple), you get a smoother dc voltage, which is why it's called a smoothing choke.

Those chokes are fine for ten meter phone rigs, but, since this is a CW rig, we care less about phone and don't need the super design of smoothing chokes to get a T9 report.

But something is needed in there to work with the filter capacitor, which turns out to be a series resistor. L1 was replaced with a 200-Ohm, 50-Watt resistor, and L2 with a 500-Ohm, 25-Watter.

From there, I moved over to the audio section, and, in a flash, two more big hunks of iron, T3 and T4, passed on to the junk box, probably never to rise again, since these are the modulation and interstage transformers.

Right about there is where paring the iron takes some steely nerves, because it's a no-return point. Those transformers go and so does any phone mode. You could always sit back and rationalize that you just might like to take a whack at AM some day and all that. Well, that's your decision.

Without the transformers, there wasn't much sense in leaving the audio tubes in their sockets, so out they came, at a saving of 15 Watts of filament power.

Meanwhile, back at the power supplies, further mods were made. It was with some pleasure that I relegated the rectifier tubes V8, V9, and V10 to the junk box, saving another 30 Watts in filament power. Solid-state rectifiers were installed.

The low-voltage power supply was converted quite simply with a plug-in replacement, the 1N2389. But you don't have to go to that expense. Use a pair of diodes in a full-wave circuit from the *Handbook*. Type 1N4006 diodes rated at 800 volts, 1 Amp, are advertised at 15 cents each. Buy a bunch and run some front-back resistance measurements to select the best with the highest back resistance.

I went to a three-diode series arrangement shown in the diagram, using three of the 1N4006s to get a safe peak inverse voltage level of 2400 volts in the high-voltage power supply. The shunt resistors and capacitors are there to protect the diodes in case one of the critters has different characteristics than the others and might take an ungainly bigger slug of peak voltage. That would have you back in there with the soldering iron right soon. The *Handbook* also talks about this situation.

The high-voltage rectifier was built on sandwiched pieces of perfboard and wired to an old tube base (that I happened to have in the junk box) from a discarded 5R4, and that just plugged into the old 5R4 socket.

After all these chops, the net change was to have cut out four chunks of iron and seven hot bottles, which was a significant weight and power reduction. I went back in to add a small 24-volt transformer, rectified with another pair of those 1N4006s, and regulated by a small 15-volt solid-state voltage regulator (Radio Shack has them for $1.50). This supply is intended for a vaguely-distant outboard FET vfo (one of these years). A VR150 was also added to the screen grid of the oscillator, and an antenna relay was thrown in for full break-in.

The first thing I noticed on firing up the rig was a hefty slug of plate voltage, well over 800 volts. Just to bore you a bit as to why there was so much more soup over the nominal

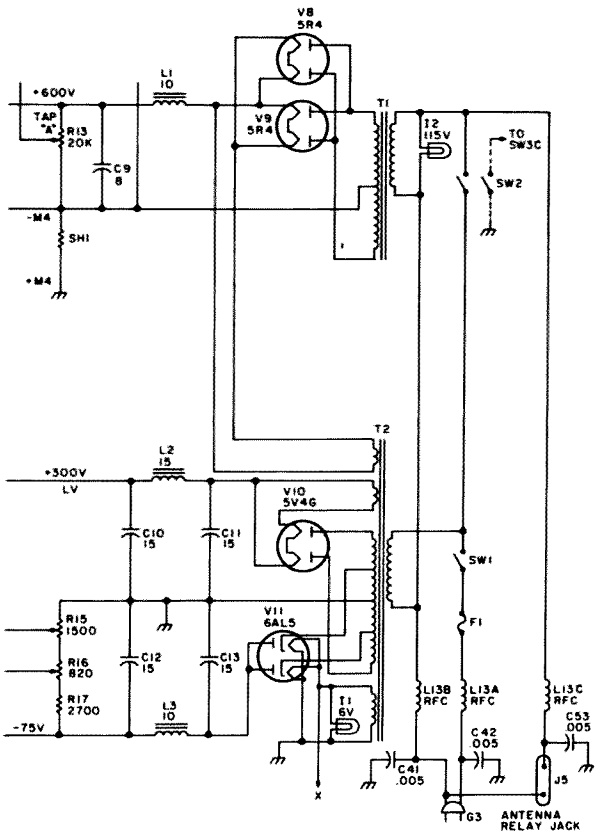


Fig. 1. Original Viking power supply diagram.

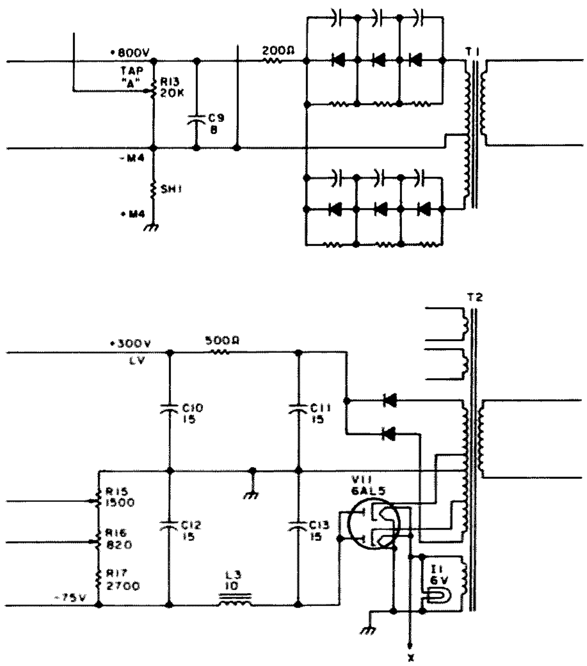


Fig. 2. Modified diagram. Diodes—1N4006s. R—1 meg. C—.01 μF.

600-volt former value, it was the replacement of the vacuum tube rectifier with the more efficient solid-state rectifier. In the theory of vacuum tubes, there is that characteristic known as the tube's dynamic plate resistance. This is a simple cut at Ohm's law, which says that anytime there is voltage across a gadget through which current is flowing, that gadget has a resistance. More properly with respect to a tube, a changing voltage with respect to a changing current gives a changing, or dynamic, resistance. Trouble with the tube is that its dynamic plate resistance can't drop as low during heavy conduction as the semiconductor's can, so the voltage across the tube is voltage wasted. Since the semiconductor doesn't have that kind of hang-up, very little IR drop is across the semiconductor under heavy forward conduction and all the soup goes into the pot, right at the final plates. (Our low value of resistance in the filter also helps.)

Also noticed real quick-like was the way rf zapped around the plate tuning capacitor. There's a lot more rf kicking around the final with higher voltages, and you really have to be careful in tuning. Had I not buttoned up the rig and gotten subsequently sidetracked, the smart addition would have been a switchable resistor in series with the screen grids to the final. I felt bad about this one getting by and strongly recommend breaking the screen lead to insert a 10k or 20k resistor in series with the present dropping resistor. Then put a switch (use the old phone-CW switch) across it so that for tune-up the switch is open and you're in QRP with low screen voltages.

With over 800 volts on the 6146s, you shouldn't walk away with the key down. You could get some experience with cherry red plates by holding the key down for a while (properly loaded) and observing. The rule under such is: red, si; blue, sick. In other words, a cherry red (I don't know why they always say "cherry" red) on the plates won't hurt, but a blue glaze or glow around the envelope when you key is a no-no. It means the tube is gassy and will do unpredictable things. You could get away with using it on 80 and 40, but on 10 or 15 you might well be in trouble (as I was when my blue final brought in a pink QSL once). Best bet is to learn exactly what the dials read when the rig is properly tuned for your antennas on each band, then log those readings. Next time you QSY, go right to those readings before keying down.

The 6146s were loaded to 300 mA with no problems to get that quarter kilowatt. There is occasional arcing, but that's a fun experience that you don't get every day. Fact is, if you had a new checkbook rig and it dared to arc over, you just might have a mild coronary. But with an old clunker like this, what could be more typical ham fun than disturbing the quiet of a pre-dawn QSO with a companionable splat-t-t-t on a long dah. Shucks, that's how you store up memories for the day you join QCWA.

In summary, here's a rig with certain anatomically connotative improvements—it didn't cost an arm and a leg to get a quarter kilo on the air, it doesn't quite break your back to heft it around, and you don't have to sprain your wrist writing out a check for the electric bill. ■

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House-Hunting for Hams

—caveat emptor!

Avoid nasty surprises.

Consider the sad tale I heard on 15 meters the other night.

A ham and his XYL, along with their real estate salesperson, went looking for a new house. In the car, he explained the kind of house he wanted and said that he was looking forward to having his first full-fledged antenna farm. They found the dream house in a fairly new development. He didn't notice any antennas on roofs, but it was early spring and most people had moved in during a long, cold fall and winter. To be safe, they drove by city hall and got a copy of the ordinance pertaining to towers. Everything looked OK. They bought. Months passed. As he was laying out the parts to a 65-foot tower in the backyard, a neighbor casually asked what he was doing.

To his grief, to his agony, he was told that the homeowners association had a rule against all external antennas.

He is not the first ham I, as a real estate broker, have counseled, either on the air or in person, about buying a home. But for him it was too late. He is now reading articles about "cliff-dweller" antennas, and "how to work the world on your attic antenna."

His first reaction, of course, had been, "Can they do that?"

You'd better believe it! In this case, the builder founded the association with the intent of keeping property values at some high common level. It's a great idea for 99% of the people, but for our friend it was tragedy. Buried in the mounds of paper accompanying the normal real estate transfer was a deed restriction giving certain rights to the association regarding the grounds and exteriors of the homes in the subdivision. One rule restricted antennas.

Let's understand one thing right away. There are many ways to get fouled up when buying real property, and new ones are being invented every day. Self-servingly, but realistically, I recommend a trusted broker. You may need to talk with several to find the one you want, but when you do, show your trust by listing the whats and whys of your property needs. Then stay with that broker. He/she will work hard for you and chase information if he knows he'll get paid in the end.

Consider the following in your early discussions with the broker:

1. Homeowners associations. Don't think that townhouses and condominiums are the only places that can restrict you. Many single-family areas of all price ranges have these associations or are attempting to form them. Even the voluntary ones exert peer pressure on non-complying owners. Many times they will have an architectural control committee that can cite you for such things as the wrong color door, a trellis extending above the fence line, or unacceptable installation of children's swing sets. Just try to get them to let you have an 80-foot tribander! I still think associations are a good thing. They do tend to keep values up, and most are reasonable. But I don't know of any allowing what hams dream of.

The listing broker should have information about mandatory or voluntary associations, but if not, your broker can contact the association or its management agent, if there is one.

2. Restrictive covenants (deed restriction or condominium declaration, if any). "Condominium" pertains to a form of ownership law, not architectual arrangements. Many single-family detached homes are coming under the condominium law. I once sold a house that was not under condominium law but had a 1908 deed restriction regarding the size and cost of the outhouse. We found it by checking the records at the county recorder's office. The existing title policy (or other evidence of title in your area) should indicate the existence, but not necessarily the nature, of restrictions. In a subdivision, at least in our area, you can check the documents filed when the division was made and be pretty safe. In non-divided areas, you must check the documents filed on that property.

3. Zoning laws or building ordinances. Most of us are familiar with the battles that hams have had nationwide to keep these laws fair to all. Be care-

ful—just because someone has a tower nearby, or just because one went up recently, does not mean it was legal then or now. Taking down is less fun than putting up.

4. Building permits. In some cases, you may even be required to appear before the town council. You may be restricted as to height, distance from property lines and power lines, and crank-up towers may be allowed only on Tuesdays when the moon is full. That is my way of saying that town councils and those that serve them are very creative when they write laws. The only way to know for sure is to get a copy of the law and ask someone there how they enforce it. You will not find that person in the day you call. In fact, he'll probably be the eighth person you talk with on the tenth day.

Knowing what to look for and being sure are two different things. Start by having a conversation with the broker about your regular home needs. (How about 4 bedrooms, 2½ baths, family room, full basement, 2½ car garage, at least an acre of yard, for not over $35,000? This is a little real estate humor, since that home sells for over $100,000 in our area—but these calls still come.) Then tell about your special needs—some of which will follow. Mention the problems as above. Discuss local areas.

If you are new to the area, contact the ARRL for a list of clubs there. Or get on two meters and find out what the local problems have been from the people who know. But remember, *they* may not be aware of some of the hidden restrictions, unless someone has had a specific problem in that subdivision. (And then, too, some subdivisions have more than one association.)

If you decide you want or need an attorney, find a good *real estate* attorney (the broker can help you). I prefer a local one who knows the area. Get some wherefores and whereas to add to the standard sales contract. They might take the form of a rider making the sale subject to no association, deed restriction, or building/zoning ordinance prohibiting you from doing whatever it is you want to do, or a rider voiding the sale if a building permit to construct (insert what you want) cannot be obtained in some reasonable time. I know many people don't want to spend money for an attorney. Most transactions go rather smoothly for the buyer without an attorney. But on those that don't, it's generally too late for one to help after you find you need one. It's better to get one up front.

Now that you have a broker and attorney working on your behalf, you should monitor their work. Even if you don't understand the law, you can make a judgment about their thoroughness. Ask questions. Remember, they are getting paid to answer your questions. Ask about every aspect of the transaction, not just ham-related ones. If they can't answer, won't answer, or don't try to get the answers, consider someone else.

Here are some more things to check: electrical capacity (verify amperage, but not by counting fuses), wiring (among other things, aluminum wiring was popular at one time and if not installed properly is a fire hazard), elevation (topographical maps, flood plain maps, and elevations-above-sea-level are available through the broker or city hall), power lines (do you really want to live under high-tension lines next to a sub-station?), airports (remember height restrictions), common television antennas (the preamps in these small systems pick you out of the ether better than channel 2), and look for a suitable quiet room away from the family traffic pattern (hi, hi).

One amazing thing I notice about home buyers is that they seldom walk the grounds. Walk all over the yard. Plot antennas as well as geraniums. Get a copy of the survey and plan the future. If the market is fast, the house might be sold before you get that done. Having the attorney prepare safeguards on a rider, prior to looking, gives you the ability to move rapidly even if you are not finished checking everything out. Once you sign, it's too late to ask about towers unless you have caused the contract to give you that right over the next few days.

Perhaps it will never happen to you. Some old deed restriction from a farmer in 1898 won't crop up (did I really write that?), and you'll always luck out, and your only worry will be airplanes dodging your guy wires. Maybe you've bought and sold ten homes and had no problems (Murphy's Law times ten squared), but a little work by you and your broker can make sure you'll get what you want.

Finally, ask about financing. Some of the new plans permit less down payment, but the monthly payment is still affordable. Since less is needed up front, you'll have more available for furnishings such as refrigerators, amplifiers, stoves, transceivers, dishwashers, and so on.

When you get the tower up and have a stacked array on top, give me a call on 15. We can all use the good news! ■

W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

from page 4

waiter asked me if I was a ham. I nodded and he asked my call. Just to be smart, I tilted my belt buckle up and read the engraved call . . . W2NSD/1. The waiter laughed and introduced himself as Fred Scully WBØFOR.

Since most of us had our HTs with us, Fred clued us in on the repeater in nearby Glenwood Springs . . . 146.67.

The next day, while we were having lunch at the Tiehack restaurant side of Buttermilk Mountain, I tried out my Tempo S1 HT and switched to 67. Sure enough, I raised the repeater and resident user Bob K9MWM. We talked while I ate the delicious pea soup, and then I asked Bob what kind of business he was in out here in a small Colorado town. I just about lost my breath when he said he was writing computer programs for the Radio Shack TRS-80 and selling them to local businesses. It turned out that he reads both *73* and *Kilobaud Microcomputing.* You can be sure that Bob joined us the next day for skiing.

It appears that Instant Software will be able to distribute some of Bob's business programs, so by next year he may have considerably more leisure time for skiing. How many small towns around the country harbor a programmer writing microcomputer business programs? That's just too much of a coincidence.

Sherry Smythe, with all those Aspen trees for which the town is famous in the background.

On the following day, our Denver legal staff drove in and we had a great time spending a full day hashing over growth plans with them. I've long had the desire to take *73 Magazine* public so that the readers would be able to own the magazine, but every time I've approached professionals about this, they have pointed out that it is necessary to have five years of certified bookkeeping before this can be entertained.

Now, with a new corporation (Instant Software, Inc.), perhaps it will be possible, once the corporation shows some significant signs of success, to take it public. Our lawyers seem enthusiastic. It would be fun to be in on the ground floor of something with the growth potential which software publishing seems to provide. Watch out, Xerox!

Between the software, the talks with manufacturers and dealers, the legal discussions, etc., the conference at Aspen was a great success. The skiing was fabulous, the meals ditto, and the company first rate.

Funny thing. I got a beef about the conference last year. One chap showed up with his wife, attended one dinner, and was not heard from again. His employer was bent out of shape at me for this! The purpose of the week-long conference is to get industry people together in a relaxed atmosphere and have ideas discussed on marketing, advertising, the future of amateur radio, etc. Discussions somehow seem to go better when you are on a ski lift together . . . eating lunch on a mountaintop . . . in a sauna . . . or having dinner at a superb restaurant.

While talking over my HT from the center of town, I was stopped by a chap who asked me the repeater frequency for Aspen. It seems that he'd read in *73* about the conference, but his wife wouldn't let him talk with other hams while he was there, so he wasn't checking in with us.

ARRL BLOWS $100,000?

Several of the insiders at the League are bent out of shape over the recent dumping of about 50,000 1978 ARRL *Handbooks*. I gather that the people wanting to blow the whistle first turned to *HR Reports*, but got nowhere. I don't know any good way to check all these allegations out, but perhaps you can get some straight answers from your directors the next time they talk at a hamfest or convention.

It appears that the chap in charge of ordering *Handbooks* made just a little mistake in 1977 when he ordered 30,000 more than the League could sell. No one seems to know just what happened to these 30,000 *Handbooks* or who collected for them.

At least someone seems to have learned by experience, for in 1978 they ordered 50,000 more than they could sell. Now, in the book business, it is not unusual to have some books left over, so publishers send out a letter asking for bids on overstocked books. In this case, where the book was selling for $6 and perhaps selling wholesale for $4, ham stores around the country probably would have jumped to buy out the lot at $3 per book. Since they probably cost around $2 to print, the ARRL still would have come up a winner.

This doesn't seem to have happened. I know that our Radio Bookshop, one of the larger sellers of radio books, never got any word that the *Handbooks* were available . . . and the larger dealers that I have talked with got no word of the brewing deal. What seems to have happened, if I can believe sources within the ARRL, is that some of the *Handbooks* were sold to Herbach and Rademan for $1 each . . . an excellent deal for H&R. The rest of the 50,000 were apparently given to *Ham Radio* magazine to be sold . . . and not for a cash-up-front payment, but on consignment. This means no investment at all for *HR* . . . with the price alleged to be the same $1. Now, if that isn't a sweetheart deal! I think I could have moved the whole 50,000 out to dealers at $3 each on a lovely deal like that.

The end result looks like the ARRL took a bath on the *Handbooks,* losing about $100,000 that they could have netted if they had had anyone with brains running the show. Of course, if there are other factors . . . like a hand under the table somewhere . . . ? And ARRL staffers are still asking what happened to the 30,000 books from 1977 and who got the money for them.

Then there is the case of the missing operating aids. Ten thousand were ordered from the printer and paid for, yet only five thousand were ever delivered. Where did the others go, and who sold them where for how much? I understand that this situation was detected but never investigated. How about asking your directors?

With a hundred thou going here and another there, kind of leaking through the cracks, perhaps it is time for getting rid of the Good Old Boys who are running the HQ and making a mint at it.

Members might ask their directors why they let the same old people run the show when even the old-time staffers are bailing out of the sinking ship. I understand that Bob White left when he was forced out over a DX decision by Baldwin. A lot of years went down the tubes . . . and Bob was about as straight a chap as amateur radio could ask for in the job. His wife apparently left when she could no longer stomach shady doings with new products. So I'm told.

The result of the recent staff changes is that virtually no one on the day-to-day staff has been there more than a couple of years. The pay is poor for the staffers, but they have to put up with what appears to be heavy-duty graft on the part of the Good Old Boys . . . things like having books published by outside publishers using *QST* material . . . trips with a secretary instead of a wife, all paid by the ARRL.

One whistle-blower suggests that I ask for a revelation of who has stock in VBC. The scenario does seem strange . . . first an editorial in *QST* saying that a breakthrough is needed . . . then some articles on NBVM which don't tell how it works, and a 1979 *Handbook* chapter on the system showing a working unit which has never even been shown at HQ. With both the FCC and the communications industry turning thumbs down on the NBVM system, you may be sure that I'll be most interested in how it really works once some units are made and shipped.

I've tried to get some information from the promoter of the effort, Tommy Lott, but have gotten silence for my trouble. This set me to wondering about whether the whole idea was more of a promotion than a breakthrough. It would be comforting to have a disclosure of who owns the stock in the firm and to find that no one at ARRL HQ is listed.

TIME TO SPARE

Recently, I had to make a quick business trip to New York. Having lived in the city for 30 years, off and on, I normally avoid it like the plague that it is. I kept track of the time it took me to get from Peterborough to my destination in Manhattan . . . and I cut things as close as was practical.

I left Peterborough at 0820 and arrived at Logan airport in Boston at 0950. I got right on a

plane and arrived at LaGuardia at 1050. By 1115 I had arrived at the subway station and was on my way to Manhattan. I arrived at my destination at 1200. Now, if I'd driven directly to New York, I'd have arrived at about 1220. I saved 20 minutes and spent a bloody fortune on the plane.

While going past the 61st Street Woodside train stop, I got to thinking back a few years to my visits there with John Williams W2BFD. John died in 1961, and I picked up some of his old equipment at the auction—I still have it around here.

John was the primary pioneer of amateur radio Teletype™. He got going with this back in 1946, and he provided most of the circuits and equipment for the entire hobby for the first few years. John ran this sort of side business out of a grubby little storefront shop in Woodside, Queens ... a radio repair shop. You remember radio? This store, usually closed, made enough for John to support his hobby of RTTY, and that's all he wanted. He designed most of the equipment we used, set the standards, made the templates, sold the parts, and generally nursed this hobby along.

John also got into trouble a lot. Ma Bell was very uptight with him because he had rigged up an automatic telephone-answering device in his store and wouldn't let their inspectors come in to see how he'd done it. They were sure that he was connecting directly to their wires, but couldn't prove it unless they could get in to inspect. They would always find the store closed.

He did indeed connect to the verboten Bell wires and had a corking-good answering system going, years before it was popular. He could talk over the phone from his home a mile away via a carrier current system. The phone-answering system used a phonograph record to give his message and a wire recorder (remember *them*?) to record the response. He was generally monitoring the call from the shop or home and would break in if he wanted to talk with you. You ran into the same problem at the store door ... with an intercom speaker which went via carrier current to his home ... and a similar system at home going to the store. You just were not about to be able to locate John if he didn't want to be located.

I remember the day the FBI came to my house to ask questions about him. That surprised me. All I knew about were his radio repairs, the RTTY involvement, and his problems with Ma Bell, so I couldn't have helped them if I had wanted to. A few years later John confided that he had been involved with a good deal of building and using of bugs, telephone and otherwise, and that this was what the FBI was wanting to know about. He had made a system which the Arabs had put into the Israeli cars in New York to allow them to follow behind and hear what was being said in the cars. I think he also got into telephone modifications which would allow the radio transmission of phone calls over a short distance, a concept which interested the Arabs, too.

The income from these efforts probably went more to keep him going than the radio repairs, as I seldom ever saw him doing any radio repairing. And most of the stuff in his store was RTTY gear, not radios in for repair.

John, with my help, set up the first amateur radio two meter repeater in the country. We set it up on top of the New York municipal building in downtown Manhattan. I will never forget putting up the antenna for the repeater in the middle of the night in a blinding rainstorm—with me up there on a very steep copper roof, holding on to little pegs here and there to keep from falling about 20 stories. I was in my mid-20s at the time and often did silly things like that in the interests of amateur radio.

There was, unfortunately, a slightly crooked side to John, too. I don't know how many hams sent him money for Teletype equipment which he never delivered. It was petty larceny, but aggravating to those of us who knew him and appreciated the extent of his genius. John, at that time, had a virtual corner on all used Teletype gear, so if you didn't buy it from him, you didn't buy it. We were buying Model 12 Teletypes at that time ... somewhere in my barn I have John's old original Model 12, in case there is an opportunity for a shrine to this pioneer to be erected. I also have a couple of the complete W2BFD systems which I built, with auto-start and -stop. They were quite modern, except for the use of dozens of tubes in each one.

Amateur Teletype, when I got interested in it over 30 years ago, was stuck up on two meters (and 11 meters), and we had about 30 stations working all on one frequency in the vicinity of New York. We were on 147.96 MHz using 8220 kHz crystals with SCR-522 systems, for the most part. Using audio frequency shift (2125/2975 Hz), we could leave the receivers on all the time. Our printers would start up if a standard start signal was received ... a couple seconds of mark signal. A steady space signal would turn everything off.

Some of the fellows left their receivers on all the time, while others hooked them into a small clock which sampled the frequency every hour for two minutes. We could then leave messages with anyone by sending the start signal for one minute during this window. I left my receiver on all the time, wanting to keep track of what was happening when I was away from home. I'd come home after a weekend to find a hundred feet of paper on the floor, filled with chit-chat and messages.

A few of the fellows had an automatic confirming system. They put a microswitch behind the Teletype carriage so that it would turn on when the carriage was in one particular position ... say, the tenth letter along. This would turn on the transmitter filaments and warm them up. Then, after a minute in that position, the release of the carrier would trigger a double pulse of the confirming transmitter as a "roger" that the message had indeed been received. Of course it wasn't exactly legal, but then what experimenting is?

Oh, on the repeater, it enabled all of the RTTY hams in greater New York to keep in constant touch and was fantastic. The FCC put it off the air after a few months. They didn't like any automatic relay systems like that. If we could have an operator present, OK, but otherwise, no go.

It was RTTY that got me into this whole ham publishing mess. I started out in 1951 with a monthly newsletter to RTTY hobbyists ... now look at it!

GRABBING THE BUS

One of the more innovative concepts which microcomputers have introduced is the idea of using a bus structure for electronic circuits. In the case of computers, this means that all of the significant signals are made available to every board

John Williams W2BFD, on the left, about 1954. I forgot the chap in the middle, but the right-hand chap is Doc W2BIV, a Brooklyn dentist.

John again, taken during a RTTY meeting about 1954. We'd often get a dozen or more RTTYers out to these meetings.

plugged into the bus. The board can then avail itself of any needed signals with no further interconnections needed.

Could such a concept be adapted to the ham transceiver? Well, let's suppose we wanted to build our system in a modular way and then make any needed connections for accessories available via a bus. We might have on the bus the +5 volts for logic circuits, +12 for control and power circuits, audio for earphones, audio for speaker, mike input, i-f input, i-f output, local oscillator, AVC line, etc.

With that array of signals available for accessories, we could design boards for interfacing SSTV, for RTTY, for CW encoding or decoding, for audio filters, a flying noise lock, synchronous detection, a keyer with memory, VOX, automatic ID, a panadaptor, an autocall unit, programmed tuning, a phone patch, a voice processor, a cassette recorder, a two-tone test, a CW regenerator, etc. There are many possibilities which such a flexible situation would open up for the super transceiver of the future.

This type of structure would make it possible to buy a barebones transceiver and then add plug-in modules as money and technology permit. It would make it possible for the CW fan to get any bandwidth i-f desired, add audio filters, a regenerator, and end up with an incredible CW receiver. The weak-signal VHF CW experimenter could narrow down the i-fs, put in the filters, a flying noise lock, a recorder, and all those things which this strange craft requires.

The Saturday afternoon ragchewer could have his system monitor any set of channels for calls from friends, all done automatically ... complete with a beeper alerting call on a VHF band, if wanted.

How much further would such a system have to be pushed to decode CW signals and look for expected DX? No strain ... and the next step, with such a structured system, would be automatic DXing.

AUTHOR PREROGATIVES

One of the publisher's newsletters mentioned that writers can charge off magazine subscriptions as a business expense. That makes sense ... and might be just another reason to become a professional writer for the ham magazines ... such as *73*.

As a professional writer, your expenses would include the cost of any equipment you have built or reviewed ... costs of your writing office, reference works, test equipment, etc. It's worth checking out with your tax accountant.

What kind of articles are we looking for at *73*? First choice goes to state-of-the-art projects ... perhaps a microprocessor-run something hammy ... small and medium construction projects are always popular. It's difficult to get too much in the way of home-built equipment articles, antenna articles, microcomputer articles ... just about anything on new techniques and modes. We need more on satellite equipment and techniques ... AM on ten meters ... new RTTY equipment ... even very low frequency articles are of interest.

I'm always on the watch for any really hot new aspect of amateur radio which I might be able to use to get thousands of amateurs interested and involved. Look what happened when I plugged the devil out of two meter FM and repeaters! This can be done again if something with good possibilities comes along ... so if you think you've got it, please start writing and let's see if it flies.

This ambulance is at the ready to cart away hams who totally lose control over the low prices at Tufts Electronics. They get a free trip to the foam-rubber room of the local funny farm until they are signed out by their wives.

Writing for *73* isn't very difficult. Remember to double space your typing (please type it), do not use all capital letters, and get me the very best pictures you can.

WEIGHTY MATTER

There are, I understand, several dozen *73* readers who have no problem with their weight ... and possibly a few of those with wives with no concern about weight, though this seems unlikely. What this all comes down to is dieting ... at least every now and then. Erma Bombeck classifies "diet" as one of the dirty four-letter words, and I tend to agree with her.

Heath has come out with a very nice electronic scale (the GD-1186) for the bionic people. It reads to a tenth of a pound, which is fabulous for dieters. Most of us serious dieters long ago shifted to what are known as doctor scales. These monstrosities are accurate down to a quarter of a pound and are excellent because they tend to give very fast reinforcement to even the first day's dieting ... when it is needed the most.

The Heath scale is small ... about a foot square, if you'll pardon the expression ... and 7" high for the readout. It's light enough so you can even take it with you on trips and make your life miserable after every fantastic meal.

Like all other Heath stuff, this comes in kit form. Figure on one good evening to put it together. It's relatively simple, and no one but me could stretch one evening's work out over a couple months ... 99.9% of which was pure neglect. Now that it's done, I don't know how I got along without it.

Like many of you, I am an incipient fat person. I have all the bad traits of a fat person ... like eating because the food is there, with little relationship to any signs of hunger. I love things with butter or rich sauces, and can easily list over 500 deserts which are tops with me. Only by doing my best to keep my breakfasts and lunches simple am I able to avoid zooming up to over 250 pounds ... a weight which I have managed to attain in the past.

It's very difficult to seriously diet when I'm eating out. After all, I'm paying for the damned food, so why not eat it? So I cram down as much as I can of everything, making sure that I do my best to get my money's worth. And if I can't get it down the old hatch, it goes into a doggy bag for tomorrow night. I don't have a dog.

All this got a little out of belt a couple of years ago, so both Sherry and I started cutting down. These days, we generally order one meal between us and still end up with something to take home ... particularly if there is a salad bar. But this still calls for a careful watching of the scales at home ... and the Heath is absolutely wonderful for that. The tenth-pound readout makes it immediately apparent when I've snacked too much.

One of the better snack cutters I've found of late has been the VTR video recorder. With this system, as I've mentioned before, virtually all TV programs I watch are recorded so that I can see them without the commercials. Otherwise, I find myself getting up, wandering around, looking for something to eat during the breaks ... heck, a cup of coffee and some cookies wouldn't hurt much ... perhaps a tenth of a pound. Maybe some nuts and fruit? Better to get up and fastforward the VTR and not snack. Then there is more to see of interest on the Heath scale in the morning.

The Heath scale would make a great present for the XYL for her birthday, Mother's Day, etc. And it would be something you put together for her. It costs $99.95, which is a very good buy compared to the much less accurate doctor's scales.

DECEMBER WINNER

Johnny C. Chestnut WA4PIN and John L. Wolcott W4CCX will each be receiving a $50 bonus prize for authoring December's most popular article, "The Lunch Counter." Remember, your ballot is your Reader Service card.

Ham Help

I would like to hear from anyone who has converted a 23-channel CB Cobra Camm 88 for use on the 10 meter band, for either the Novice Tech CW portion or for the phone portion of the band.

Berand (Henry) Kirschner
WB9YCQ
12756 Newport Ave., Apt. C
Tustin CA 92680

Will anyone living in the San Diego, California, area volunteer to administer the Novice exam to a fine young man? His name and address: Mike Batson, 1539 Motor Way, San Diego CA 92145; (714)-566-2910.

Robert D. Cummings
U.S. Navy PEP DET Netherlands
c/o U.S. Embassy
APO NY 09159

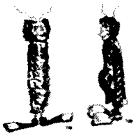
Microcomputer Interfacing

from page 24

terrupt to the microcomputer. Some real-time clocks are free-running, always keeping time. Others are programmable or preset for a particular period. The free-running clock interrupts the computer at repetitive intervals, while the programmable clock interrupts the computer only once, at the end of its preprogrammed period. Integrated circuits such as the Intel 8253 and Texas Instruments TMS 5501 contain time-keeping circuitry which is easily interfaced to most 8080 systems.

For simplicity, we will use the software clock in our example rather than an interrupt-based real-time clock. The software for the 100-point data acquisition program is shown in Table 2. After completing the program, the computer might be programmed to jump to the type of data display software discussed previously. If you look at the program carefully, you will not find a separate register used to count the 100 passes through the data acquisition software. Since the memory address stored in registers H and L is already a counter, we have chosen to detect the 200th address rather than the 100th loop. This saves an internal register. Instead of decrementing a counter and detecting the zero condition, the contents of register L are compared to the final address and equality is used to signal the end of the loop.

Analog-to-digital converters are not "instantaneous" devices which take only a few microseconds to perform a conversion. In many real situations, the analog input to the converter will vary while the ADC is trying to perform a conversion. This presents the converter with a problem. How does it know what the real value of the voltage is? In most systems, the ADC module has a *sample-and-hold* (SH) on the analog input. The SH circuitry samples the analog voltage when pulsed to provide a steady analog output to the ADC for conversion; the ADC is then pulsed to start the conversion. The Intersil IH 5110 is a typical sample-and-hold device.



OSCAR Orbits

Courtesy of AMSAT

The listed data tells you the time and place that OSCAR 7 and OSCAR 8 cross the equator in an ascending orbit for the first time each day. To calculate successive OSCAR 7 orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the day's first ascending (northbound) equatorial crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world from you, it will descend over you. To find the equatorial descending longitude, subtract 166° from the ascending longitude. To find the time OSCAR 7 passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR 7 when it is within 45 degrees of you. The easiest way to determine if OSCAR is above the horizon (and thus within range) at your location is to take a globe and draw a circle with a radius of 2450 miles (4000 kilometers) from your QTH. If OSCAR passes above that circle, you should be able to hear it. If it passes right overhead, you should hear it for about 24 minutes total. OSCAR 7 will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15° east or west of you, add another minute; at 30°, three minutes; at 45°, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

OSCAR 8 calculations are similar to those for OSCAR 7, with some important exceptions. Instead of making 13 orbits each day, OSCAR 8 makes 14 orbits during each 24-hour period. The orbital period of OSCAR 8 is therefore somewhat shorter: 103 minutes.

To calculate successive OSCAR 8 orbits, make a list of the first orbit number (from the OSCAR 8 chart) and the next thirteen orbits for that day. List the time of the first orbit. Each successive orbit is then 103 minutes later. The chart gives the longitude of the day's first ascending equatorial crossing. Add 26° for each succeeding orbit. To find the time OSCAR 8 passes the North Pole, add 26 minutes to the time it crosses the equator. OSCAR 8 will cross the imaginary San Francisco-to-Norfolk line about 11 minutes after crossing the equator. Mode A: 145.85-.95 MHz uplink, 29.4-29.50 MHz downlink, beacon at 29.40 MHz. Mode J: 145.90-146.00 MHz uplink, 435.20-435.10 MHz downlink, beacon on 435.090 MHz.

Oscar 7 Orbital Information

Orbit	Date (Apr)	Time (GMT)	Longitude of Eq. Crossing °W
20011	1	0024:32	68.4
20024qrp	2	0118:49	82.0
20036	3	0018:09	66.9
20049X	4	0112:26	80.5
20061	5	0011:47	65.3
20074	6	0106:04	78.9
20086	7	0005:24	63.8
20099	8	0059:41	77.3
20112qrp	9	0153:58	90.9
20124	10	0053:18	75.8
20137X	11	0147:35	89.4
20149	12	0046:55	74.2
20162	13	0141:12	87.8
20174X	14	0040:33	72.7
20187	15	0134:50	86.2
20199qrp	16	0034:10	71.1
20212	17	0128:27	84.7
20224X	18	0027:47	69.5
20237	19	0122:04	83.1
20249	20	0021:24	68.0
20262	21	0115:41	81.6
20274	22	0015:02	66.4
20287qrp	23	0109:19	80.0
20299	24	0008:39	64.9
20312X	25	0102:56	78.4
20324	26	0002:16	63.3
20337	27	0056:33	76.9
20350	28	0150:50	90.5
20362	29	0050:11	75.3
20375qrp	30	0144:27	88.9

Oscar 8 Orbital Information

Orbit	Date (Apr)	Time (GMT)	Longitude of Eq. Crossing °W
5459Jbn	1	0130:21	66.0
5473Abn	2	0135:19	67.3
5487Abn	3	0140:31	68.7
5500X	4	0002:29	44.2
5514Abn	5	0007:40	45.5
5528Abn	6	0012:52	46.8
5542Jbn	7	0018:03	48.1
5556Jbn	8	0023:14	49.4
5570Abn	9	0028:26	50.7
5584Abn	10	0033:37	52.0
5598X	11	0038:49	53.3
5612Abn	12	0044:00	54.7
5626Abn	13	0049:12	56.0
5640Jbn	14	0054:23	57.3
5654Jbn	15	0059:34	58.6
5668Abn	16	0104:46	59.9
5682Abn	17	0109:57	61.2
5696X	18	0115:08	62.5
5710Abn	19	0120:20	63.8
5724Abn	20	0125:31	65.2
5738Jbn	21	0130:42	66.5
5752Jbn	22	0135:53	67.8
5766Abn	23	0141:05	69.1
5779Abn	24	0003:02	44.6
5793X	25	0008:13	45.9
5807Abn	26	0013:25	47.2
5821Abn	27	0018:36	48.5
5835Jbn	28	0023:47	49.8
5849Jbn	29	0028:58	51.2
5863Abn	30	0034:09	52.5

Corrections

A reader, Wilbur Stevens, was nice enough to point out an error in "Build a $10 Digital Thermometer" (January, 1979). In Fig. 4, on page 54, the values on the pots are reversed.

Gary McClellan
La Habra CA

Thank you for printing my OM's story about CW music ("This Station Plays Beautiful CW") in the February issue of *73*. His secretary and I both appreciate the celebration dinner made possible by the author's fee.

Nevertheless, I would like to caution the XYLs of your readers who may build a keyboard. While the diode matrix is so simple that the OM can make the hookup "while the XYL is talking," it does not necessarily follow that the OM will hear what the XYL is saying. Further, if the impasse reaches the point where not even an "uh huh" is expressed, the XYL should step up and point out that there is an error in Fig. 1. Each bus (K_0-K_7) is fed through a 10k resistor which is not shorted out as the schematic indicates.

It is a worthwhile project because, after it is completed, the XYL can carry on a CW conversation with other XYLs. All that is necessary is to use the OMs as interfaces between headsets and conventional typewriters. This will suffice until WB9WRE completes his low-cost CW typewriter.

Jean Crom
XYL of WB9WRE
Mt. Prospect IL

Ham Help

I need the schematic for a Fukuyama Multi-7 (FDK) 2m FM Radio, as well as the alignment procedure. Can anyone help?

N. W. Zimmerman W7MAF
1815-17th Ave. So.
Great Falls MT 59405

I need the schematic of a Dage model 6SA-3 TV camera (or of a similar tube-type model) manufactured by Dage.

James M. Zacher
15 W. Cypress
Arlington Hts IL 60005

Social Events

from page 39

and flyers, contact Richard Spahl K1SYI at (617)-943-4420 after 8:00 pm.

TRENTON TN
MAY 20

The Humboldt ARC will hold its annual hamfest on Sunday, May 20, 1979, at Shady Acres City Park, Trenton, Tennessee. There will be a flea market, prizes, ladies' activities, and food. For further information, contact Ed Holmes W4IGW, 501 N. 18th Ave., Humboldt TN 38343.

BURLINGTON KY
MAY 20

The Kentucky Ham-O-Rama will be held on May 20, 1979, at the Boone County Fairgrounds, Burlington, Kentucky, For easy access, take the Burlington exit off I-75 south. There will be a chance for prizes included with the $3.00 gate ticket. There will also be hourly drawings, exhibits, a flea market, and refreshments. Talk-in on 146.19/79 and 52/52. For more information, contact NKARC, Box 31, Ft. Mitchell KY 41017.

EASTON MD
MAY 20

The fifth annual Easton Amateur Radio Society Hamfest will be held on May 20, 1979, from 10:00 am to 4:00 pm, at the Easton Senior High School cafetorium on Rt. 50, just south of Easton at mile marker 66. From the Baltimore or DC areas, go across the Chesapeake Bay bridge; the mile marker is about 27 miles from the bridge. There will be hamfest signs on Rt. 50, north and south. Refreshments will be available. There will be a donation of $2.00 with an additional $2.00 for tables or tailgaters. Talk-in on 52 and 146.445 /147.045. For more information, write Charles C. Walgren WA3ZWX, Box 7, Trappe MD 21673, or the Easton Amateur Radio Society, Inc., Box 781, Easton MD 21601.

HAMBURG PA
MAY 27

The Reading Radio Club will hold its annual hamfest on Sunday, May 27, 1979, beginning at 9:00 am, at the Hamburg Field House in Hamburg, Pennsylvania. There will be door prizes, food, tailgate sales, and dealer space available. The hamfest will be held rain or shine. Talk-in on .31/.91 and 146.52. For more information, write The Reading Radio Club, Hamfest Committee, PO Box 124, Reading PA 19603.

UPPER HUTT NZ
JUN 1-4

The 1979 Annual Conference of the New Zealand Association of Radio Transmitters will be held on June 1-4, 1979, at Upper Hutt, New Zealand. Visitors are welcome to attend this conference. For registration forms, contact the Secretary, 1979 Conference Committee, PO Box 40-212, Upper Hutt NZ.

WEST HUNTINGTON WV
JUN 3

The Tri-State ARA will hold its 17th annual hamfest and family picnic on June 3, 1979, starting at 10:00 am, at the Camden Amusement Park, West Huntington, West Virginia. There will be a planned program for the XYL and kids, or you can enjoy the amusement park if you prefer. There is a possibility the FCC will administer amateur exams. There will be major prizes, a large flea market, exhibitors, and displays. Dealers are always welcome to space in the covered pavilion. Talk-in on 34/94 or 16/76. For more information, write TARA, PO Box 1295, Huntington WV 25715.

MANASSAS VA
JUN 3

The Ole Virginia Hams A.R.C., Inc., will hold the Manassas Hamfest on Sunday, June 3, 1979, at the Prince William County Fairgrounds, ½ mile south of Manassas, Virginia, on Route 234. There will be indoor and outdoor exhibit areas, dealers and manufacturers, and tailgaters. Also included will be plenty of parking, prizes, an FM clinic, breakfast and lunch, a YL program, and children's entertainment.

PRINCETON IL
JUN 3

The Starved Rock Radio Club will hold its annual hamfest on Sunday, June 3, 1979, at the Bureau County Fairgrounds, Princeton, Illinois. The fairgrounds are centrally located and easily reached via routes 80-6-34-89-26. Watch for the large yellow "Hamfest" signs. There will be lots of room for the free swappers' area and parking. New equipment dealers, manufacturers, and their representatives are invited to request details on reserving space in our inside display area. There will be food and refreshments available during the day. Camper, van, and trailer spaces are available for a nominal fee and should be reserved in advance. Please include an SASE for map, motel information, and advance reservations at $1.50, if postmarked before May 20 ($2.00 at the gate). For more information, write W9MKS/WR9AFG, Starved Rock Radio Club, RFD #1, Box 171, Oglesby IL 61348, or phone (815)-667-4614.

GUELPH ONT CAN
JUN 9

The Central Ontario Amateur Radio Flea Market will be held on Saturday, June 9, 1979, from 8:00 am until 4:00 pm at Centennial Arena, College Ave. W., Guelph, Ontario, Canada. Commercial displays will open at 10:00 am. Admission is 75¢ per person with children 12 years and under admitted free. Admission for vendors is an additional $2.00. There will be a large indoor and outdoor flea market, commercial exhibits, free balloons, free handouts, and operating ham stations. Talk-in on .52/.52, .37/.97 VE3KSR, and .96/.36 VE3ZMG.

MEADVILLE PA
JUN 9

The Crawford Amateur Radio Society will hold its fifth annual hamfest on Saturday, June 9, 1979, at Crawford County Fairgrounds, Meadville, Pennsylvania. Admission is $2.00. Gates will open at 8:00 am. Bring your own tables. The cost to display is $2.00 for an inside area and $1.00 for an outside area. There will be door prizes, refreshments, and commercial displays. Talk-in on .04/.64, .81/.21, .63/.03. For details, write CARS, Hamfest Committee, PO Box 653, Meadville PA 16335.

SENATOBIA MS
JUN 9-10

The fourth annual Tri-State Hamfest will be held on June 9-10, 1979, in the coliseum of Northwest Junior College, Senatobia, Mississippi. Indoor air-conditioned space will be available for manufacturers, dealers, and distributors. For information, contact Joel P. Walker, 1979 Hamfest Chairman, PO Box 276, Hernando MS 38632; (601)-368-5277.

LOUISVILLE KY
JUN 29-JUL 1

The Louisville Area Computer Club will hold its 4th annual Computerfest™ 1979 from June 29 through July 1, 1979, at the Bluegrass Convention Center, Louisville, Kentucky. Activities include a flea market, seminars, and exposition, as well as activities for the entire family. Seminar and exposition admission is $4.00. Pre-registered Ramada Inn guests ($29.00, single; $34.00, double) receive free admission. For advance mail information, write Computerfest '79, Louisville Area Computer Club, PO Box 70355, Louisville KY 40270, or phone Tom Eubank, Chairman, at (502)-895-1230.

BELLEFONTAINE OH
JUL 1

The Champaign Logan Amateur Radio Club, Inc., will hold its annual hamfest on Sunday, July 1, 1979, at the Logan County Fairgrounds, South Main Street and Lake Avenue, Bellefontaine, Ohio. There will be free admission and door prizes. Trunk and table sales are $1.00, and there will also be a bid table. Talk-in on 146.52. For more information, contact John L. Wentz W8HFK, Box 102, West Liberty OH 43357, or Frank Knull W8JS, 402 Lafayette Ave., Urbana OH 43078.

PITTSFIELD MA
JUL 21-22

The NoBARC Hamfest will be held on July 21-22, 1979, at Cummington Fairgrounds, Pittsfield, Massachusetts. There will be tech talks, demonstrations, and dealers. Flea market admission is $1.00. Advance registration is $3.00 single and $5.00 with spouse, and $4.00/$6.00 at the gate. Gates open at 5:00 pm on Friday for free camping. Talk-in on 146.31/.91. For reservations, contact Tom Hamilton WA1VPX, 206 California Ave., Pittsfield MA 01201.

MOOSE JAW SASKATCHEWAN CAN
JUL 27-29

The Moose Jaw Amateur Radio Club will hold its 1979 Hamfest (Particlfest 79) on July 27-29, 1979, at the Saskatchewan Technical Institute, 600 600 Saskatchewan St. W., Moose Jaw, Saskatchewan, Canada. Registration will be held on Firday evening with a full day of activities on Saturday culminating in a banquet and dance. Most of the meetings and workshops will be held on Sunday. There will also be a busy schedule for the XYLs.

FINDLAY OH
SEP 9

The Findlay Radio Club will hold its 37th annual Findlay Hamfest on Sunday, September 9, 1979, at Riverside Park, Findlay, Ohio. There will be both commercial and amateur display space available. Ticket donation is $1.50 in advance and $2.00 at the hamfest site. For more information, write the Findlay Radio Club, c/o Randy Peterson, Hamfest Chairman, 6016 Marion Twp. 243, Findlay OH 45840.

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7	7A	14	14	14
ARGENTINA	21	14A	14	14	7	7	14	21	21	21A	21A	21A
AUSTRALIA	21A	21	14	7B	7B	7B	7B	14	14	14B	14	21A
CANAL ZONE	21	14	14	7	7	7	14	21	21	21A	21A	21A
ENGLAND	7A	7	7	7	7	7A	14	14	21A	21	21	14
HAWAII	21A	14	14	7B	7	7	7	7A	14	21	21	21
INDIA	14	7B	7B	7B	7B	7B	14	14	21	21	14	14
JAPAN	21	14	14	7B	7B	7B	7	14B	14	14	14	21
MEXICO	21	14	7	7	7	7	14	14A	21	21	21A	21A
PHILIPPINES	21	14	7B	7B	7B	7B	7B	14B	14	14	14B	21
PUERTO RICO	14	14	7	7	7	7	14	14	14	21	21	21
SOUTH AFRICA	21	14	7	7	7	14	21	21A	21A	21A	21	21
U. S. S. R.	7	7	7	7	7	7A	14	21	21	14	14	7B
WEST COAST	21	14A	14	7	7	7	7B	14	21	21	21	21A

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7	14	14	14	14
ARGENTINA	21A	14	14	14	7	7	14	21	21	21	21A	21A
AUSTRALIA	21A	21A	14	14	7B	7B	7B	14	14	14B	14A	21
CANAL ZONE	21	14	14	7	7	7	14	21	21	21A	21A	21A
ENGLAND	7A	7	7	7	7	7	14	14	21	21	21	14
HAWAII	21A	21	14	14	7	7	7	7A	14	21	21	21A
INDIA	14A	14	14	7B	7B	7B	7B	14	14	14	14	14
JAPAN	21	21	14	14	7B	7B	7	7	14B	14	14	21
MEXICO	21	14	7	7	7	7	7	14	14	21	21	21
PHILIPPINES	21	21	14	7B	7B	7B	7B	7B	14	14	14B	14
PUERTO RICO	21	21	14	7	7	7	14	21	21	21	21A	21A
SOUTH AFRICA	21	14	7	7B	7B	7B	14	14A	21	21A	21A	21
U. S. S. R.	7	7	7	7	7	7B	7B	14	14A	14	14	7B

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7A	7	7	7	7	7A	14	14	14
ARGENTINA	21A	21	14	14	7	7	7A	14A	21	21	21A	21A
AUSTRALIA	21A	21A	21	21	14	14	14	7	7	14	14A	21A
CANAL ZONE	21A	21	14	14	7	7	7	14	21	21	21A	21A
ENGLAND	7A	7B	7	7	7	7	7	14B	14	14A	21	14
HAWAII	21A	21A	21	14	14	14	7	7	14	21	21	21A
INDIA	14A	14	14	7B	7B	7B	7B	7B	14	14	14	14
JAPAN	21	21	14	14	7B	7B	7	7	14	14	21	21
MEXICO	21A	21	14	7	7	7	7	14	14	21	21	21
PHILIPPINES	21	21	14	14	7B	7B	7B	7B	14	14	14B	14
PUERTO RICO	21A	21	14	14	7	7	7A	14	21	21	21	21A
SOUTH AFRICA	21	14	7	7	7B	7B	7B	14	14	21	21A	21
U. S. S. R.	7B	7B	7	7	7	7B	7B	7B	14	14	14	7B
EAST COAST	21	14A	14	7	7	7	7B	14	21	21	21	21A

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor
SF = Chance of solar flares

april

sun	mon	tue	wed	thu	fri	sat
1 G	2 G	3 G	4 G/SF	5 G/SF	6 P/SF	7 P/SF
8 P/SF	9 F	10 F	11 G	12 G	13 G	14 G
15 G	16 G	17 G	18 G	19 G	20 G	21 G
22 F	23 G	24 G	25 G	26 G	27 G	28 G
29 G	30 G					

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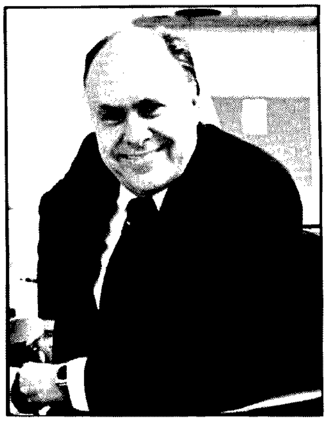
W2NSD/1 NEVER SAY DIE

editorial by Wayne Green



ATLANTA, JUNE 16-17

While June is a very busy month in both the microcomputer and ham businesses, no year would be really complete without a trek to Atlanta for the Atlanta Hamfestival. First, I'll be down to Dallas on June 2-3 and be giving talks at the Dallas hamfest on both computer programming and on the present state of affairs in amateur radio.

My next stop will be New York and the National Computer Convention (IEEE), where I will talk about computer program development and sales. That's June 5-7, if you're in the vicinity.

Atlanta's hamfest has been growing year by year and is starting to give Dayton some worries. There are an awful lot of hams in the southeastern part of the country, and just about every one of them packs up his family and heads for Atlanta come June. Thousands come in from every southern state. It's a madhouse . . . and it's a ball.

Chaz Cone, the chap who has been pulling this event off (not without a lot of able help), has come up with some incredible prizes . . . last year they gave away a car with a complete ham rig installed. There are so many prizes that it is difficult to escape getting something which is worth more than the registration fee.

I'll be there and be giving a couple of talks . . . one on computing, with the emphasis on amateur radio . . . and not a little information on how to get into computing and take advantage of the incredible growth which this field still has ahead of it. Never before have there been so many opportunities to make a fortune . . . if you're willing to work for it. The money is there, waiting for anyone who really wants it.

The other talk will be ham-oriented and will try to put the past, present, and future into perspective. Does Wayne really hate the ARRL, or is this a figment of the imagination foisted on a gullible public by Newington?

What is Wayne really like? Is he the prophet of doom and gloom or is he a pragmatist, calling the shots the way they are? Is Wayne really as rich as some people from Connecticut say he is? And how in the devil did *73 Magazine* get to be the largest in the ham field? Bring your questions, and Wayne will answer them.

In addition to exhibits by most of the top ham equipment firms, you'll find dealers fighting tooth and nail for your business. Many are bringing trailer loads of ham gear to try to sell before the summer slump. There will also be some exciting displays of the latest in personal and small business computers. Maybe it's time for you to get more familiar with these little buggers and integrate one into your ham station . . . and home?

THOSE TOLL-FREE NUMBERS

A letter from Ed Leviton AB3B points out that the Federal Trade Commission has rather strong rules to protect mail-order buyers, but when you order over the telephone, you forego this protection. The entire text of the mail-order merchandise rules are lengthy and have some strong teeth. A copy can be obtained from the Government Printing Office, CCH booklet #4803, $1.50.

If you are lazy, like me, and prefer to use the phone, then it's caveat emptor (buyer beware).

ON TOP OF OLD SMOKEY

A recent court case (People v. Case—NY—365NE2d 872, 87ALR3d 77) involved a CBer who reported a radar checkpoint over his radio and was arrested for this. He was convicted in a justice court, and his conviction was upheld in the County Court. It was then reversed by the Court of Appeals. This court held that "under the statute making the obstruction of governmental administration a crime, obstruction must be by means of intimidation, physical force, or interference, or by means of any independently unlawful act and that the defendant's verbal message via his Citizens Band radio did not constitute a physical interference with governmental administration."

Since people seem to worry about that aspect of CB and hamming, I thought you'd like to know and have the reference.

Another lawyer has promised to write and let me know more about a situation which has developed in his area in which hams are virtually exempt from radar-inspired speeding tickets by virtue of the unsettling effects of a two meter rig in the car.

My thanks to Attorney Duncan Kreamer W1GAY for the above reference.

THE ROVING CAMERA

As if things aren't bad enough in New Hampshire in February (unless you happen to be a skier), the Interstate Repeater Society (I detest the

Continued on page 116

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Looking West

Bill Pasternak WA6ITF
24854-C Newhall Ave.
Newhall CA 91321

Having just celebrated my thirty-eighth birthday, and remembering back to my teens and the traumas I went through to obtain my amateur license, I was kind of amazed the other evening when my friend Harvey Ross WB6YNO recounted the story of how his now nine-year-old became General class licensee WD6FLP not long ago. It's an interesting story, and I'd like to share it with you.

I've known Harvey and his wife Bonnie WA6SNB almost from the day we moved to Los Angeles. We first met on the air via the PARC WR6ABB repeater and were later formally introduced by Walt W6EJK. As Harvey tells it, one day close to two years ago he was busy operating 20 CW when his son David asked him to teach him Morse code. After some thought, Harvey not only agreed to do so, but also made a game out of the project. David was fast to catch on, and it was not long before he had mastered the 5 wpm necessary to pass the Novice exam.

To help David with the theory, Harvey enlisted the help of a friend named Bill Ellis. Bill, whose callsign is WA6USB, runs what is possibly the nation's most successful amateur training school: Murphy's Amateur Radio Class, which meets weekly in Culver City, California. At Bill's suggestion, Harvey enrolled David in Murphy's Novice training program; the move was a very successful one. For his eighth birthday, David received quite a present: amateur callsign WD6FLP. Now, many youngsters would be content with attaining a goal such as this and move on to other things. However, in that regard, David is not your average youngster. He had developed a love for amateur radio, and a Novice ticket would just not suffice. He continued working toward his next major goal, a General class license.

In July of 1978, David thought it was time to try. Though he literally breezed through the CW exam, the theory stumped him. He was kind of disappointed—but in no way beaten. Back to the books he went, so that next time the elusive General ticket would be his. His tenacity paid off on December 14, 1978, when he walked out of the FCC office in Long Beach, California, with General class privileges and the ability to sign WD6FLP—interim LB. His first QSO? It happened to be on 450 MHz to inform his very proud father that he had made it!

What does a nine-year-old General do, you ask? The same as any other ham. He operates all bands, belongs to radio clubs, and is probably the youngest person to be found on a remote-base system anywhere. Oh, yes, in his spare time David is hard at work with his younger sister, teaching her code in hopes of making it an all-amateur-radio family.

The case of Scott Lookholder WB6LHB is another matter entirely. We have been following this legal matter since it became public some months ago, and here is the final chapter. On February 6th, Judge Lawrence T. Lydig in Los Angeles Federal District Court passed sentence upon Mr. Lookholder, who had earlier, on January 10th, pleaded guilty to three counts of using foul and abusive language on the air. The sentence broke down as follows: count 1—$500 fine; count 2—$500 fine; count 3—one-year probation. In addition, the court has forbidden Mr. Lookholder to use his amateur privileges for the term of the probation, and, while not making it a mandatory part of probation, the court did suggest that Mr. Lookholder seek psychiatric care. In his closing remarks just prior to the passing of sentence, the court described Mr. Lookholder as "being a disgrace to himself, his family, and the amateur service."

Lookholder's alleged operations as "W6JAM" had raised havoc over a number of Los Angeles area 2 meter repeaters for several months. Particularly hard-hit had been WR6ABN, and it has been thought that many ABN users would be present for the sentencing. Alas, that was not the case. As is usual in amateur circles, apathy dominated the day, with but four area amateurs in attendance. Earlier, when the court was soliciting voluntary written statements from those who had been adversely affected by Mr. Lookholder's operations, only eight area amateurs took the time to write at all. Eight out of close to 20,000! The fact that not even 1% of the total ABN usership (which these days numbers close to 400) took the initiative to express their views to the court when requested is a rather sad commentary on the overall amateur society. Yet, during the "W6JAM Reign Of Terror," hundreds of anti-W6JAM comments could be heard each day. Now, the average on-the-air commentary is to the effect that the court was far too lenient in the case. To those who had their chance to affect the case and were too lazy or apathetic to utilize it, I can only say, "you blew it."

I do not wish to single out the overall ABN usership for admonishment in this matter. Letters from other parts of the nation tell the same story. A jammer is caught, and when it comes to the nitty-gritty of prosecution, everyone suddenly disappears. One or two are left to do the work for many. On-the-air rhetoric against the offender is loud and boisterous, but overall cooperation is nil. Maybe this is the reason for the development of a new kind of interference-tracing and -documentation method, the quiet clandestine operations which simply gather input and develop airtight legal cases. In many areas, it has become obvious that trying to get the assistance of the average "Joe Ham" has become impossible. Sure, he cares, but not enough to get out and T-hunt the offender or even write a letter of complaint. So, in many locations, the small number of people who really are concerned are banding together. Probably you will never know who they are until the time arrives when a major offender is brought to justice. Perhaps not even then. The Lookholder case has proven one thing to many: It has shown that our legal system can and will work if we are prepared to use it. Action taken

Continued on page 148

David Ross WD6FLP.

TASMA's 1979 leadership: Chairman Bob Thornburg WB6JPI (left) and Vice-Chairman Dave Ferrone WA6KOS.

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DX

Chuck Stuart N5KC
5115 Menefee Drive
Dallas TX 75227

DX PROFILE

This month's DX Profile is on one of the better-known DXers in the world, Dr. San Hutson K5YY/K5QHS, of Little Rock, Arkansas.

San's ham career began in the mid-1950s when he picked up an old S-38 receiver and started monitoring the ham bands. After receiving a few QSL cards, he decided to get in on the action side of the hobby and applied for his Novice exam. San received his Novice license in 1958, along with the call KN5QHS, and four months later he passed the General class exam. In 1977, San upgraded to Extra class and received his present call, K5YY.

San has always been primarily a DXer, but because of college he missed a few years. During that time, he also missed several now-deleted countries that would have brought his DXCC total to nearly 350. As it is, his total still stands at 333, and he needs only BY and VS9K to have them all.

Due to his medical practice, San has moved around quite a bit since receiving his medical degree from the University of Arkansas in 1969. However, all of his operating has taken place inside the state of Arkansas (with the exception of two years spent in Broken Bow OK).

San's first DXpedition was the only authorized DXpedition to Swan Island. In the eight years since, he has become one of the most traveled amateurs in the country, operating from CE0Z, CE3, ZF1, KS4, VP2D, FM0, FG0, FL8, FH8, D6, ST2, ST0, 3B8, and 5H1, along with F0, I0, and G. San was the first to operate from D6 and the first to activate two new DXCC countries on a solo effort when he operated from D6A and FH8 in 1976.

His DXpedition experiences have made San much in demand as a featured speaker at DX gatherings across the country. He has spoken to the Arkansas DX Association many times, the W9DXCC banquet twice, DXpo, SEDXA in Atlanta, and many others.

A past president of the ADXA and presently head of the Executive Committee, San was recently appointed to the ARRL DX Advisory Committee. He feels this DXAC appointment to be the crowning point in his twenty years of hamming, especially in light of the serious aspects of WARC '79 and present DXCC disgruntlement facing the committee.

Still in his mid-30s, San is the Senior Medical Consultant for Social Security in the state of Arkansas. He is married and the father of three children (aged four, ten, and eleven). Other than amateur radio, his hobbies include sporadic coin collecting (mostly pennies from 1850 on) and Corvettes—he has owned 13 Corvettes in the last 11 years. He enjoys hunting and tries to go deer hunting every year. He also enjoys all sports and, true to the medical profession, he is an avid golfer.

Somewhat of an equipment collector, his present station includes two Signal Ones and a home-brew 4-1000 linear, a Drake C-Line and Alpha linear, a Collins KWM2-A and L4B linear, the Kenwood twins with a two meter hookup, and a 75A4 receiver. Antennas include a Telrex beam for 20, a duobander for 10/15, a sloper for 40, a dipole for 80, and a loop and shunt-fed tower on 160. He says that his first real antenna was a five-element Telrex twenty meter beam at 130 feet, but since moving into larger cities, he has had to compromise somewhat.

San Hutson K5YY and his station in Little Rock. San says the station changes constantly, but this is it at the moment.

He hopes some day to have a super station with several operating positions for visiting hams and contests. San likes contest operation on the low bands and has over 60 countries confirmed on 160 meters.

San is planning another DXpedition for later this year and says he will always be planning one of some sort. One of the most interesting aspects of DXpeditions is meeting and getting to know other hams all over the world. On his last trip alone, San met ST2SA, ST2HF, 3B8DA, 3B8DA, 3B8CJ, FH8OM, FH8YL, FH8CJ, D68AD, I0MGM, and many others in Italy, Great Britain, and along the way.

Respected as a DXer around the world, San was the ADXA DXer of the Year in 1973. He also won the Virginia Century Club Award in 1976, the ADXA Achievement Award in 1977, and the Diplome du T.F.A.I. in 1976, and holds certificates for A1 Operator, WAZ, WAC, WAS-160, DXCC Honor Roll—phone and CW—and many more.

San claims that once he works BY and VS9K to have them all, he will just sit back and play with his sports cars. We find that hard to believe. The feeling here is that whenever and wherever there is a new one to be worked, K5YY will be on one end of the pileup or the other.

HEARD ON THE BANDS

With the recent mutual recognition between the U.S. and China, the feeling among many DXers is that BY stations will soon be blossoming everywhere. Although the chances for a true-blue BY-type operation from downtown Peking are better than they have been in many years, those with inside knowledge believe it may still be a bit premature to expect any immediate action, especially by any visiting U.S. operators.

The operation, when it comes, will most likely develop along the lines of the Iraq activity, where some YUs were able to help the locals develop their skills and form a national radio club. Already, several foreigners working inside China have been allowed to bring in their transceivers and install antennas for listening purposes.

On January 17th, ON4QX reported working a station signing BY1AA at 1406Z on 14010. The operator gave his name as Pyng, was very fluent in English, and said to QSL via Box 68 in Peking. Many Europeans and some W/Ks heard the signal, but apparently ON4QX was the only one to get through. Chances are this was Peking Slim, but Bob is watching the China mail nonetheless.

Where-there-is-a-will-there-is-a-way department . . . N5XX tired of trying to work through the large and unruly mob chasing 3Y1VC on Bouvet and decided there must be a better way. He obtained the telephone number of LA5NM in Norway, telephoned long distance, and persuaded LA5NM to ask 3Y1VC to listen for him after their daily 10 meter CW sked. It worked, and Clark was able to add a rare new one to his DXCC total. Clark says the long-distance charges were only $3.75 for 3 minutes, but he didn't say how many 3 minuteses the persuasion took.

The forthcoming trip in the Pacific by Peter Sutter calls for his vessel, *Wild Spirit*, to be at VR3/Christmas around June 15th, VR3/Fanning around June 20th, and KH5/Palmyra around June 24th. Exact times depend largely upon the trade winds and currents.

The reciprocal licensing agreement between Haiti and the U.S. has apparently hit a snag, with no further action being taken. While on the subject of Haiti, we might mention that the HH authorities report no such license exists for HH2SL who has been showing recently.

Slim joined the YASME DXpedition of Lloyd and Iris Colvin while in the British Virgins and helped fill the log of VP2VDJ. So far, he hasn't forwarded copies of his logs.

The ARRL is running some two months behind in processing DXCC applications. Enclose an SASE and you will at least know your cards arrived safely.

Congratulations to the new officers of the Arkansas DX Association: AF5M/President, W5LQN/VP, K5OVC/Secretary-Treasurer, and K5YY/Executive Committee.

W3KVQ, the long-time QSL manager for 9N1MM, has changed calls and QTHs. He is now Edward Blaszczyk N7EB, 12802 Sun Valley Drive, Sun City AZ 85351.

Although 160 meter operation is not officially allowed in Guatemala, you will occasionally hear a station on. Apparently, as long as the operator is careful about avoiding interference, the signal will not be noted. Guatemala also maintains a ban on phone patches.

A group of USSR types was supposed to head out to Franz Joseph Land last April. If you need FJL and you hear UK1PAA, UK1PAT, or possibly R1FJ, you will know they arrived.

The station at YI1BGD now has both the FT-101E and

Jun JA2BJW and his nice station. Jun prefers CW because he is fascinated by the prospect of communicating his mind to others through intermittent tones rather than ordinary language. (Photo courtesy of N9YL.)

FTDX-500 on line and has asked permission to operate other bands and to establish more stations. Meanwhile, it continues to be heard regularly on twenty.

The Southeastern DX Club shipped a remote vfo to A51PN, which has been making the operation a bit easier for Pradhan.

The first USSR amateur radio meeting took place last December in Moscow, with over 200 of the locals showing up. They are hoping for 160 permission with a 10-Watt input. A special "EU" prefix will be used during the summer Olympics to be held in Moscow next year.

Later word has it that K1RH also worked that BY1AA station we mentioned a few items back. Ralph notes that Pyng gave his QTH as Pecinng and that a check with some language experts at Yale indicated this to be an acceptable way of spelling Peking. Ralph caught the station on 28023 at 1455Z. K1RH, like ON4QX, awaits the China mail.

N5KC recently received a direct QSL from VR6TC for a QSO in August, 1973. Never give up.

K5MK resigned as QSL manager for 8P6JD, citing an inability to get the station logs as the reason.

CO2FA is looking for 160 action. He has a 75-meter antenna and can usually be found around 3800. Sometimes CW, sometimes SSB.

Fernando says that if you sent a QSL for a CO2FA contact and do not receive one in return within six months, you should try again. The mail sometimes takes three or four months getting to Havana and there appears to be little way to speed things up. Fernando also mentions that IRCs have little value in Cuba and that a green stamp works much better.

There apparently will be a flood of individuals and groups heading to the Isle of Man during June and July to operate during the celebration of the 1000th anniversary of the Isle of Man parliament, "Tynwald." Look for the GT prefixes.

Bill Rindone, who hasn't been heard from since he was the first to bring DXCC attention to the southern Sudan, STØ, reports that he will be heading back out again this summer. He will be aiming for the East Africa and Indian Ocean area, and more information should be forthcoming soon. You might remember Bill as the last person to activate Geyser Reef before it was deleted from the DXCC countries list.

If you like six meter DX—and there is quite a bit of F-layer stuff around these days—monitor 28885, where news is passed and schedules are made.

RF6F, heard in the CQ DX Contest last fall, was the Radio Club of Voroshilovgrad there in Georgia. Their effort netted 7.8 million points on SSB and 5.9 on CW. The club callsign is UK5MAF, and they are reported to be readying another multi-multi operation for the WPX contest, possibly signing R5M.

VU2KB, often found on 14 MHz CW, is an avid stamp collector and is interested in swapping with like-minded W/K DXers.

John Kanode N4MM has resigned his duties with the W4 QSL Bureau after four years of volunteer labor. John handled the W4/K4/N4 section of the bureau. His duties have been taken over by John Boyd W4WG, with the address remaining the same.

3B8DA is considering another 3B6 effort this summer. Nothing definite at this time, but we will let you know as plans progress.

Last month, we reported on the planned activity by Bruce Frahm KØBJ from the *Yankee Trader* on its ninth world cruise. We have obtained a copy of the ship's scheduled stops and will be reporting these each month. Stops in May include Samoa and Fiji.

The Gilbert Islands will become independent this July. Look for a new prefix to replace the present VR1. Meanwhile, VR1BD can usually be found around 28503 kHz from 2000Z.

9M8HG passes along his sincere thanks to the many DXers worldwide who sent get-well cards during his recent illness. Some W/K DXers donated a new 300-Watt rig and beam to replace Horace's little 80-Watter and dipole. He frequents 21320 kHz at 2200Z and then drops down to the 14225 kHz net at 2300Z. Horace, now 82, was first licensed in 1924 as OB2SK. He won the world DX Contest in 1932, running 5 Watts.

OE6EEG is reported to have forwarded the necessary HZ1BS/8Z4 documentation to the DXCC desk.

A team led by KH6CHL will activate rare Kalawao county on 10 through 80 meters from May 25th to the 27th.

The E/W DX Net which meets each Thursday on 14248 kHz at 0500Z continues to be a gathering spot for Pacific and African DX types.

George Collins VE3FXT will be on hand September 6th to help Vendaland celebrate its Independence from SA. A tower is being erected (equipment was left on an earlier trip).

Lloyd and Iris Colvin report making 6,000 contacts from W6KG/TI5 in Costa Rica, split

Continued on page 162

VU2VKK, in the center, visits with VU2GO and VU2GX while the latter wait in vain with the rest of the VU4ARC Laccadive DXpedition crew for operating permission that never came.

LETTERS

TARA SINGH XZ2KN

I am sending a picture of my late father, Tara Singh XZ2KN. This is the latest picture I have of him, taken just last year. This was taken in Pegu, about 60 miles out of Rangoon. The statue of the Reclining Buddha is the background.

My father was born in Kalaw, Shan States, Burma, in 1918 and was educated in Rangoon. He graduated with a BS in Mechanical Engineering from Rangoon University. He was a very active sportsman and became golf champion twice. He also represented Burma abroad many, many times. He got his amateur license in 1938 and was very active. Soon after, due to WWII, he evacuated to India with his family. They walked to India, a trek which took over 3 months. He had tied his radio equipment to the rafters in the attic to prevent damage in his absence. He was a contractor and was instrumental in building the Burma-China railway before evacuating. On his return, he helped my grandfather with the machine-shop and foundry business. Known as the Empire Foundry, it was one of the largest in Burma. He was an avid believer of the good antenna over high power theory and, having the resources, always was building new antennas. At one time, he built a 4-element wide-spaced beam for 20 meters with a 44-foot boom. The boom used 1" x 1" x ¼" angle iron, and the beam assembly weighed about 2000 pounds. He then got infatuated with cubical quads. The last antenna he built was a 4-element quad, with which he had excellent results. He used an AR-88 receiver and, when he could get it working, an ET-4336 transmittter.

The last rig we used was a Johnson Viking Ranger running 65 Watts—yes, 65 Watts into a 4-element quad. We made many, many stateside contacts and never had trouble or felt inadequate. As no new licenses were being issued, I was the second operator for XZ2KN. Amateur radio was banned on 10 January 1964, and no one has legally operated after that date. The licenses are renewed every year, but with specific instruction not to use the equipment which has not been confiscated. I might mention that my father was the Secretary/Treasurer of the Burma Amateur Radio Society for as long as I can remember. My father was hit by a car while crossing a street on 11 February 1979 in Rangoon. He died in the hospital on the 12th and was cremated on the 13th.

Gurbux Singh WB9TTN
Rochester IL

P.S. In his last letter, received a week before his death, he wrote that amateur radio was certainly out and that he saw no hope for it in the future.

Tara Singh was most accommodating when I visited Rangoon, taking the time to show me all around the city so that I could take pictures, introducing me to the British Ambassador (there was no U.S. embassy in Burma), and filling me in on the history of this most interesting country. It was during this short visit that I met Gurbux, his son. While visiting Singapore a few days later, I sent Gurbux some strings for his badminton racquet via a local ham, also named Singh. Eventually, Gurbux had to leave Burma, and the only address he had was 9V1NR in Singapore, who had forwarded the strings for me. The next I heard, Gurbux was marrying 9V1NR's daughter and moving to the U.S. Quite a world! I was saddened to hear that Tara had passed away without ever getting back on the air again, for I remember how his eyes lit up when he talked about amateur radio . . . a true love of his.—Wayne.

Tara Singh XZ2KN.

IMPRESSED

I'm sorry I haven't written earlier to praise you and your staff for publishing the finest amateur magazine in America. You may not remember me, but my wife and I visited you at your station on Mt. Monadnock before we were married . . . I think it was in 1965 or so . . . back when W2NSD/1 was so strong down here in New Jersey on two meter AM that you could take out most of the locals on my old Gooney box.

I've always been impressed by your sincere devotion to amateur radio, and I read your editorials with interest each month. I ditto your comments about Sam Harris in January *73*. Sam was one of my first two meter "DX" contacts, back when 250 miles was a long haul on that band, and Helen was my first Puerto Rican contact on six meters. He will be missed.

Please keep up the good work, and pray with me that post-WARC '79 days will give you a reason to continue publishing an amateur radio magazine!

Steve Katz WB2WIK
Budd Lake NJ

LOYALISTS

From reading your editorials, which I tend to agree with as well as enjoy immensely, it seems to me that there is more than enough evidence to firmly establish the fact that the ARRL is detrimental to the future of amateur radio. When something doesn't function properly, it should either be repaired or discarded; this is the case with the ARRL. Since it is operated in such a manner as to make repair nearly impossible, then, in my opinion, it should be done away with.

I do not agree with the "but it's all we've got" philosophy. As long as the ARRL exists, it is "all we'll have"—they'll see to that! You always make the point that you've been a member of the ARRL for most of your ham career; I fail to see the logic in spending $12 a year to support something I can't believe in. Were you to quit the ARRL, in protest, chances are that 50,000 hams would do likewise and the ARRL would fall in to that degree—or do you have 50,000 loyal followers? Might be interesting to find out.

More than half the hams I have queried about their reasons for joining the ARRL tell me that they "take the magazine," "just joined to get *QST*," etc. That is why I would never subscribe to *QST*—I don't want to be "represented" by the ARRL, at WARC '79 or anywhere else. If we did have a truly representative amateur radio organization, I would endeavor to join and support it. As I've said before, why don't you and some of the prestigious hams who are *73* loyalists resurrect the Institute of Amateur Radio? It's high time!

Bill Harris K9FOV
Lafayette IN

Bill, as far as I know, I have no loyal followers . . . and I don't want any. If anyone agrees with what I write, I want it to be on the basis of intelligence, not reaction and emotion. If I were to drop out of the ARRL, I doubt

Continued on page 156

Contests

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

NEW YORK STATE QSO PARTY
Starts: 1700 GMT Saturday, May 5
Ends: 2359 GMT Sunday, May 6
(with a rest period between 0500 and 1200 GMT on May 6)

Sponsored by the University of Buffalo ARC, WA2NPQ, this contest is open to all amateurs. Stations may be contacted once on phone and once on CW on each band. NY stations may work each other and mobile/portables changing counties may be reworked.

EXCHANGE:

QSO number, RS(T), and NY county or state/province.

FREQUENCIES:

SSB—3900, 7275, 14285, 21375, 28550.

CW—1810, 60 kHz up from the bottom of each band.

Novice—3725, 7125, 21125, 28125.

SCORING:

Score one point per QSO times the number of multipliers: states, provinces, countries, and NY counties for NY stations, or the number of NY counties for others (62 max.). Note that this is the first time NY stations may include NY counties in the multiplier total.

ENTRIES & AWARDS:

All entries must contain name, address, and county (if NY). Number the first contact for each new multiplier. A checksheet is required for stations making more than 100 QSOs. Awards to the number 1 score from each county, state, or country. Entrants desiring results please send a #10 SASE. Logs must be received by June 16 to qualify. Send all entries to: Michael Bergman WD2AJS, 45 Swartson Ct., Albany NY 12209.

FLORIDA QSO PARTY
Starts: 1500 GMT Saturday, May 5
Ends: 2359 GMT Sunday, May 6

This is the 14th annual Florida QSO Party sponsored by *Florida Skip* and all amateurs worldwide are eligible and invited to participate. Each entrant agrees to be bound by the provisions of this announcement, the regulations of the applicable licensing authority, and the decisions of the *Florida Skip* Contest Committee, which are final. All amateur bands may be used and all stations will separate phone and CW logs! A station may be worked once on each band on each mode. Neither crossband nor crossmode contacts will count for contest credit. Florida stations may work other Florida stations, but for QSO points only. Out-of-state stations may not work each other for contest credit. Contacts made on repeaters do not count! Florida stations will be divided into two classes: Class A stations are those operating portable or mobile on emergency power and running 200 Watts or less inside Florida but outside of their home counties; Class B stations are all other stations operating inside Florida.

EXCHANGE:

RS(T) and Florida county or state, province, or country. Out-of-state mobile stations operating not within the jurisdiction of any country send ITU region (1, 2, or 3) in which operating.

FREQUENCIES:

CW—355, 7055, 14055, 21055, 28055.

Phone—3945, 7279, 14319, 21379, 28579, 146.52.

SCORING:

Florida stations count 1 point per QSO with out-of-state or other Florida stations and multiply by the sum of states (49 max.), provinces (12 max.), DX countries (15 max.), and regions (3 max.) actually worked. Maximum multiplier is 79. Out-of-state stations count 2 points per QSO with each Florida station and multiply by the number of different Florida counties worked (67 max.). Class A Florida stations *only* multiply score by 1.5 to obtain final total.

AWARDS:

Certificates for phone and CW top single-operator score in each state, province, DX country, and each Florida county. There are also five plaques to be awarded as follows: high single-operator Florida and out-of-state, CW and phone, and to the Florida club with the highest aggregate score.

ENTRIES:

At the direction of the contest committee, stations and/or operators may be disqualified for improper reporting, excessive dupes, errors in multiplier lists, unreadable logs, obvious cheating, etc. Anyone disqualified in this year's Florida QSO Party will be barred from the contest next year. Phone and CW entries are to be separated. Along with legible logs in chronological order, a summary sheet is required with each entry. The summary sheet must contain score, number of QSOs, multiplier, station's callsign, entry class and county of Florida entries, power score for Class A entries, state/province/country/region for out-of-state entries, callsigns of all operators/loggers if multi-op, name of club if part of a club aggregate score, name and address typed or printed in block letters, and a signed declaration that all rules and regulations have been observed. Include a 15¢ stamp for contest results from a future issue of *Florida Skip*. All entries must be received on or before May 31, but late DX entries will be accepted within reason. Mail entries to: *Florida Skip* Contest Committee, PO Box 660501, Miami Springs FL 33166.

LIARS 10-X QSO PARTY
Starts: 0001 GMT Saturday, May 5
Ends: 2359 GMT Sunday, May 6

Sponsored by the Long Island Amateur Radio Service (LIARS) Chapter of the 10-X International Net. The object of the contest

Calendar

May 5-6	NY State QSO Party
	Florida QSO Party
	LIARS 10-X QSO Party
May 12	World Telecommunications Day Contest—Phone
May 12-13	Luckenbach DXpedition
May 19	World Telecommunications Day Contest—CW
May 19-20	Annual Armed Forces Day Communications Tests
	ARRL EME Contest (part 2)
	Michigan QSO Party
	Massachusetts QSO Party
May 26-27	CQ Worldwide WPX—CW
June 2-3	Minnesota QSO Party
June 6-7	SOWP CW QSO Party
June 9	DAFG Short Contest—SW
June 9-10	ARRL VHF QSO Party
June 10	DAFG Short Contest—VHF
June 23-24	ARRL Field Day
June 30-July 1	Seven-Land QSO Party
July 4	ARRL Straight Key Night
July 14-15	ARRL IARU Radiosport Competition
July 28-30	CW County Hunters Contest
Aug 4-5	ARRL UHF Contest
Sept 8	DAFG Short Contest—VHF
Sept 8-9	ARRL VHF QSO Party
Sept 9	DAFG Short Contest—SW
Sept 15-16	Scandinavian Activity—CW
Sept 22-23	Scandinavian Activity—Phone
Oct 13-14	ARRL CD Party—CW
Oct 20-21	ARRL CD Party—Phone
Nov 3-4	ARRL Sweepstakes—CW
Nov 17-18	ARRL Sweepstakes—Phone

Results

RESULTS OF THE 14TH ALEXANDER VOLTA RTTY DX CONTEST

	QSOs	Mult.	Points	Bonus	Score
1) I3FUE	224	96	3750	—	80,640,000
2) SM6GVA	199	80	2263	41,000	36,067,960
3) I5MYL	162	76	1977	—	24,340,824
4) DJ2YA	151	78	1913	39,000	22,570,314
5) DL0TS	152	70	1868	44,000	19,919,520
6) W1MX	106	48	3584	31,000	18,266,392
7) I2OLW	135	68	1931	—	17,726,580
8) G3UUP	137	61	1861	41,000	15,593,377
9) G3RED	140	52	1306	47,000	9,554,680
10) VE2QO	87	44	2090	14,000	8,014,520
11) K4YZV	67	36	2208	7,000	5,332,696
12) DK0OW	94	41	1326	34,000	5,144,404
13) OH6AA	104	48	793	33,000	3,991,656
14) W3KV	59	33	2044	7,000	3,986,668
15) YO3JJ	89	36	951	26,000	3,073,004
16) I2ZGP	72	32	1287	—	2,965,248
17) EA4XW	71	43	926	13,000	2,840,078
18) I2WEG	99	42	638	—	2,652,804
19) HB9AVK	64	41	984	12,000	2,594,016
20) I8JRA	71	40	813	—	2,308,920
SWL					
1) Horst Ballenberger	155	71	1932	43,000	21,304,660

is to contact as many stations as possible on 10 meters, 28.9 to 29.2 MHz.

EXCHANGE:

Station call, name, QTH, and 10-X and LIARS membership numbers.

SCORING:

Score 1 point per contact; only 2-way QSOs are valid. Add 1 point for each 10-X number and 1 point for each LIARS number with a maximum of 3 points per exchange.

ENTRIES & AWARDS:

Only 10-X members are eligible for awards. A first- and second-place certificate to each state, province, or DX foreign country. A first-place trophy to highest scoring participant holding a LIARS number. Any clear method of logging will be acceptable. Include your LIARS number, if any. Send a copy to: Bob Watson, 2 Suffolk Court, Oceanside NY 11572. Please include an SASE if a copy of the results is desired. Logs must be received by June 15.

LUCKENBACH DXPEDITION
0800 May 12 to 1200 May 13, 1979 Central Standard Time
Callsign: W5TEX

The idea of a "Luckenbach Dxpedition" began as a joke between several stations, including WB5VDL, KB5DV, WB5ROQ, N5AOW, and AI5Q, in early December of 1978. During the course of operating around the bands, they found many amateurs had not only heard of Luckenbach, but also looked forward to working a station there.

Luckenbach, located in the heart of the Texas hill country, was brought to national attention by a country/western hit song by Willie Nelson. It is a town virtually untouched by modern civilization and is nestled between two small rivers. It boasts a general store, one house, and a barn. Their first pay telephone was just installed late last year. It is not uncommon to drive the only street in town and have to stop for the cows to cross.

To make this area available to those desiring a QSO, W5TEX will be operating during the dates/times shown above with a special QSL certificate to commemorate the event. To receive the certificate, stations should send a legal size (4" x 9½") SASE to W5TEX, 2618 Rigsby, San Antonio TX 78222. Only QSOs confirmed by W5TEX logs will receive the certificates. The certificates will be 8½" x 11", printed tricolor on bond paper, and should be a welcome addition to any shack.

Operating frequencies are: CW—7110 and 21110 ±5 kHz; FM—52.525, 29.600, and 146.52; SSB—3900, 7235, 14285, 21360, 28625, 50.110, 144.200, all ±5 kHz.

Kennedy Associates, the South Texas Yaesu dealer, has kindly provided Yaesu radios and station equipment, while antennas will be furnished by Wilson Electronics for this special operating event.

WORLD TELECOMMUNICATIONS DAY CONTEST
Phone
0000 GMT to 2400 GMT
May 12
CW
0000 GMT to 2400 GMT
May 19

This contest, sponsored by Liga de Amadores Brasileiros de Radio Emissao (LABRE), was instituted in order to commemorate yearly "World Telecommunications Day" (May 17). Each participating radio amateur will attempt to make the highest possible number of contacts with the different ITU zones of the world in order to enable his country to win the ITU Trophy. Use all bands 80 through 10 meters on phone and CW. Categories include: 1) single operator—multiband; or 2) radio clubs and associations—considered as special multi-operator/multiband participants.

Points are computed separately, certificates being awarded to the top winner in each country on each mode, phone and CW. To the world top winner on each mode, a silver plate.

EXCHANGE:

RS(T) and ITU zone.

SCORING:

In the same country, any band = 0 points (same country considered as same ITU zone); in another ITU zone/country: in the same ITU zone, but different country = 1 point (any band); in another ITU zone, on the same continent = 3 points (any band); in another ITU zone, on another continent = 5 points (any band). Final score is the sum of QSO points multiplied by the number of ITU zones worked. Repetition of contacts with the same station on different bands will be permitted though each ITU zone must be counted as a multiplier only once.

For this contest, what constitutes a country will be determined by the ARRL DXCC list. In order to obtain the number of points for a country, on each mode of operation, the sum of points earned by the top 5 contestants of the country will be taken. In the case of less than 5 entries from a given country, the sum of points of the submitted logs will be taken. Points earned by participants considered as clubs or multi-operators will not be valid for country points sum.

Continued on page 154

Results

RESULTS OF THE FLATLAND FARMER 10-X CHAPTER QSO PARTY, DECEMBER 3, 1978

***World Leader and Grand Champion*—WB7UFO, 144 points**

Area Leaders

Area	*Call*	*Points*
DX	VE6BKO	106
First U.S. Call Area	WA1SQB	86
Second U.S. Call Area	WB2MAN	12
Third U.S. Call Area	No Entries	
Fourth U.S. Call Area	WD4OIR	101
Fifth U.S. Call Area	No Entries	
Sixth U.S. Call Area	W6ELR	85
Seventh U.S. Call Area	WB7UFO	144
Eighth U.S. Call Area	No Entries	
Ninth U.S. Call Area	WB9YJF	105

Results

NINTH WORLD TELECOMMUNICATIONS DAY CONTEST
ITU TROPHY 1978
OFFICIAL RESULTS

ITU TROPHY

First Place—Brazil, 1,649,954 points

Phone Team

PY3EE	249,622
ZZ6AM	181,115
PY4OD	172,200
ZV2CK	168,405
PP5AZ	161,040

CW Team

PY4OD	229,248
ZX4ITU	175,456
PS2ITU	160,360
PY4MA	82,620
PY2BW	69,888

Second Place—France, 413,193 points

Phone Team

HW6ITU	135,168
F6EBN	83,127
HW5ITU	43,530
F6DLM	6,256
F6BVB	2,924

CW Team

F6EBN	68,556
HW5ITU	65,496
F8TM	4,176
F6BHX	3,960
F6EPO	1,956

MEDALS

Gold—Top Scorer of the World

Phone—Lithuania, UP2NK, 275,465
CW—Brazil, PY4OD, 229,248

Silver—2nd Place in the World

Phone—Brazil, PY3EE, 249,622
CW—Brazil, ZX4ITU, 175,456

Bronze—3rd Place in the World

Phone—Brazil, ZZ6AM, 181,115
CW—Brazil, PS2ITU, 160,360

USA

Phone

W2LEJ—11,914
LU1BAR/W3—3,504
N4MM—2,145
WB9OBX—396
WØIUB—264
K5DEC—205

CW

W9OA—31,995	N4MM—3,536
WBØGOB—13,340	WB5OON—2,223
WØIUB—11,186	WBØUCP—950
W7ULC—10,296	N6GL—848
K8MR—5,096	K4JEZ—776
W4YN—4,403	W1OPJ—760
W5SOD—3,945	AA6EE—624
W1CNU—3,576	WA2PQU—413

RTTY Loop

Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

This month, we complete the second year of RTTY Loop. I must say that it has been, and continues to be, a real thrill to be able to share so many facets of RTTY communication with you all. We have covered a lot of ground in these past two years. Early columns started with the basics of teletype™ circuits, and lately we have worked into digital logic systems. This month, we will dip into the bulging mail sack, in no particular order, to answer, respond to, or pass along some of the thoughts that have been sent in to me.

Starting out on a somewhat oddball vein (but that's routine for this column), I have a letter from Jerry Keefe W0HAQ. Jerry has an SWTPC 6800 computer and a KSR-33. The KSR-33 was apparently used in Britain with a non-standard interface. Jerry, the teletype should directly interface with the serial (MP-S) interface of the SWTPC 6800. You have sent along a circuit, reproduced as Fig. 1, that was given to you as an "RS-232 interface." By my unskilled but logical eye, there is definitely something wrong here! Any readers willing to commit themselves may write their opinion and I will pass it along to Jerry. In the meantime, it might be worth your while to try to get the "standard call control unit" that will turn your ugly duckling into a beautiful swan-etype.

Speaking of computers (how's that for transition), Dave Ewing WB9PHQ sends along word that he is up and running with a bare KIM-1 and homebrew 567 decoder. Sounds interesting, Dave. Send along some details and we will try to spread the word to other KIM and 6502 owners.

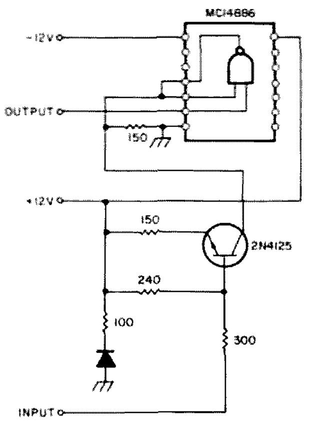


Fig. 1. W0HAQ's mystery circuit.

George Young K4SDG is another SWTPC 6800 owner who is trying to get a system up and running on RTTY. George asks about ASCII-to-Baudot conversion in hardware. Well, I would rather do the conversion in software, as the receiving program of last year shows, but, if you are insistent, *73* has published several good hardware conversions in the past few years. One which comes to mind rather quickly was an ASCII-to-Baudot converter described by Cole Ellsworth W6OXP on page 52 of the February, 1976, issue of *73*. This design converts all ASCII characters to the corresponding Baudot character, filling characters which have no match with a Baudot blank. While you're looking at that article in the magazine, you might want to check out the cover story, too. It's out of this world.

One of those things we all like to do is try to copy some of the commercial and press RTTY transmissions for personal enjoyment. Bob Magill WA6MUG is one of several readers interested in such information. I would be willing to compile some sort of list, if any data is available. Readers with information on commercial, press, etc., RTTY transmissions are asked to jot down times, frequencies, shift, speed, ASCII or Baudot, and send them to me at the above address. I'll try to present some useful form in the future.

Some more inquiries have come in on the Microlog RTTY system. To Lee Lust WA2ETQ and the others who have asked my opinion by mail and via other media, all I can do is reiterate what I said a few months back. As of this writing (March, 1979), data promised me in October, 1978, has not arrived. Several hams have used the system, and, while it appears to perform as advertised, it *is* rf-sensitive. If you have any rf around the shack, as with a high swr, you may have trouble. Caveat emptor.

A quick QSL to Clifford Erback VE5QY up there in Moose Jaw, Saskatchewan, Canada. With a Model 15, Flesher 170, and FT-101E, he has quite a nice RTTY station. The F1200B linear and TH6DX beam only help to get him into those "gray areas," right Cliff? Tom (no last name) WB8BDG is another member of the kilowatt club who feeds his TR4 into a MLA2500 linear. Teletype Model 15 and 14 equipment provides the green key interface, along with a HAL ST-5. The last member of this month's teletype group is Howard Olson WA9KEK, whose RTTY equipment consists of a Model 19 feeding either an Icom 245 for two meter RTTY or an NCX3 for HF work. While the abundance of hams on RTTY are using equipment produced by the Teletype Corporation, and most of those are using Model 15/19 setups, there is no clear consensus.

The second most popular machine is usually a product of the Kleinschmidt manufacturing concern. R. B. Gober, DDS W5ZNN writes of the Corsicana Teletype Society. It seems he and another member, N5ALA, are working on a few Kleinschmidt Model TT-100B-FG machines. Also laboring on one of these is Rob Lawson WB4BSZ, who is sweating over a TT-117-FG. Anyone having good wiring and application material is invited to send it along to this column to help get these and other fraters out of a jam.

Along the lines of the press transmissions mentioned earlier, Rob raises the possibility of copying weather data from stations located down south where he lives. Any data on these stations would also be handy.

Some of you may question why I take the space to run down this or that ham's gear, Teletype, computer, etc. When I was new to RTTY, or ham radio in general, I was frequently confused by the vast (at *that* time) proliferation of equipment and systems. Now, here we are in an age of sophistication. Model 99s, 6880 computers, and LSMFT rush into the novice's vantage and mingle into an amorphous blob. What I hope to do is show, by example, what hams are using now on the air. Hopefully, the old and the new will integrate into a unified scheme and the newcomer will be a little better informed when someone offers him a "slightly used Model 12." So much for philosophy.

Next month, we will begin the third year of RTTY Loop as we began the second—exploring the computer in RTTY. I will present a transmitting program for the SWTPC 6800, using a parallel port for output. As with the receiving program of last year, flowcharts will be included to allow adaptation of this program to other systems. Until then, keep on loopin'!

Ham Help

We are presently setting up a School of Communication here at Toccoa Falls College, Toccoa Falls GA. Being a ham, I have presented the possibilities of amateur radio as a way of communication. We have been given a room and space for antennas. Some of the students have already started working on code and theory. We are now looking for good used equipment for the club station. Any donations of such equipment will be appreciated. Tax-deductible receipts will be given for the good equipment.

We also have a Nagra III Swiss-made tape recorder for which we need a manual. If anyone has one, we would like to copy it. We would buy one if an address can be given as to where to write.

Any help given will be appreciated.

Dale McMindes KA4HBW
Toccoa Falls College
Toccoa Falls CA 30577

I need plans for a 2m duplexer that we can build for our club repeater. We would be interested in buying a used duplexer if someone has one.

Gene Kirby W8BJN
Union Co. Amateur Radio Club
13613 U.S. 36
Marysville OH 43040

I need the schematic and/or owner's manual and alignment information for the Courier 50 FM. Any help will be much appreciated.

Walt Persans WA2ZBE
135 Roe St.
Staten Island NY 10310

I am interested in getting in touch with anyone who would like to be involved with an organic gardening net.

Carl Gorodetzky WD4DKP
3526 Richland Ave.
Nashville TN 37205

I have an Eico 720 transmitter that I would like to buy an Eico 722 vfo for. Anyone having such a unit for sale can get in touch with me and we'll work out the details. Thank you.

Frank D. Paprzycki KA8CKY
1529 Henry Ave. S.W.
Canton OH 44706

I am in need of a Shure M-5D monaural phono cartridge for an experimental circuit. I called the warehouse in Evanston, Illinois, and Shure does not have this in stock anymore. Are there any special shops that might stock hard-to-get parts like this? Fellow amateurs seem to be the only source of help. I will gladly pay up to $20.00 for one from someone's junk box.

Geoffrey W. Tilga WA2YIX
196 South Main St. #3
Brockport NY 14420

New Products

SINCLAIR PDM 35 DIGITAL MULTIMETER

Although around for a few months, the Sinclair PDM 35 digital multimeter is a very versatile unit, considering its compactness, and the price is right! In fact, it may be the lowest-priced commercial pocket digital multimeter on the market.

The PDM 35 provides a very bright reddish-purple 3½-digit display reading to ±1.999. Polarity of the display is automatic and resolution is within 1 mV and 0.1 nA (0.0001 uA). The decimal point is fixed, so it is necessary to mentally extrapolate readings depending upon the range selected. For instance, when the display shows 0.987 and the multiplier switch is on x100, the digits are read as 98.7.

Dc input impedance is 10 megohms for four ranges of dc voltage to a maximum of 1000 volts. Accuracy in this mode is 1.0% ±1 count. A single ac voltage position (40 Hz to 5 kHz) permits readings up to 500 volts rms, accurate to 1.5% ±2 counts, with an input impedance of 450k Ohms. Six current positions switch from 1 nA to 200 mA. Five resistance ranges permit accurate readings from one Ohm to 10 megohms, also with 1.5% accuracy. Five additional junction-test ranges are also available.

The instrument measures resistance by forcing a known constant current through the resistor and measuring the voltage developed. It is possible, using the resistance ranges on the meter, to measure the forward voltage drop of semiconductor junctions and to match the V_{be} of transistors. The current used corresponds to the current range scale, and the display reads the forward voltage drop in volts.

Measuring only six inches by three inches by 1½ inches thick and operating on a single nine-volt battery, the PDM 35 is ideal for use away from the bench. However, on the negative side, I found that the test leads and, more especially, the test lead sockets detract from an otherwise outstanding unit. The leads are stiff and kinky, and inserting and removing the plugs in the sockets is extremely difficult due to the mechanics of both the plug and socket. This is distracting because mode switching is not employed for DCV to ACV to mA/Ohms, and one test lead must be re-inserted for each mode.

With the exception of the x1000 volts dc range and the ac position, all ranges can be used to a maximum displayed value of ±1999. Exceeding this will display ≡000, or =000, indicating that the next higher range should be selected.

The operating instructions accompanying the multimeter are complete and adequate. A schematic in this booklet is barely legible because of size, even with the use of a 10X magnifier. No parts values or type numbers are shown on the schematic—only component reference designators. Because neither a parts list nor a theory section is provided, these designators serve no purpose.

The PDM 35 comes complete with test leads, soft carrying case, and instruction book. An ac adapter, 30-kV probe, and padded case are extra-cost items. Guarantee period is one year.

Starshine Group, 924 Anacapa Street, Santa Barbara CA 93101; (800)-528-6050, ext. 1052. Reader service number S89.

A. A. Wicks W6SWZ
Agoura CA

TRAC DELUXE CMOS ELECTRONIC KEYER

Trac Electronics, Inc., has introduced an addition to its line of state-of-the-art CMOS keyers. The Trac Deluxe CMOS Electronic Keyer, Model TE 144, contains all CMOS integrated circuitry. The front panel contains controls for speed, weight, tone, and volume. In addition, a rear-panel switch allows "bug"-type operation (automatic dots, manual dashes) as well as straight-keying operation. The Deluxe CMOS Electronic Keyer provides both dot and dash memory, iambic keying, 5-50 wpm, sidetone, and speaker, all housed in an eggshell-white base and woodgrained top. It is compact in size, 6" x 4" x 2". The unit is operated on a single 9-volt battery and keys both positive- and negative-keyed rigs. Available direct from *Trac Electronics, Inc., 1106 Rand Building, Buffalo NY 14203*, or at most dealers throughout the US and Canada. Reader service number T18.

DAIWA RF-440 RF SPEECH PROCESSOR

It was the acid test for my brand new Daiwa RF-440 rf speech processor: nighttime phone operation on 75 meters. Would the RF-440 really help my low-power signal punch through the bedlam? My CQ was answered by a station in Pennsylvania. After the usual exchange of pleasantries, I asked him to evaluate the performance of the RF-440 while I switched it in and out. The result of this mini-test? "Without the processor, you were down in the mud; I couldn't copy anything. With the processor, I copy 90%." That was enough for me. I was hooked.

Since that first night, I have used the RF-440 in a variety of situations. While the results are not always as dramatic as the instance cited above, the processor has yet to disappoint me.

The RF-440 is designed to increase "talk power" without introducing distortion and splatter. It's packaged in a very attractive all-metal enclosure that is several cuts above the cheap-looking boxes used by some accessory manufacturers. The small size (6" x 2½" x 6") of the unit and the smooth feel of the controls give the RF-440 the aura of a precision watch. It's solid.

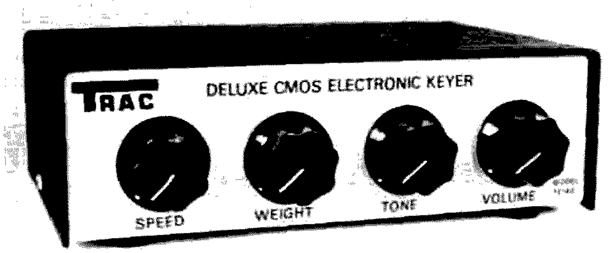
The RF-440 simply installs between your microphone and transceiver. It comes pre-wired for Kenwood equipment, so I had to swap connectors to use it with my Heathkit gear. The processor has an internal ac power supply, but it also operates from 12 V dc for mobile use.

Using the RF-440 is a pleasure. Simply set the gain control for a proper level using the built-in meter, then adjust the output control so as not to overdrive your rig. I adjusted the output control using an oscilloscope, then went on the air and was told that my signal sounded fine, with no distortion. Alternatively, you could start with the control set at its midpoint, then solicit on-the-air opinions for a final adjustment.

One school of thought says that speech processor controls should be inside the case so you can set them and forget them. As a confirmed knob-twiddler, I was pleased to see the controls of the RF-440 right there on the front panel where they belong. This really simplifies matters if you intend to use the processor with more than one microphone or rig. Another convenience is an "OFF" position on the gain control which bypasses the processor for straight-through operation.

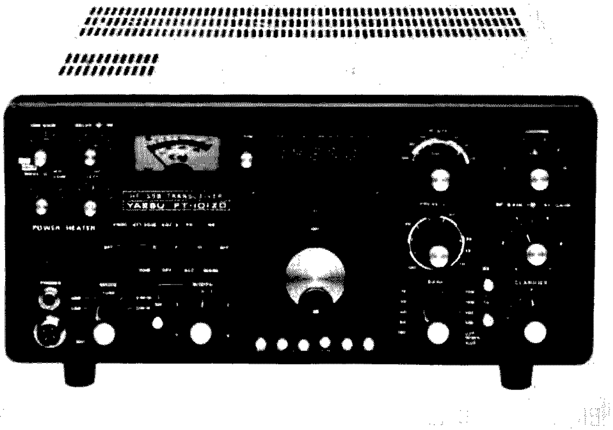
The impressive Daiwa product line is being distributed in the USA by the *J. W. Miller Division of Bell Industries, PO Box 5825, Compton CA 90224.* Reader service number B47.

Jeff DeTray WB8BTH/1
Assistant Publisher



Trac's Deluxe CMOS Electronic Keyer.

Daiwa's RF-440 speech processor.



Yaesu's new FT-101ZD.

Sabtronics' model 2010A.

YAESU INTRODUCES THE FT-101ZD

Yaesu Electronics Corporation of Paramount, California, is pleased to announce the introduction of the FT-101ZD transceiver.

The FT-101ZD is all new in design and offers many of the features of the internationally acclaimed FT-901DM.

The FT-101ZD is a no-compromise HF SSB/CW transceiver which offers variable i-f bandwidth for 2.4 kHz to 300 Hz, digital plus analog display, built-in rf speech processor, a built-in ac power supply, a new highly effective noise blanker, rugged 6146B final tubes, all band coverage 160-10 meters, WWV, plus WARC band expandability and a true frequency counter (no more recalibrating when changing modes).

Additionally, the FT-101ZD is compatible with all of the FT-901DM accessories.

The FT-101ZD is now available from your local Yaesu dealer. *Yaesu Electronics Corporation, 15954 Downey Ave., PO Box 498, Paramount CA 90723; phone (213)-633-4007.* Reader service number Y1.

HIGH-SPEED DIGITAL OPTO-COUPLERS FOR 5-VOLT LOGIC INTRODUCED BY MOTOROLA

Motorola has introduced two fast, low-cost, digital optocouplers for 5-volt logic applications. Designated the MOC5005/6, they offer 7500-volt peak ac isolation and are UL-recognized.

The new high-speed optocouplers' turn-on time is 225 ns (typical) for the MOC5006 and 420 ns (typical) for the MOC5005. The two devices are TTL compatible and are designed for applications requiring very high electrical isolation, fast response time, and digital logic compatibility. Such applications include interfacing computer terminals to peripheral equipment, interfacing with microprocessors, digital control of power supplies, motors, and other servo-machine uses.

Designed as a digital converter, the application of current to the LED input results in a low voltage output; with the LED off, the output voltage is high. The circuits are current-, voltage-, and temperature-compensated and will sink an eight-gate fan-out (13mA) from DTL, TTL, or CMOS with an applied power supply voltage of 5 volts and 16 mA applied to the input. The units offer built-in hysteresis and internal pull-up resistor and feature low power consumption of 4 mA (typical) @ 5 volts in the ON state.

Delivery is from factory stock and authorized Motorola distributors. *Motorola Semiconductor Products Inc., PO Box 20912, Phoenix AZ 85036; phone (602)-244-6900.* Reader service number M20.

NEW LOW-COST 3½-DIGIT DMM OFFERS TOUCH-HOLD FACILITY

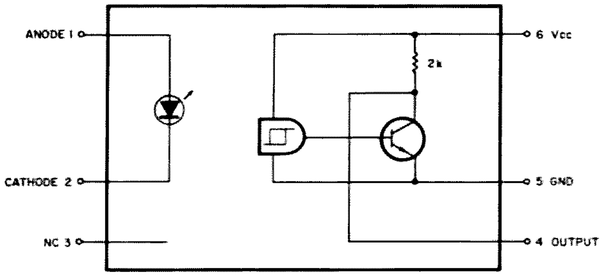
Sabtronics International of Dallas, Texas, has introduced a new low-cost bench/portable 3½-digit DMM that features touch-and-hold capability with an optional test probe. This permits retaining the display's reading even when the probe is removed from the circuit. The model 2010A DMM provides standard ac, dc, and high/low-power resistance measurements in 31 ranges.

The model 2010A DMM is designed for current measurements up to 10 Amps (ac or dc), with an ac frequency response from 40 Hz to 50 kHz, and with an input overload protection to 1200 V dc or rms on voltage ranges. A unique feature of this DMM is a "times 10" multiplier switch for convenient setting to the next higher decade range.

Single-chip LSI circuitry is the basis of this compact unit; the display is made up of large LEDs that read to ±1999 with automatic decimal point. The manufacturer has incorporated a stable bandgap reference for long-term accuracy and states that typical DCV accuracy is 0.1% ±1 digit. Other features of the unit are automatic zeroing, fuse protection on Ohm and current ranges, automatic polarity, and overrange indication.

Optional accessories for the model 2010A include a touch-and-hold probe for measurements in hard-to-reach places, a high-voltage probe, rechargeable nickel-cadmium batteries, and an ac adapter/charger. All are available from Sabtronics.

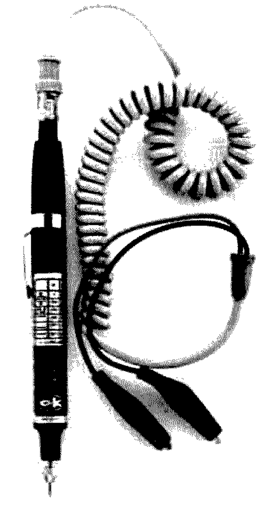
The model 2010A may be ordered directly from the manufacturer. Write *Sabtronics International, 13426 Floyd Circle, Dallas TX 75243; phone (214)-783-0994.* Reader service number S27.



MOC5005/6 digital optocoupler schematic.

10 NSEC LOGIC PROBE IS LOW COST

The new PRB-1 digital logic probe costs less yet offers the full features of much more expensive probes. It detects pulses as short as 10 nsec and has a frequency response to 50 MHz or better. The unit provides automatic pulse stretching to 50 nsec (+and −) and is fully compatible with all RTL, DTL, HTL, TTL, MOS, CMOS, and microprocessor logic families. It also features 120k-Ohm impedance, power lead reversal protection, and overvoltage protection to +70 V dc. Constant brightness LEDs are provided over the full supply voltage range of 4-15 V. There is an optional PA-1 adapter for use with supply voltages of 15-25 V. Included are a six-foot coiled power cord and tip protector. The unit comes neatly packed in



OK's PRB-1 digital logic probe.

CSC's 500-MHz prescaler.

The Communicator II from Pace.

a reusable case with complete troubleshooting instruction booklet. It is available at local electronics distributors and retailers or directly from *O.K. Machine and Tool Corporation, 3455 Conner Street, Bronx NY 10475; phone (212)-994-6600.* Reader service number O5.

CSC 500-MHz PRESCALER NOW AVAILABLE

Continental Specialties Corporation first previewed their new PS-500 500-MHz frequency prescaler at spring's NEWCOM show, then officially introduced it at summer's WESCON show. Actual production began in late summer, and quantities are now in stock for immediate delivery.

The PS-500 prescaler has been designed to complement CSC's MAX-50 and MAX-100 frequency counters.

For additional information, contact *Continental Specialties Corporation, 70 Fulton Terrace, New Haven CT 06509; (203)-624-3103, TWX (710)-465-1227.* Reader service number C9.

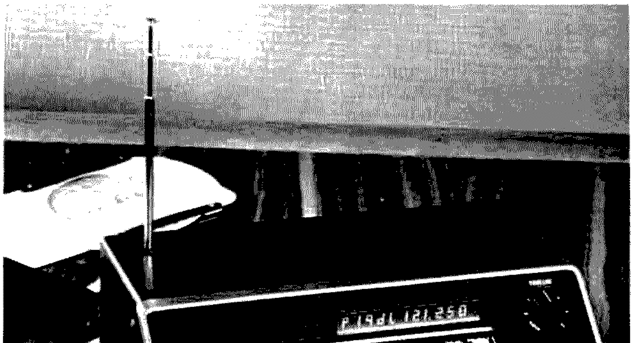
"BEARCAT® 220" SCANNER RECEIVES AM AIRCRAFT BAND PLUS FM PUBLIC SAFETY BANDS

Electra Company has announced a breakthrough development in scanner technology that allows a single scanning monitor to receive not only public safety, marine, ham, and other FM frequencies, but also the AM aircraft frequencies. The new Bearcat 220 scanner is the first scanning monitor which combines AM and FM reception capability. Until now, two of the most popular monitoring activities—listening to aircraft and listening to police calls—had to be received on separate monitor receivers. But now, six VHF and UHF FM public service bands plus the AM aircraft band are covered by this single radio.

The new Bearcat 220 also features three search operations for finding active local frequencies. It has the normal search operation where frequency limits are set and the scanner searches between them. All active aircraft and marine frequencies are preprogrammed into the scanner's search memory so frequency limits aren't necessary. The user simply pushes the aircraft or the marine search button and the BC 220 seeks out the aircraft or marine frequencies being used locally.

Crystal-less push-button frequency entry which was pioneered in the Bearcat 210 scanner is used in the Bearcat 220. The actual frequencies being monitored are shown on a bright digital display. Up to 20 frequencies can be in any sequence or mix of bands. A priority function is also provided, instantly alerting the listener when a call is made on the priority frequency programmed into the channel one position. Channels can also be activated in banks of 10, permitting the operator to "call up" a group of 10 channels with one push-button.

Other features included in the Bearcat 220 are patented selective scan delay, scan speed selection, ac/dc operation, automatic and manual squelch, individual channel lock-out, and direct access to any programmed channel without the need to manually step through channels. Electra Company's patented "track tuning" is used to provide optimum reception across entire frequency bands. Complete details are available from Bearcat suppliers or by writing to *Electra Company, PO Box 29243, Cumberland IN 46229.* Reader service number E40.



New Bearcat 220 scanner.

PACE'S COMMUNICATOR II

Pace Communications Division of Pathcom, Inc., has been known for its superb CB and commercial FM two-way radio products for many years. A few months ago, the Amateur Radio Products Group of Pace introduced its Communicator line. Top of the line is a 4-MHz, 800-channel, all-synthesized two meter FM mobile, the Communicator II.

By using three knobs (MHz, 100 kHz, and 10 kHz) and an in-out push-button for 5 kHz, the receive frequency is rapidly dialed into the unit and displayed on the .375" 6-digit LED readout. Transmit is selected by a 5-position rotary switch giving simplex, ±600-kHz, and ±1-MHz splits. When the PTT is depressed, the digital readout automatically shifts from receive frequency to transmit frequency, leaving no doubt as to where the unit is set. Also of note is a push-on, push-off power switch that relieves the user of having to reset the volume control. The Communicator II weighs 6.6 pounds and is 6.4" W x 2.8" H x 10.2" L. Current draw is 1-1.5 A receive and 1.5 A (1 W)-6.0 A (25 W) transmit.

Using 52 diodes, 8 LED units, 32 transistors, 6 FETs, and 18 ICs, the Communicator II operates in a 16F3 mode. Power output is 1 or 25 Watts push-button controlled (with the 25 Watts being adjustable for those who wish QRP). Frequency deviation is ±5 kHz maximum. Spurious harmonics are 65 dB below carrier. Frequency stability is ±5 ppm for −30° to +60° C.

The receiver is a double superheterodyne using 16.9-MHz and 455-kHz I-fs. Sensitivity is less than .4 microvolts for 20 dB quieting (.20 microvolts for 12 dB SINAD). Image and receiving spurious rejection is 65 dB down; selectivity is 65 dB down at ±12 kHz. The internal 8-Ohm speaker allows 1.2 Watts at 10% THD. One of the 8-mm plug jacks on the rear mutes the internal speaker when an external speaker is connected. The other 8-mm jack allows not only an external speaker to be used,

Continued on page 163

Microcomputer Interfacing

Peter R. Rony
Jonathan A. Titus
Christopher A. Titus
David G. Larsen

SUBROUTINES AND STACKS

Subroutines are powerful software building blocks. They facilitate program development since they may be written and tested apart from the main body of software. In addition, they can be adapted for use with almost any type of program. In this month's column, we will focus upon their operation as well as on the use of stack instructions.

Both *unconditional* and *conditional jump* instructions transfer computer control to another software task starting at the sixteen-bit address specified within the jump instruction itself. The jump instruction is a one-way branch since it points to a single address, as illustrated in Fig. 1. In many software tasks, however, there exist short subprograms which are used repeatedly. Examples of such tasks include mathematical computation, control, and teletypewriter input/output routines. It seems wasteful to duplicate these subprograms throughout the main program, so an attempt is made to separate them at the end of the main program and, in some manner, branch to them when they are needed.

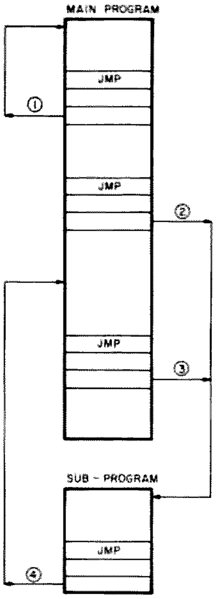


Fig. 1. Diagram illustrating the characteristics of the jump instruction.

The use of jump instructions to access these subprograms will not be successful since there will be no *link* back to the main program once the subprogram's task is completed. The use of an additional jump instruction at the end of the subprogram which points back to the main task is unsatisfactory, since jump instructions can point to a single address. This is also illustrated in Fig. 1. The jump instructions at 2 and 3 point to the same subprogram, but upon completion of the subprogram's task, the jump instruction at 4 can only provide a link to one place. A new operation, the *call* instruction, is required. This has the effect of inserting the subprogram's software steps in the main program flow at points 2 and 3, but without the problems associated with the use of a jump.

The call instruction, like the jump instruction, transfers control to another portion of the software. When that portion has completed its task, however, control is returned to the main program. This is illustrated in Fig. 2. In the figure, two subroutines are used by the main program, each being

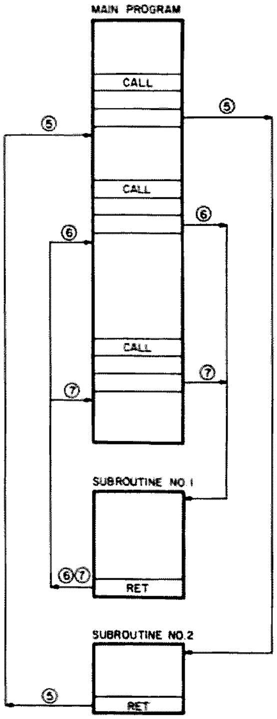


Fig. 2. Diagram illustrating the characteristics of the call and return instructions.

GLOSSARY

Subprogram: A section of a program which may perform a particular operation to be used with a larger program. Subprograms are not general-purpose and are generally used by one program.
Subroutine: A program which is general-purpose and which may be called or used by a main program or another subroutine.
Main Program: A short notation to indicate the software tasks which will occupy most of the computer's time.
Link: A pointer address which will point the computer to another section of a program or back to a program which it may not be currently using.
Nesting: The operation of one subroutine within another, e.g., a one-minute delay subroutine may call a one-second delay subroutine 60 times.

accessed by a call instruction which specifies the starting address of the subroutine as a sixteen-bit, or two-byte, word. *At the completion of the subroutine, control is returned to the next instruction which follows the three-byte call instruction.* Through the use of call instructions, the program shown in Fig. 2 has inserted the subroutine program steps in the flow of the main software task. Subroutine number 2 is used only once, but subroutine number 1 has been used twice although it is present only once in the microcomputer's memory.

Each subroutine is accessed via a call instruction and ends with a *return* instruction RET. The return is a one-byte instruction which does not contain any address information, yet it acts to return control to the main program. The return of control takes place since the call instruction saves a *linking*, or return, *address* which acts to branch the computer back to the address of the instruction immediately following the three-byte call. The return instruction causes the microcomputer to retrieve the address from storage and use it as the link back to the main task.

The sixteen-bit return addresses associated with call instructions are stored in an area of read/write memory called the *stack*. The transfer of address information is performed automatically by the 8080 microprocessor chip to and from the stack during call and return operations. Thus, the 8080 chip *pushes* the return address onto the stack during the execution of a call and *pops* it off the stack during a return. The actual memory area set aside for the stack is determined by the programmer through the use of an LXISP instruction, which loads the sixteen-bit starting address of the stack into the *stack pointer register* located within the 8080 chip. It is the programmer's responsibility to set up a stack pointer before calls and returns are used; the programmer must also make certain that the stack area will not be used for other purposes during program execution.

In the program example shown in Table 1, we decided that the stack should have a starting address of 003 377. The first step in the main program, therefore, is to set the stack pointer to this address using the LXISP instruction. Later, when a call instruction is executed, the 8080 chip transfers the return address to the stack area of R/W memory. If the stack pointer is initially set at address X, the return address is stored with the low address byte in location X-2 and the high address byte in location X-1. Thus, *the stack adds address data at addresses below the address value of the stack pointer.* When the return address is popped back into the 8080 chip, the stack pointer is automatically incremented back to address X as the return is retrieved byte by byte. When the next subroutine is called, the stack locations are used for storage of the new return address, since the old return address has already been popped back into the 8080.

Subroutines may be placed one within another, or *nested.*

Continued on page 150

```
                        *003 000
003 000 061   START,    LXISP    /SYMBOLIC ADDRESS OF START
003 001 377             377
003 002 000             000
003 003 333   LOOP,     IN       /INPUT DATA FROM PORT 5
003 004 005             005
003 005 376             CPI      /COMPARE IT TO 026
003 006 026             026
003 007 312             JZ       /IF IT MATCHES GO TO "DETECT"
003 010 015             DETECT
003 011 003             0
003 012 303             JMP      /IF IT DOESN'T MATCH, GO TO
003 013 003             LOOP     /LOOP AND CHECK AGAIN
003 014 003             0
003 015 171   DETECT,   MOVAC
003 016 323             OUT
003 017 007             007
003 020 166             HLT
```

Table 1. Software example showing a typical assembler output.

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New Castle IN 47362

CB to 10

—part XVIII: several PLL rigs

Who called it "Ancient Mode?"

Recently, many hams have been converting CB radios to operation on the 10 meter ham band. With 40-channel CBs being sold now, there are many good used 23-channel units available at very reasonable prices. Some of these units will make very handy 10 meter AM phone transceivers, as they contain excellent AM receiver sections as well as efficient 4-Watt output transmitter sections in a small package ideal for mobile use. One of these units which may be easily (a few hours of work at most) and cheaply (less than $10 for the conversion and perhaps $40 to $50 for the radio) put on ten meters is the Midland model 13-882 C.

Although this article is concerned primarily with the 13-882C, the information can be applied to the following radios which use the PLL-02A phase-locked-loop IC in the same circuit configuration:

General Motors—CBD-10;
Hy-Gain—2680, 2681, 2683;
Kraco—KCB-2310B, -2320B, -2330B;
Lafayette—HB-650, -750, -950, Micro-223A
Lafayette—Com-phone 23A, Telsat 1050;
Midland—13-830, -857B, -882C, -888B, -955;
Pearce-Simpson—Tiger 23 MK II, Tiger 40A (40 ch.);
Truetone—CYJ-4732A-77, MCC-4434B-67.

There are probably more units containing the PLL-02A in the arrangement discussed here. They can be recognized by the numbers PLL-02A on the chip near the front of the rig, three crystals in the radio, and the numbers PTBMO33AOX, PTBMO-36AOX, PTBMO37AOX, or PTBMO39AOX on the circuit board. There are some 40-channel radios using the PLL-02A in a different arrangement (only two crystals) which cannot be put on 10 meters by the method described here, as the crystal that has been eliminated is the crystal to be changed in this modification. Also, it should be noted that earlier versions of the units listed above do not use the same circuitry. The Kraco KCB-2330, for example, uses a crystal synthesizer, and the KCB-2330A uses a PLL-01A chip, which is not equivalent to the PLL-02A chip.

Photo A. An overall shot of the rig with the case off.

Operation of the PLL-02A

The voltage-controlled oscillator (vco), whose frequency is controlled by the PLL-02A chip and associated circuitry, provides injection to the first receiver mixer and to a transmitter mixer stage. The oscillator operates at 10.695 MHz above the

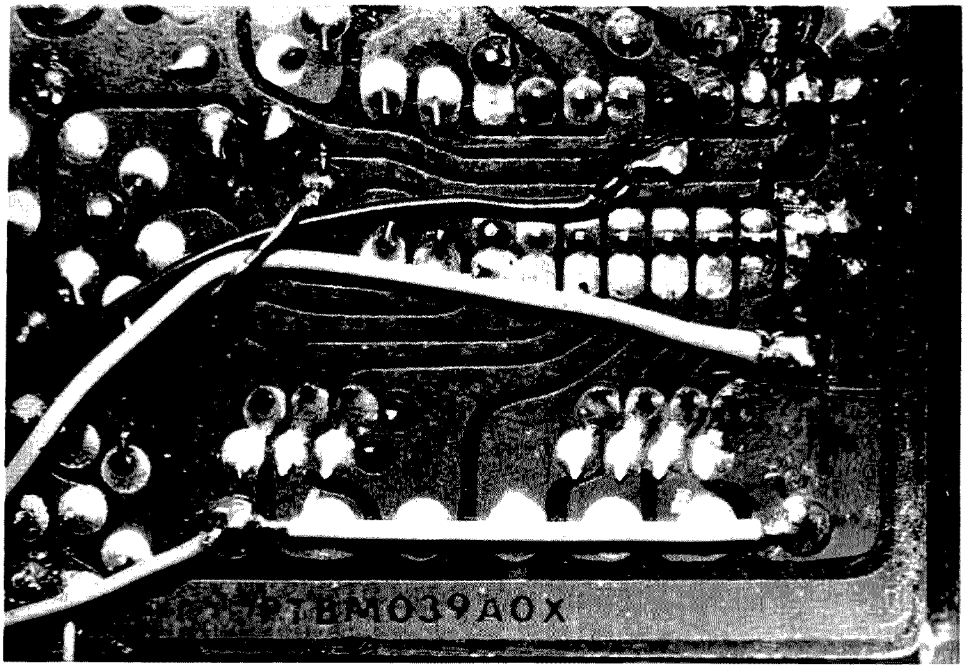


Photo B. Close-up of the channel-switch area of the circuit board, showing the modification to provide 23 additional channels 320 kHz above the "normal" 23 channels.

operating frequency, or 37.660 to 37.950 MHz for operation on CB channels 1 to 23.

Output from the vco is also mixed with the third harmonic of the 11.80666 MHz crystal oscillator (Q105) at 35.420 MHz, to produce a difference frequency of 2.24 to 2.53 MHz, which is fed into pin 2 of the PLL chip. 10.240 MHz energy from the 10.240 MHz reference/second receiver mixer injection oscillator is fed into the IC at pin 3.

Inside the IC, the 10.240 MHz signal is divided by 1024 to produce a 10.00 kHz reference signal. The 2.24 to 2.53 MHz signal is divided by n, where n is a number determined by the binary coding from the channel switch to pins 7-15 of the IC. See Table 1.

For channel 1, n is 224, dividing the difference frequency at pin 2 by 224. This frequency is compared to that of the 10.00 kHz reference signal. If the output of the n divider is less than 10.00 kHz, the voltage at pin 5 of the PLL chip (the control voltage for the vco) is raised, causing the frequency of the vco to increase. If, on the other hand, the frequency of the n divider output is higher than 10.00 kHz, indicating that the vco is too high in frequency, the voltage at pin 5 drops, lowering the vco's frequency. This action, similar to that of a thermostat, regulates the frequency of the vco. By changing the value of n (the job of the channel switch) or the frequency of the 11.80666 MHz oscillator and adjusting the slug in the vco oscillator coil (to set its tuning range), the operating frequency of the vco, and thereby the operating frequency of the entire rig, can be changed, while maintaining stability approaching that of a crystal oscillator.

Conversion to 10 Meters

To convert the radio to 10 meters, the 11.80666 MHz oscillator must be changed. The frequency required to give channel 1 a frequency of "F" MHz is:

crystal frequency (MHz) = (F + 8.455)/3

or 12.405 MHz for channel 1 at 28.760 MHz, the channel 1 for many converted CBs now in use, especially in the Los Angeles, California, area. The crystal should be available from any of the major crystal manufacturers. When ordering, specify the frequency desired and the model of radio you are converting. The crystal manufacturers usually have information on holder type, load capacity, and other specifications for CB units on file. If not, send a copy of the oscillator schematic along with the order.

To get the rig up to ten meters, the vco must be moved to near 39 MHz and the transmitter must be completely realigned. The easiest way I have found to do this is to use a dummy load, wattmeter, or other output indicator, frequency counter, or receiver covering 27 to 29.5 MHz with some accuracy and a signal generator or steady on-the-air signal in the following procedure.

With the unit off, isolate pins 5 and 6 of the PLL from the circuit board foil (use solder wick to remove the solder). Pin 6 is a protection voltage which drops to 0 if the PLL fails to lock up (i.e., the PLL can't regulate the vco frequency for some reason) and disables the transmitter. Pin 5 is the control voltage to the vco. Temporarily connect a jumper wire from pin 1 (5-volt supply to the IC) to the foil at pins 5 and 6, without connecting to the pins themselves. It probably wouldn't hurt the IC if the pins did touch, but, at $12.00 or more for a replacement IC, I don't recommend taking chances. This temporary modification runs the vco at maximum frequency, unlocked from the PLL, and overrides the transmitter disable line, allowing the transmitter to function. Connect the wattmeter and dummy load to the transmitter. Connect the frequency counter according to its instructions to monitor transmitted frequency.

Turn the unit on and key the transmitter. The frequency counter should read somewhere above 27.4 MHz. Tune the slugs of T111, L103, L104, T102, T103, L106, L109, and L110 for maximum output (the numbers are next to the coils on the circuit board). Exercise extreme caution in tuning, as the slugs are very fragile. Tune the vco oscillator coil, T101, until the frequency is about 300 kHz higher and retune the above coils for maximum

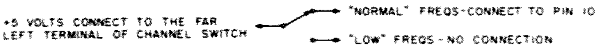


Fig. 1.

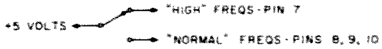


Fig. 2.

n	Ch.	Freq.	pin: 7	8	9	10	11	12	13	14	15
224	01	26.965 MHz	0	1	1	1	0	0	0	0	0
225	02	28.975 MHz	0	1	1	1	0	0	0	0	1
226	03	26.985 MHz	0	1	1	1	0	0	0	1	0
228	04	27.005 MHz	0	1	1	1	0	0	1	0	0
229	05	27.015 MHz	0	1	1	1	0	0	1	0	1
230	06	27.025 MHz	0	1	1	1	0	0	1	1	0
231	07	27.035 MHz	0	1	1	1	0	0	1	1	1
233	08	27.055 MHz	0	1	1	1	0	1	0	0	1
234	09	27.065 MHz	0	1	1	1	0	1	0	1	0
235	10	27.075 MHz	0	1	1	1	0	1	0	1	1
236	11	27.085 MHz	0	1	1	1	0	1	1	0	0
238	12	27.105 MHz	0	1	1	1	0	1	1	1	0
239	13	27.115 MHz	0	1	1	1	0	1	1	1	1
240	14	27.125 MHz	0	1	1	1	1	0	0	0	0
241	15	27.135 MHz	0	1	1	1	1	0	0	0	1
243	16	27.155 MHz	0	1	1	1	1	0	0	1	1
244	17	27.165 MHz	0	1	1	1	1	0	1	0	0
245	18	27.175 MHz	0	1	1	1	1	0	1	0	1
246	19	27.185 MHz	0	1	1	1	1	0	1	1	0
248	20	27.205 MHz	0	1	1	1	1	1	0	0	0
249	21	27.215 MHz	0	1	1	1	1	1	0	0	1
250	22	27.225 MHz	0	1	1	1	1	1	0	1	0
253	23	27.255 MHz	0	1	1	1	1	1	1	0	1
255	27	(see text)	0	1	1	1	1	1	1	1	1
Binary number:			256	128	64	32	16	8	4	2	1

A 1 indicates 5 volts at pin; 0 indicates no voltage.

Table 1.

output. Repeat the procedure, "walking" the transmitter up to about 200 kHz above your highest ten meter channel (about 29.35 MHz for channel 1 at 28.760 MHz). Turn the unit off.

Disconnect the 5-volt jumper wire which was temporarily installed from pins 5 and 6 to pin 1 and reconnect the pins to the foil. Turn the unit back on, and set the channel switch to channel 1. Adjust the trimmer capacitor next to the crystal for the proper output frequency. Turn the channel switch to channel 18. Adjust all of the coils mentioned except T101, the vco coil, for maximum power output. (This is done at a higher-than-center frequency because the power output drops off faster above the peak frequency than below. This is normal even on 11 meters and should not be the cause of any worries about changing capacitor values, trimming coils, etc., unless the coils just refuse to resonate. All three units I have converted have tuned beautifully with 4 to 5 Watts output without juggling any component values.)

Connect the transceiver to the signal generator or other signal source. Set the channel switch to channel 12 and adjust the generator for output on the same frequency. Adjust the rf stages in the receiver (T104 and L112) for maximum received signal strength on the S-meter. Alignment of the other receiver tuning adjustments should not be necessary, as the i-fs are on the same frequency as when the unit worked a couple of MHz lower.

Additional Channels

Channel 27 may be available in the blank position between channel 23 and channel 1 on the dial by installing an insulated jumper wire on the foil side of the circuit board between the terminal on the far left of the channel switch and the terminal on the far right of the switch. This modification will supply 5 volts to the vco and to IC pins 8 through 10 when the channel switch is in the blank position. Channel 27 will be 20 kHz above channel 23, or 29.070 MHz for channel 1 on 28.760 MHz. On some units, the blank will be another channel 1, but it's worth a try and, if it doesn't work on your rig, you can always take the jumper back out.

Each channel can be moved up or down 320 kHz by performing one of the following modifications. If one of these modifications is done, each channel will have two possible frequencies, one 320 kHz above the other. Thus, channel 1 in the higher position will be 30 kHz above the lower channel 23 and 10 kHz above the lower channel 27. In other words, the 320 kHz offset switch is selecting between two different bands of 23 channels (or 24 channels) each. The only component required for the modification is an SPDT switch, which may be installed in the front panel, or, to preserve the stock appearance of the radio, the function of an existing switch may be changed.

To be able to move the 23-channel band down 320 kHz, isolate pin 10 of the IC by cutting the foil on the circuit board around it. Then wire the switch as shown in Fig. 1.

To move up 320 kHz requires a little more work and is the modification I have shown in the photographs. Cut the foil on both sides of the connection to pin 7 to isolate it from ground. Then cut the foil to isolate pins 8, 9, and 10 as a group from the switch contact and from the thin strip of foil going to one end of R103, the series resistor in the B-plus lead to the vco. Install a jumper from this end of R103 to the 5-volt line at the left-most terminal of the channel switch or to the point shown in the photograph, which is just on the other side of a jumper from the terminal. If this jumper is forgotten, the vco won't oscillate. Connect the switch as shown in Fig. 2.

After the conversion has been completed, affix a label to it in an obvious place stating that the radio is not capable of operation on Citizens Band frequencies and that an amateur radio license is required to use it. The label could save a lot of embarrassment or a pink ticket from the FCC in the event a passenger riding in your car says something like "You have a CB just like mine!", picks up the microphone, and yells "Breaker 4" all over the world on 29.050 MHz.

My 13-882C on ten meters has provided quite a few contacts, mostly with stations on the west coast. My dad (Dale K9HIS) also has a 13-882C on ten, and my brother (Larry WB9BAQ) runs a 13-857B (an 882C without the noise blanker or antenna warning light) mobile with a trimmed-down CB magnet-mount antenna, working mostly stations on the west coast and southeastern U.S. What 4 or 5 Watts of AM phone will do on a clear frequency gave me quite a surprise. Who called it Ancient Mode, anyway? ■

PROM IDer for Longer Callsigns

—don't be caught short

Take care of RPT.

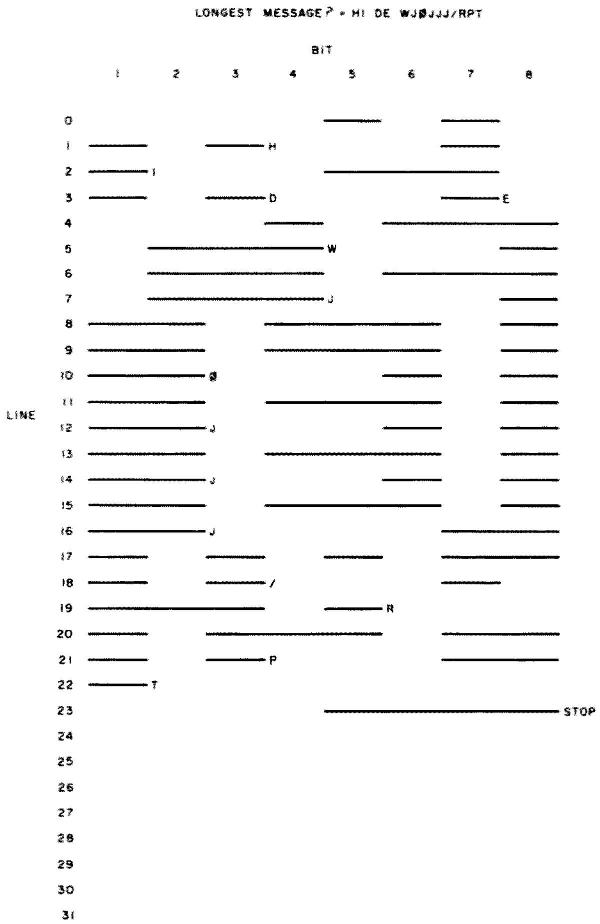


Fig. 1. A "not-so-typical" callsign.

E. E. Buffington W4VGZ
2736 Woodbury Drive
Burlington NC 27215

The Peter Stark K2OAW CW identifier has seen good service for several years now. Since it was inexpensive and easy to program, I adapted it to a plug-in configuration. (See *73 Magazine*, June, 1977.) Now it seems that a CW identifier with longer message capability is needed, due to the demise of

Parts List

Qty	Description
8	10k Ohms, ¼-W composition
2	270 Ohms, ¼-W composition
1	2.2 uF tantalum
1	1.0 uF electrolytic
1	100 uF tantalum
1	10 uF electrolytic
1	7474 flip-flop
1	74151 parallel-to-serial
2	7493 hex divider
1	82S23 memory (custom bit pattern)
1	7420 gate
1	7400 gate
1	10k pot, Bourns 3389W

Circuit boards and parts can be obtained from:
O.C. Stafford
427 S. Benbow Rd.
Greensboro, NC 27401

WR repeater calls. Now we must identify the repeater with the trustee's callsign followed by RPT.

The longest of callsigns can be programmed by altering the bit pattern of the 82S23 memory. Fig. 1 lists a not-so-typical callsign to show how much room is available on the ROM.

You can do it right the first time if you remember a few rules and definitions. First, a slot is the minimum length of time between data transmissions. Now then, a dit is 1 slot high followed by 1 slot low; a dah would be 3 slots high and 1 slot low. The space between characters is 2 slots low. You should leave a few slots at the beginning to allow the transmitter to come fully on. A stop command consists of bits 5, 6, 7, and 8, all high.

The leading edge of the start pulse causes the IC1 flip-flop to change state, resulting in the hold command going high. The $\overline{Q}$ output of the flip-flop enables the two 7493 four-bit ripple counters and the 74151 parallel-to-serial converter. The 8 bits of each line of memory are thus pulsed out until bits 5, 6, 7, and 8, being high, are detected as a stop command. It should be pointed out that no other data should be on the stop line as it would never be pulsed out. A keyed CW oscillator that furnishes audio to the transmitter completes the circuit.

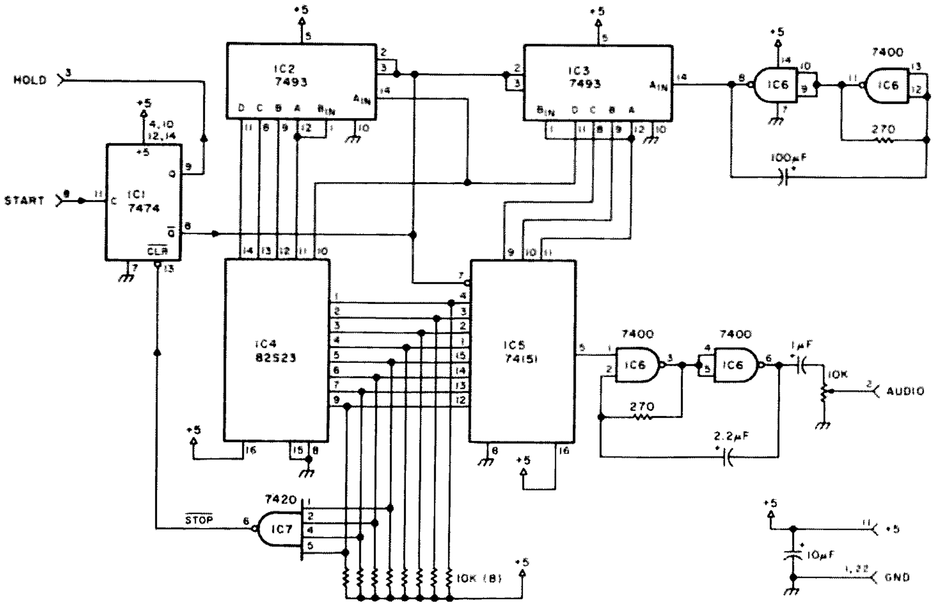


Fig. 2. PROM CW identifier.

This ID unit plugs into the same socket (with no wiring changes) as the one shown in my June article. A logic-high pulse starts it, and during the time that the ID unit is running the hold command is high to keep the transmitter on.

A sample program is shown in Fig. 1. As you can see, this "longest call" uses only lines 0 to 23. There may be room to have even your QTH included.

Contest freaks can have several ROMS programmed for their various contests, and just plug them in when contest time rolls around. I have one programmed: "DE W4VGZ Transmitter

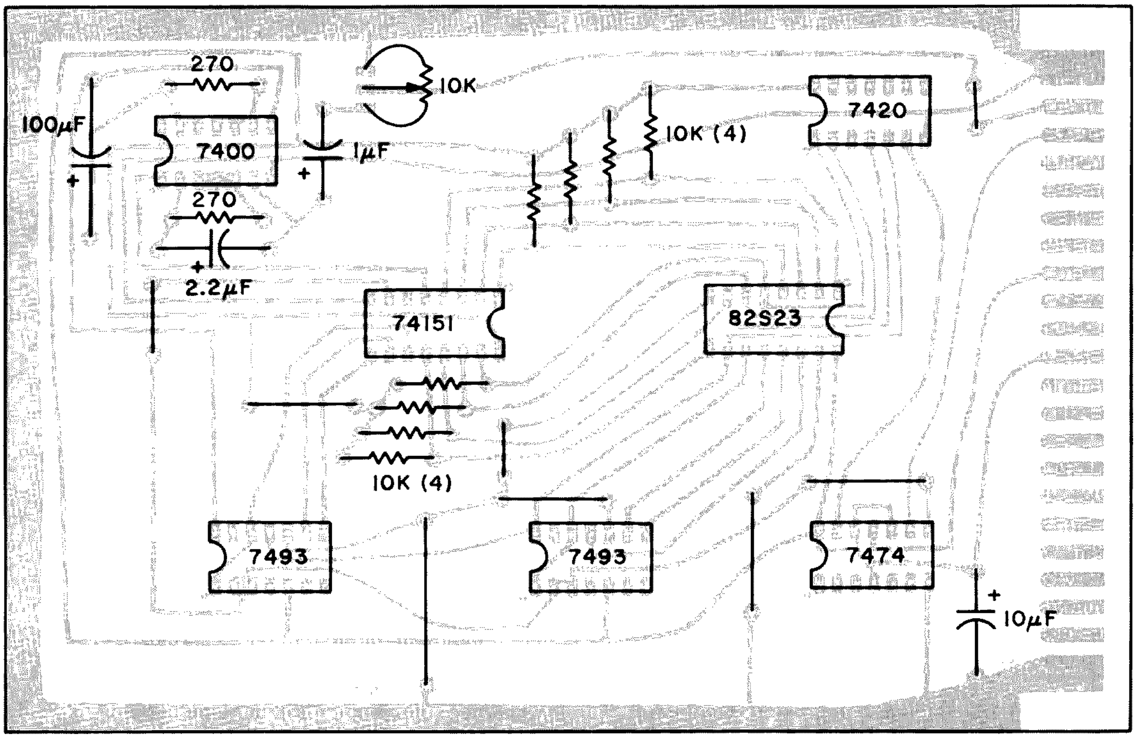


Fig. 3. Component layout.

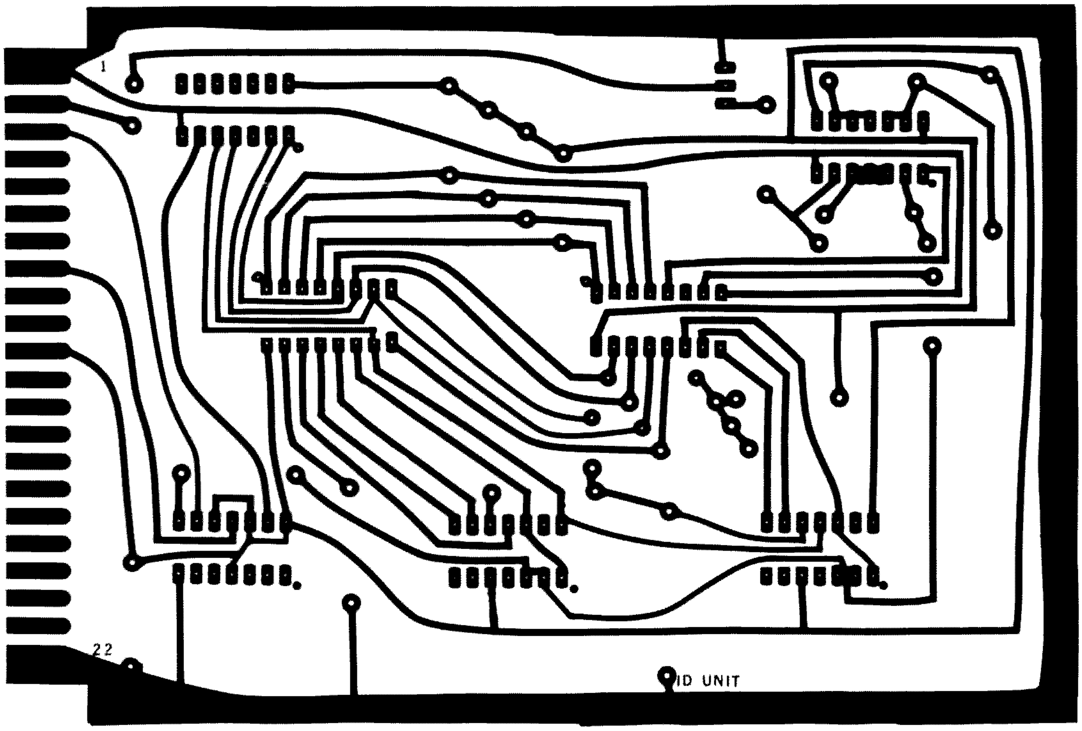


Fig. 4. PC board.

Hunt Hi Hi." I use a VHF Engineering 2 meter transmitter and a 555 timer to cycle the ID unit. With battery power, this unit can be hidden almost anywhere.

I will gladly correspond if you have any questions concerning this or any of the other articles I have written. Please send an SASE! ■

Reader Service—see page 195

Martin W. Krey K7NZA
7037 E. Chaparral Road
Scottsdale AZ 85253

The W7GAQ Key Collection

— 250 museum masterpieces

Do you have one he doesn't?

It could be the Smithsonian Institute or it could be little Foothills Junior College in California which houses the Lee De Forest collection— John Elwood W7GAQ isn't sure which, but one of these museums, or perhaps some other one in the United States, will one day be privileged to display the finest collection of telegraph keys in the world. John is devoting his retirement years to acquiring and restoring with almost unbelievable care as many different keys as he can possibly find. One day when he deems the time right, he will donate the whole collection to the museum of his choice.

John Elwood W7GAQ holds a small English spy key that he swapped for with an English ham. Three and one-half inch screwdriver shows the relative size of the tiny key.

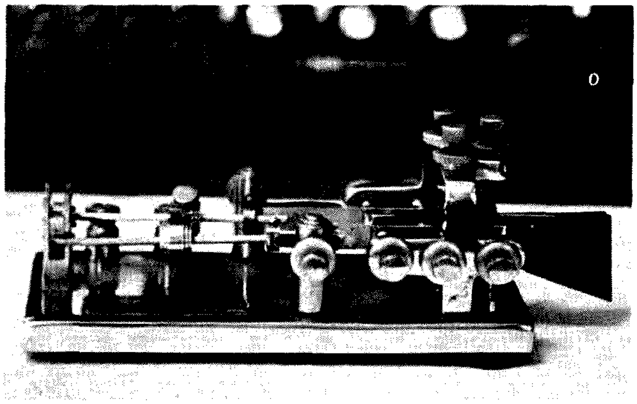
At the moment, John's collection amounts to 250 different types of keys, which he is quick to point out is not the largest collection in the world. But to this writer, who grew up in the atmosphere of the tool-and die-making trade, it is obvious that there may be no one else on Earth willing and able to spend as much as fifty hours cleaning, restoring, and polishing a key the size of a J-38, and more on a complex key such as an original Martin Blue Racer. John Elwood's keys look more like a modern elaborate sales display than an antique collection. He has been that deliberate and final in his restoration and care of them.

John was introduced to CW radio at the Army Air Force Radio School in Sioux Falls SD, in 1942, but it was several years before he got a chance to pound brass. He and his twin brother, Henry E. III, worked together running a control net system, VHF direction-finding station at Paine Field, Everett WA, in 1943. Then John went overseas with the 328th Fighter Control Squadron, 64th Fighter Wing, and for the duration of World War II he ran direction-finding equipment helping to get triangular fixes on disoriented fighter aircraft and vectoring them in to safe landings in Italy, Corsica, France, and Germany.

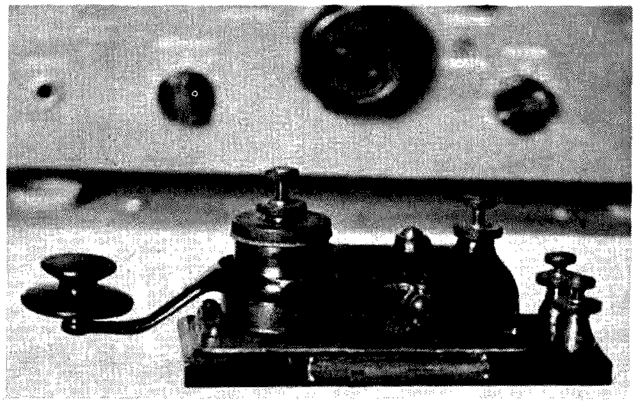
John finally got a chance to work CW as an operator in Panama, but he had to sign up for another hitch in the Air Force to do it.

"We were sent out to a place called Rey Island to work in an administrative net handling CW traffic back to Panama," John said. "It was great, and I knew I was hooked on CW for the rest of my life."

John worked CW in Greenville SC, and then got his best shot at concentrated CW operating in Operation Seminole, a joint Armed Forces field operation in Florida in 1947-48. Then he was shipped to England to operate CW at Burtonwood in the Midlands. All this time, the little contact machines that made CW communication



Melehan Valiant, made in the 1950s. This is a favorite key of John's, because you can set the vibrating arms for both dits and dahs, the dahs being three times as long as the dits. Then both dits and dahs are made by spring action.



This is a 1912 Flame Proof hand key manufactured by Machinery Division, Boston Navy Yard. The key is rated at 1-2 kilowatts. It is cast iron with brass hardware.

possible were facilitators to John. The charm of the little devices hadn't yet struck him.

The Berlin Airlift of 1949 taxed all parts of an airplane to the breaking point, radio equipment included. John was flung into a maintenance gap and had to foresake CW for a while.

"I worked my butt off repairing radio equipment on C-54s during part of the airlift," John said, "but as soon as I could, I switched back to operating CW and finished out the Berlin Airlift doing ground-to-air communication with weather ships over the North Sea."

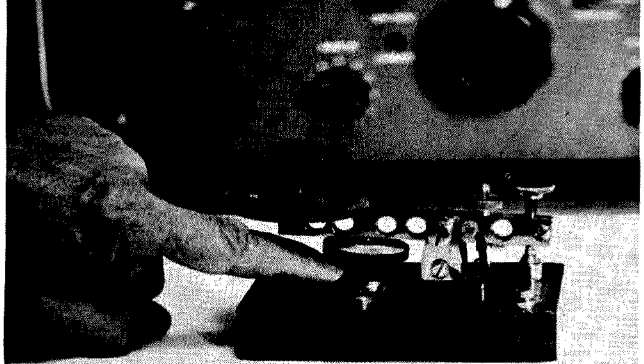
John wrapped up his Air Force career as ROTC radio instructor at Ohio University. Then he switched to the Federal Aviation Agency, from which he retired when he was Facility Coordinating Officer at the Los Angeles Air Route Traffic Control Center at Palmdale CA.

It was at this final duty in California for Uncle Sam that John finally got swept away by the charm of telegraph keys—and it took a woman to gather him up. Louise Moreau, now W3WRE, was living in California in 1971 and working CW with her WB6BBO call. Since she was a prime collector of telegraph keys, she responded to a call from the Lancaster Radio Club to speak about them. John sat in the audience and listened and found himself captivated by the love and enthusiasm that Louise expressed for her keys.

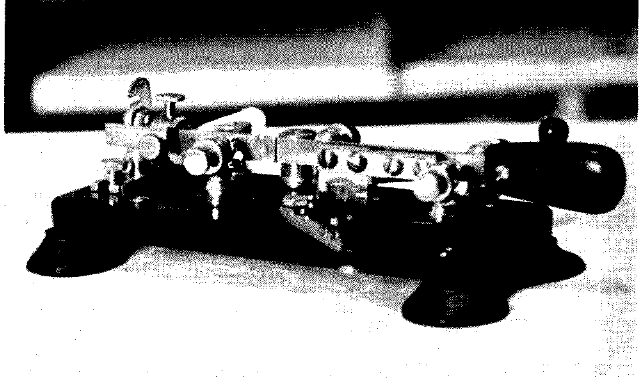
"She spoke with such excitement and interest," John said, "that I couldn't help wanting to become a key collector. When I left the room that night, I was a collector."

A friend gave John a big Japanese key and, as a gesture of fellowship, John cleaned it up in one of his now-routine fifty-hour restoration projects, drove down to Altadena, and presented it to Louise Moreau. Louise showed him her key collection representing twenty years of effort and encouraged him to get on with his own collecting. This he did, and he and Louise have been friends and correspondents ever since.

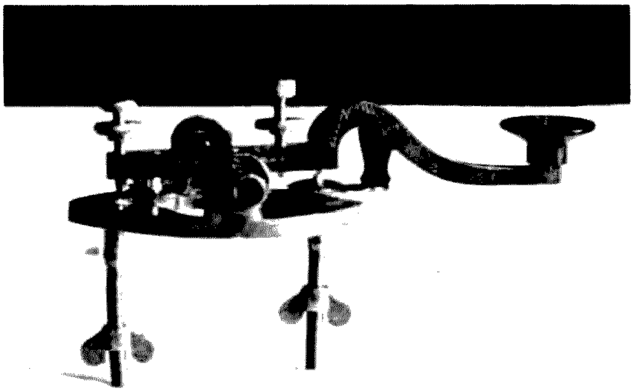
John's wife Edie bought him the first key for his own collection: a Boston Fire Alarm key which she got from J.J. Glass Surplus Radio in Los Angeles. John went to work on the key, soaking and scrubbing and polishing until every speck of foreign material had been removed. That key amounted to free rein for John. He hit the highway at every chance, scouring the whole of the west coast for telegraph keys. Edie caught the travel bug, too, and went on nearly every trip



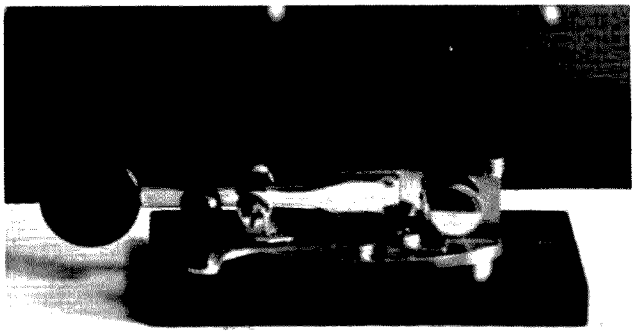
John Elwood's well-used keying finger points to oil well on the Ducrete and Roger (Paris) oil break key. Oil dampened the spark of spark gap transmitters. The key was a gift from Ed Rasner W2ZI, Trenton NJ. The gear in the background is John's R-391 Collins receiver.



This is a Signal Electric semi-automatic key that can be used as a sideswiper by dropping a locking arm over the vibrating arm and closing the arms of the contact terminals.



This G.M. Phelps "camelback" leg key is from the 1850-1860 era. The inventor, George M. Phelps, was the chief of Western Union at Utica NY. It was he who introduced the spring adjustment for this type key. Brass "legs" were inserted through holes in top of desk and the key was tightened down with brass wing nuts.



Here is a J.H. Bunnell & Co. "Sideswiper" double-speed key. It requires only half the movement of an ordinary key. Advertisements claimed it eliminated muscle cramping. John turned down $200 offered for this key when it was on display at the ARRL Convention in Hollywood. In the background is an RM18 US Signal Corps Type 5007A British Air Ministry control unit, part of the SCR-575 VHF/DF unit of the type John used in World War II.

with him.

"If you see any kind of antique store, junk shop, or radio store between Oceanside CA and Vancouver Island, Canada, that looks like it might have a telegraph key in it, we've been there," John said. "And we've dug up a lot of keys worth saving."

It wasn't long before John's friends heard about his key collecting and, respecting his zeal and purpose, they kept their eyes open for keys. About twenty of them have had the satisfaction of contributing to his collection.

Once, in Portland OR, John and Edie went into a little, out-of-the-way antique shop, and what they found made their trip a success. The proprietor told them he didn't know what he had, so they should go into the back room and take a look.

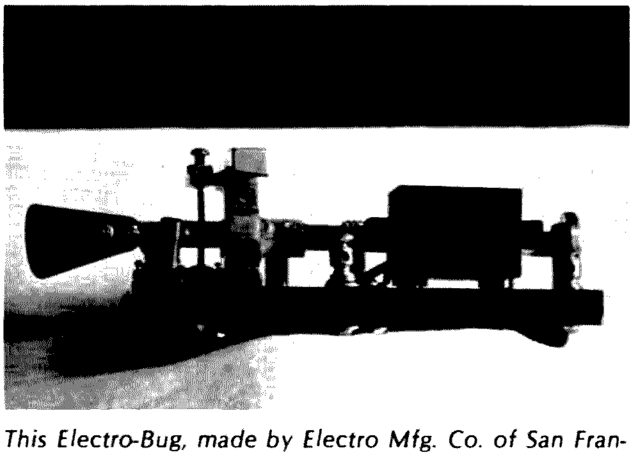
"We looked," said John, "and found big boxes with an antique radio station in them, cat's whiskers and all. But since I don't collect radios, we picked out two camelback keys and a Marconi wireless antenna knife switch built by Cross and Hines, and we bought them and left."

John wrote a friend in California about the old radio station, and the friend went up to Portland and bought it. He got an extremely rare Marconi loose coupler, a Clapp-Eastham one-half-kW spark transmitter and receiver, a marble base detector, a Colby loose coupler, and some United Wireless gear.

Once, at the Rose Bowl flea market in Pasadena, Edie, who John swears is clairvoyant regarding radio gear, had a strong feeling that this would be John's day. She was right. John found a man with a wooden box of telegraph gear for sale for fifteen dollars. Among the contents were a Martin Vibroplex, a Boy Scout training key, three Menominee leg keys, a Bunnell straight key, and four Bunnell sounders. John paid the man the fifteen dollars and picked up the box to leave.

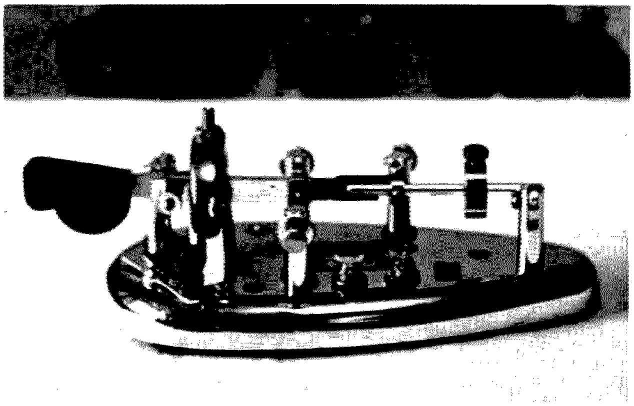
"Hey," said the man, "don't take that box. It doesn't go with that other stuff."

As collecting became more difficult, John began advertising in the maga-

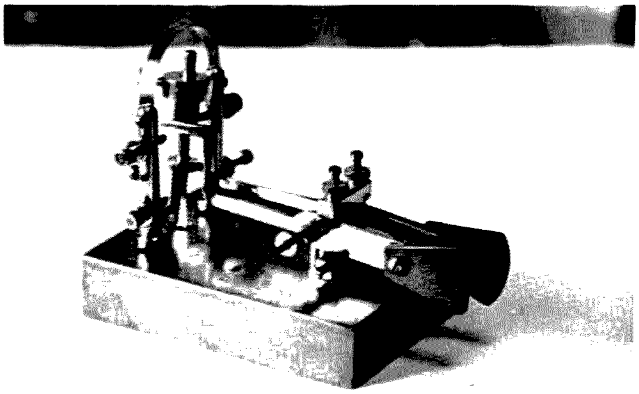


This Electro-Bug, made by Electro Mfg. Co. of San Francisco, has a line magnet and works like a doorbell buzzer, attracting the vibrating arm and then breaking the contact. "You can hold the paddle over and it will make dits all day long," says W7GAQ.

This Horace G. Martin Rotoplex key built for the US Army Signal Corps during World War II has a black crackle finish on a steel base and is mounted on a quarter-inch rubber mat.



This chrome-steel teardrop base semi-automatic key was made by T.R. "Ted" McElroy in Boston. McElroy is credited with the Morse code receiving speed record of 75.2 wpm set in a tournament at Asheville NC on July 2, 1939.

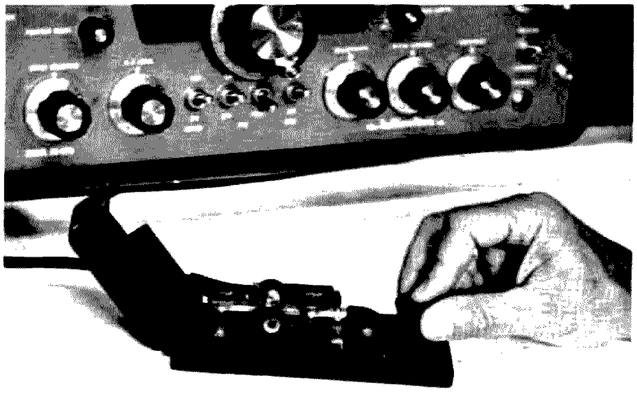


This is an Australian PMG vertical semi-automatic landline key made for the Postmaster General Department. The PMG controls all communications in Australia.

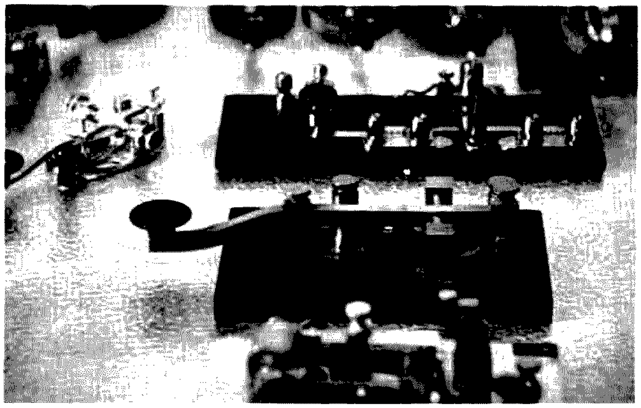
zines of England and America. Half the world reads English and American magazines. John found that the foreign countries have collectors, too, and they were interested in swapping keys. Since John had duplicates of some types, he made mail-order agreements with several hams and, as a result, he got some interesting German, French, and English keys. Recently he has made contact with a doctor in Belgium who collects keys, and they have worked out a mutually worthwhile swap agreement. One ham in Australia has traded nine keys to John.

When John gets a key that is in rough condition, he applies penetrating oil to frozen or rusted screws, nuts, and moveable parts. Once the parts have loosened, he disassembles the key completely and submerges all metal parts in carburetor cleaner to remove dirt and lacquer and get down to base metal. Then he makes a cleaning potion of one-third cup each of baking soda, white vinegar, and ammonia, and one cup of very hot water. He soaks all brass parts in this solution for twenty-five minutes, polishes them with Dupont chrome polish, washes them with soap and water, and dries them. Then he finishes up the brass with Happich Simichrome polish (German) and washes it with hot soap and water. On the steel parts, he uses steel wool, working down to four-ought grade. He uses taps and dies to restore threaded holes and screw threads. He has chrome- or copper-plated parts re-chromed or re-coppered. If a part is missing, he hunts for it until he finds it. Then he reassembles the key and puts it into his display case. Because of the time-consuming job of keeping brass keys polished, John is now thinking of coating them with lacquer.

John has an almost clinical attitude toward his keys—his patients. There they are in all their sparkling beauty. He has taken them in, analyzed their difficulties, repaired them, and stitched them back up again as good as when



Here is a German Baumuster T1 military key of the 1930s. "This is my favorite hand key because the adjustments are precise and the concave knob gives it a good feel," says John Elwood, who purchased the key from Louise Moreau W3WRE. In the background is John's Hallicrafters SX-101A receiver. That's John's precise fist in action.



The thick-base key in the foreground is the famous "Boston" key made by Class-Eastham Co. This key is called a "Cadillac Class" key of the spark era by Louise Moreau. The key was designed for luxury liners and the yacht trade, and every amateur wanted one. Behind it is a Boston Fire Alarm key, and to the left is a recent copy of the T.R. McElroy Professional Hand Model Key made by Daniel L. McElroy, grandson of the record holder, who is making them in honor of his grandfather. Out of focus in the foreground is a Mecograph semiautomatic key once headed for the Smithsonian until its owner, Howard Lorenzen W3BLC, heard of John Elwood.

they were created. Now it's time to think of them as healed. They are well again, and that's a fact. Now he must get on with the business of locating and repairing others. He feels he must be successful before collectors with only a monetary interest in keys have collected them and taken them out of range of the ham fraternity.

John wishes he could swap keys with more hams in this country and abroad. He'd especially like to get the miniature Bunnell key and sounder once used as watch charms. He'd also like to get a Vibroplex vertical bug. He never sells keys, though he has been offered as much as two hundred dollars for a small sideswiper key, but he will be happy to trade and will work out satisfactory trade agreements.

Not once did John speak of "my" collection. He seems rather to consider the keys as the property of everyone. His responsibility seems to him to be an almost sacred duty to get the keys and make them new again so that the world will be able to see them and know what pounded out man's joys, sorrows, successes, and failures during a century and a half of incredible progress in communication.

Also, John is preoccupied with that ultimate decision he will one day have to make: Which museum will display the keys to the best advantage and take the best care of them?

Whichever one he picks, that museum will some day find itself the keeper of a remarkable and interesting collection. ■

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Proper FM Transceiver Adjustment

—good club project

In search of the crisp signal.

Anyone who listens to the great number of rigs on two or six meter FM these days may wonder why there is such a great variation in the quality of signals they hear. One HW-2036 may sound clear and crisp, while the next may sound distorted, especially on audio peaks.

In almost 100% of the cases, the problem can be traced to either over-deviation or off-frequency operation, and sometimes a combination of both. Unfortunately, most hams are quick to notice low audio, but few seem to point out excessive audio.

If you have been active on SSB or AM, you may ask why these two items are so important to maximum range when using the FM mode. If you take a moment and glance at Fig. 1, we will try to show you.

Fig. 1 shows an FM transmitter on 146.520 MHz with a 1000-Hz audio tone deviating the carrier frequency ±4.5 kHz, and being received by a receiver with an i-f passband of ±5 kHz. (Please note that an i-f filter selectivity curve is not as sharp as depicted.) As one can see, the on-frequency signal, with its 4.5 kHz of deviation, fits perfectly through our i-f filter where it enters the FM detector and becomes a good clean signal at the speaker.

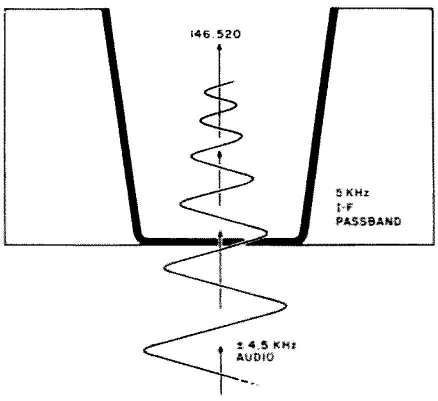

Fig .1.

Now let's move the transmitter off frequency by 3 kHz and see what happens. This may not seem like any amount of error to be concerned about, but look at Fig. 2.

Since the receiver discriminator, or some form of FM detector, only converts to audio what passes through the i-f filter doorway, one can rapidly see why a good signal can sound distorted when it's only 3 kHz off frequency. As Fig. 2 shows, over 60% of the transmitted audio on the high side is being chopped by the filter and over 60% of the low-side audio is attempting to be detected on the high side of the carrier frequency. As a result, audio distortion occurs.

You may ask why a weak off-frequency signal is more noticeable than a strong local signal. The true selectivity curve of the i-f is such that strong signals brute-force their way through the filter, thus not affecting the audio quality as much. The selectivity of the receiver is directly proportional to the strength of the signal being received. This does not mean that if you are close to the repeater your frequency is not as critical. Remember, your off-frequency signal could be affecting the user of the next channel up or down.

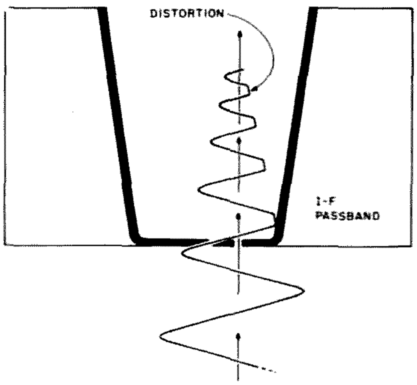

Fig. 2.

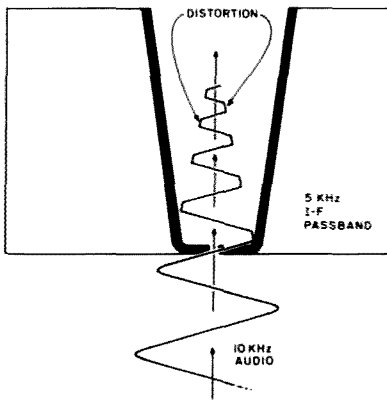

Fig. 3.

The only solution to the above is to adjust your transmitter back on frequency, or reduce your deviation 60% by backing away from the mike. The latter is only a poor temporary cure.

Deviation

Since the receiver i-f passband can accept only those signals that transmit within its 5-kHz limits, we must make sure the transmitter does not exceed this amount.

If you look at Fig. 3, it is very apparent why over-deviation (±10 kHz) will produce highly distorted audio.

At a recent tune-up session at the Kitchener-Waterloo Amateur Radio Club, some rigs were found to be deviating in excess of 15 kHz. If you visualize this amount of audio trying to find its way through a 5-kHz filter, it is no wonder why some signals were almost unreadable prior to the tune-up clinic.

With the number of repeater frequencies already used in the Metro areas, the repeater councils have adopted a plan to split the channels and create new ones every 15 kHz, thus placing a new repeater pair between each existing one. Because of this split, it is rapidly becoming very important that our deviation be kept at 5 kHz maximum.

Fig. 4 shows what happens when an over-deviating signal is placed on the air adjacent to one of the new channels.

This same adjacent channel interference can occur if the transmitter is off frequency, since it allows part of the signal to fall into the passband of the receiver using the next channel up or down.

The new band plan adopted for use with these new split or "tertiary" frequencies will minimize some operator error in the following way. All *new* frequencies *above* 147.000 will use low inputs and high outputs (reverse of the standard high in, low out). This will mean that off frequency and over deviation on a repeater input will not bother the adjacent input, only the output, so you will only get pins in your coax from your neighbors, not the complete repeater group. This will put all repeater operators in a position where they will be forced into keeping the peak deviation below 5 kHz and off-frequency operation to less than 1 kHz. If they wish to meet current DOC (Department of Communications, our FCC) commercial specs, they should keep within 5 ppm or 735 Hz at 147 MHz.

Don't feel you will have to run out and buy a new super-selective rig with these new splits. They will be issued about 50 miles away from adjacent channel repeaters and should not cause a problem except on the older wideband rigs. Current DOC guidelines are 35 miles between tertiary frequencies, with some as close as 5 miles with no interference problems, so don't get upset about the new splits.

Frequency Adjustment

The best method for frequency adjustment is, of course, with a counter capable of 150 MHz. A counter capable of only 10-15 MHz can also be used by reading the actual oscillator frequency and calculating the frequency by multiplying by the number of times the rig multiplies. For example, a GE Prog Line using a 6-MHz transmit crystal would have an oscillator frequency of 6.1050 MHz when producing a 146.520 output.

If no counter blesses your ham shack, have a local ham lend you his receiver that is known to be on frequency and uses a discriminator for FM detection. This type of detector, when properly aligned, produces a voltage relative to "0", either positively or negatively proportional to the amount of off-frequency operation. You simply adjust your transmitter trimmer until the discriminator reads zero on the meter. A lot of the new rigs use ratio detectors, or quadrature detectors, which cannot be used to determine receive frequency unless it is beat against an accurate i-f frequency generator, e.g., 10.7 MHz.

Another method to use if no counter and no receivers with discriminators are available is to transmit a very weak signal to a known on-frequency receiver. Simply adjust your trimmer while talking into the mike. The point where your audio has the least distortion should be very close to frequency.

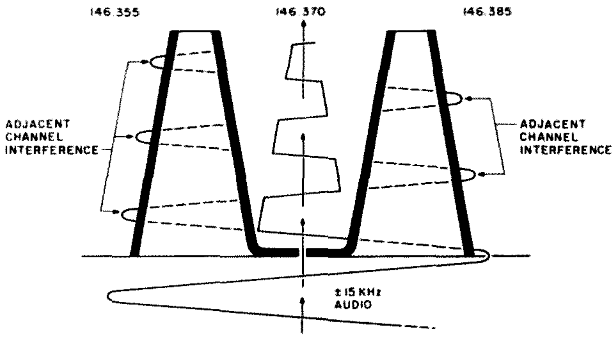

Fig. 4.

Deviation

Deviation is normally set by the factory before shipping. Unfortunately, 90% of the rigs that get on the market appear to be set at 7.5 kHz. Almost all users of these rigs sound much better when they back off from the microphone. As we all know, within a couple of transmissions, we tend to crawl back into our normal mike habits. The only solution is, of course, to adjust the deviation as set out in the manufacturer's instructions.

To set this control properly, one needs a calibrated deviation monitor which very few hams, including myself, own. The next best way is with a weak signal into an on-frequency receiver, adjusting the deviation for best audio. Have the person adjust his squelch at threshold with no signal. When you transmit, try whistling. If the squelch closes, you are exceeding the bandwidth of the receiver and should back off a bit until the squelch does not close on peaks. It is very important when using this method that the signal be just full quieting, .7-1 uV.

The commercially accepted level for adjusting FM deviation is 4.5 kHz of audio. This is measured with a 1000-Hz tone driving the transmitter audio limiter stage into limiting.

So, as you can see, one does not have to mortgage the house to invest in test equipment in order to have a good-sounding signal on 2 meters. Most of these adjustments, if set once, require very little attention. Because of this, there are many generous hams who have the equipment and don't mind helping out a ham in trouble. ■

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Dual-Band Smokey Detector

—Super Scooper does it all

The battle goes on.

The "Smokey Detector," described in the 1976 Holiday issue of *73*, has been the subject of much mail received at W1SNN. Many have asked if it could be used on the higher frequencies found with newer types of radars which have been designed to improve entrapment techniques and decrease confidence in Smokey Detectors.

The author has learned of new methods used to deploy obsolete police radar along highway ranges used for surveillance. Newer radar is used in conjunction with this method, which is known in police circles as "seeding." The older radar units are set up and left unattended so that they "illuminate" stretches of highway for many miles—depending on the number of "seeds" that are used. Most of those units operate on 10.525 GHz in X-band.

The newer radars, usually operated from a fixed position, are hand-held and triggered only when the device is pointed at a particular stream of traffic. The purpose of seeding is to keep the Smokey Detectors activated and, therefore, cause drivers to slow down. Confidence is soon decreased in the Smokey Detector, however, and the unsuspecting driver is trapped by the hand-held device. Yes, it works on X-band, too, but too late for a detector warning because the speeder has moved right into trigger range.

But that isn't the only technique used. How about this one: As before, seeding is used. Radar which has been designed to be used in vehicles while moving is employed. These units have a device that arithmetically removes the vehicle speed, allowing the officer to pursue and record the speed of the car being chased. Here again, the police car can depend upon the seeds to keep Smokey Detectors operating, and even when the police come into range of vehicles using detectors, they can follow without detection. The new radar operates in the K-band region. Most of the older radar detectors will not receive at this frequency range; again, confidence is lost.

These techniques are used by large municipalities and state agencies for the most part. They can afford to maintain the antiquated equipment for seeds. Others will be adopting them, however, because of newer seed equipment that is being manufactured by several companies at prices which can fit smaller budgets. The newer units are simply a small oscillator and battery supply. The oscillator will feed an antenna that floods an area with the oscillator's signal. They can be left unattended, fastened to street signs and stop-go signals. Other radar units that promise greater control for police agencies are in the works; the war is still on.

What can we do with our radar detectors? Well, we can update them to detect the newer frequencies and learn how to use the older ones to be sure that we are detecting an active radar and not a seed. It is not too hard to manufacture detectors that are sensitive enough to detect a seeding and radar entrapment, and thus provide a warning that both are being used, or to warn that just a higher-frequency moving radar is activated. Look at the block diagram of a dual warning system which accompanies this article.

A circularly-polarized horn coupled to a circular waveguide is coupled to a pair of crystal detectors. The detectors are mounted in cavities which support the frequencies of interest. The larger of the two cavities is tuned for the X-band frequency, 10.525 GHz, while the smaller one has a step ridge mounted into its E-plane coordinate. The step ridge performs as a tuning device that allows the smaller of the two cavities to work over the 16.5- to 26.5-GHz range. There are several frequen-

cies used in this range for hand-held and moving-surveillance radar units.

Coupling to the circular waveguide is accomplished by careful placement of the two detectors which are mounted in rectangular waveguide to provide coupling to the circular mode.

Two preamplifiers, one for each waveguide-mounted detector, amplify the signal—which is the dc component of the detected signal. The amplified signal is passed through a CMOS switch which serves as a signal modulator.

Each of the switches has its own driving oscillator. An oscillator at 1 kHz modulates the X-band-detected signal, and another at 400 Hz serves as the K-band signal modulator.

The outputs of the two modulators are summed at the input of an audio amplifier that drives a loudspeaker.

The resulting warning signal will be two-toned when both X- and K-band radar units are detected. If just the X-band detector is activated, the higher-pitched tone of the 1-kHz oscillator will be heard. Likewise, the 400-Hz signal will be heard when a K-band signal is detected. When both are on, it is very likely that you are in an entrapment area which is well seeded. Beware when the higher-pitched tone stays on for long periods. If it is on for over 4,000 feet of driving, you are probably in a seeded area. If the signal continues, slow down and watch for your friend in blue.

The circuitry illustrated here is straightforward audio construction and can be built on a small board using flea clips or wire-wrap. No special attention is required. The completed board must be mounted so that the leads that connect to the detector outputs are short—that is, not over six inches long. Several adjustments to the electronics are required and will be described below.

The hardest part of the construction of the Super Scooper is its antenna and circular waveguide. In the original Smokey Detector article, instructions were given on how to construct the horn antenna. This was the subject of many inquiries both as to its beamwidth and gain and relative to variations from the given dimensions. First of all, the gain of the antenna is approximately 14 dB over a reference antenna that provided a 3-dB gain standard. The gain standard was determined in a laboratory using a section of circular guide terminated in a matching impedance to a standard signal generator. A similar antenna was used with a detector and spaced one meter from the generator gain standard and three meters above the ground. Once a level was determined by setting the signal generator attenuator to produce a full-scale deflection on the detector indicator, the new antenna used on the Super Scooper was substituted for the transmitting horn, and then the attenuator was readjusted to produce the same full-scale reading as with the reference antenna. The attenuator difference was 14 dB at 21 GHz and 17 dB at the X-band frequency.

Since most amateurs will not be able to duplicate these dimensions, a pattern shown in the drawings has been laid out so that it can be closely duplicated. Several antennas were constructed and measured, and variations from the values given were not worth mentioning. The dimensions were deformed

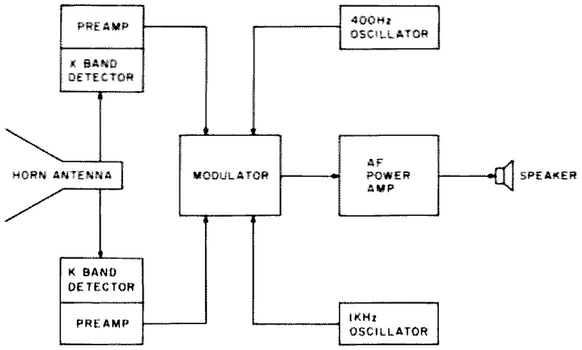

Fig. 1. Block diagram, Super Scooper Smokey Detector.

from true circular to a shape which occurs when the seam is soldered. Not a true circle, the variation in gain wasn't worth the trouble to measure. It is apparent that that would take quite a departure from a true funnel shape.

The beamwidth was measured, and it required a considerable amount of time to determine that it was a circular beam of 9 degrees. Variation from a true funnel shape does distort the beam considerably, so care in achieving the cone shape should be exercised. The beamwidth was measured on an antenna range at the same laboratory, using a quality of range equipment probably not available to most amateurs. A nine-degree beamwidth is very similar to that of most circular antennas used on police radars and should intercept most radiation from them.

To construct the antenna, it is necessary first to acquire a piece of copper flashing sold in most hardware stores. (Brass can be used but should be thin so that it is easily worked.) The sheet should be at least 10″ x 6″. With a compass, lay out a 9-5/16″ circle and, from the same center, scribe the second ½″ circle. (See the drawing.) Outside of the circle leave enough metal so that the tooth-like section can be cut and bent. Cut the sheet with tin shears and flatten out all bends and dents acquired in the cutting procedure. Make sure that the tooth-like cuts are bent at right angles to the sheet, and then lay it aside.

Next acquire a piece of construction paper with the same dimensions as the flashing sheet. Lay out the same dimensions as before, but forget the tooth-like part—just cut a smooth ½″ half-circle. Cut out the complete sheet so that it can be glued at the seam tab. Now you should have a cone that has a mouth 3¾″ in diameter and a length of 4-1/16″. The opening at the rear should be about ½″ in diameter.

Make up about two cups of plaster of paris that is nearly dry but easily molded, and fill the cone so that a substantial amount of it protrudes from the ½″ hole. Shape the plaster so that the cone is as rounded as possible, and set it aside to completely harden. This form will serve as a mandrel for the metal horn when soldering its seam. Simply bend the metal around the form and hold it in place with rings placed at several points on the cone. Solder the seam. Shape the metal and set it aside until the circular guide is finished.

The circular waveguide is made from a section of ½″ water pipe 3″ long. Lay out the dimensions shown in the drawing. Measure up along the outside

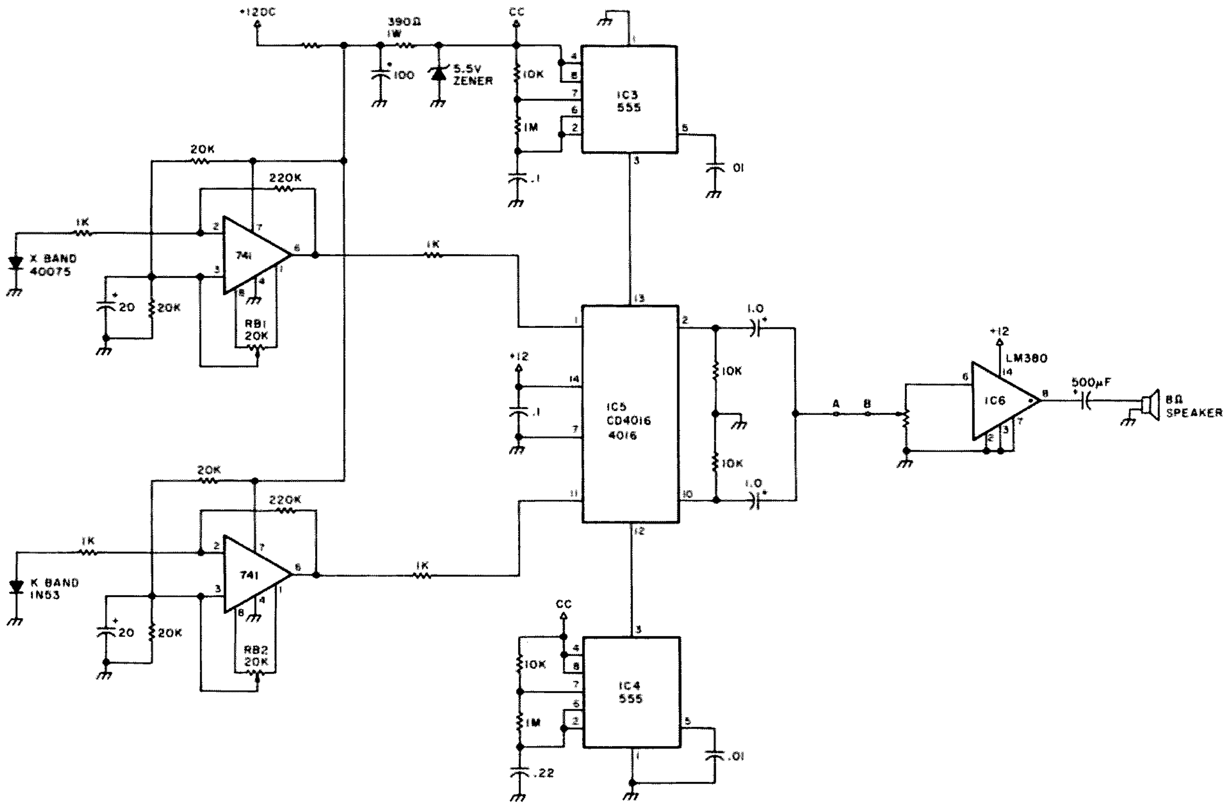

Fig. 2. Schematic, Super Scooper Smokey Detector.

of the pipe and make two marks to indicate the width of the cuts. They will be .250" wide and will support the K-band waveguide when soldered in place. Make this cut so that the .250" x .500" guide sits in place in such a way that edges of the guide mate with the H-plane walls of the K-band waveguide. Remove all burrs. (The cuts are easily made with a hacksaw, but can be better if done by a friendly machinist and a milling machine.)

No other cuts are needed in the circular waveguide, but its length is very important. The ends should be square and free of burrs. It also would be to your best advantage to clean the pipe inside and out with steel wool so that solder will easily tin the metal. Set the circular waveguide aside for now, and proceed to drill the holes in the E-plane dimension of each waveguide section.

Lay out the holes on the X-band guide as shown in the drawing. The crystal detector mounting for the 40075 X-band detector should be a 3/16" drilled hole on the centerline of the E-plane. Mark a point 11/16" from the smoothed end of the guide. Carefully centerpunch a point for the drill and drill through both walls of the guide. Open one hole to 5/16 of an inch. Place a section of 3/16" pipe or tube, 3/16" long, into the other hole.

(This pipe is found in most model shops; it is brass tubing used in model construction. If you try to buy it at a metal dealer you will pay for a lot more than you need since there it will be a one-foot section you will have to purchase.)

Solder this small piece in place so that it is just even with the inside wall of the X-band guide. This serves as a connection for the small end of the X-band diode. Now lay out the other two holes in line with the 5/16" diameter hole, drill them, and tap for 4-40 threads. Next, drill holes located 3/4" from the B tuning hole through both walls. Use a #36 drill. On the same side of the guide wall as the detector holes, open the #36 hole to a 5/8" diameter. Tap the remaining #36 hole for 6-32 threads. Deburr the hole inside and out. This hole is used to couple the circular guide to the X-band detector. Mount two 4-40x½" brass screws in the holes marked B and C and use nuts as locks for these screws. A ½" brass 6-32 screw and nut is used for the same purpose at point A.

Next, lay out the hole required on the K-band waveguide. This hole must be on the centerline of the E-plane side of the waveguide. Very carefully centerpunch a point 5/16" from a smoothed end of the guide, and at this point drill a .187"-diameter hole through one wall of the guide. Deburr on each side of the hole, as on the X-band guide. Mount a ¼" long piece of copper tube .250" in diameter. The ends should be deburred inside and out. This piece of copper serves as the outer part of a capacitor and choke for the K-band 1N53 detector diode. The copper tube and the diode are coaxially mounted, so it is necessary for the tubing to be aligned so that the hole in the guide is exactly in the center.

The next step is to lay out the 1/8" thick piece of brass which will serve as the step ridge for the K-band waveguide. Lay out the steps, cut with a hacksaw, and smooth with a file. The steps are set so that the bandwidth of the K-band cavity is quite broad and will cover many of the frequencies used by K-band radar. Departure from the dimensions given will decrease the sensitivity of the Super Scooper, so

try to stay as close as possible.

Next, in the middle of the second step from the top of the structure, drill a hole with a number 60 drill. This hole must be on the centerline of the step, and fall 5/16″ from the end of the structure so that it will align with the hole in the waveguide when the structure is in place. Remove the center conductor from a BNC chassis jack (UG-1094/U). Cut off the solder section so that the pin is .250″ long, and file it smooth. Insert the cut end into the number 60 hole and carefully solder into place. (Take care that solder does not fill the flutes on the opposite end.) This pin serves as the connection to the center conductor of the 1N53 diode—a coaxial diode that has a pin connection.

Slide the step ridge section into the waveguide so that the pin is in the center of the .187″-diameter hole. This ridge section must lie on the center line of the inside (E-plane) of the guide. (It may be held in place by wood wedges while it is soldered on the bottom to the waveguide wall.)

Now solder the X-band and K-band detector mounts in place. The 2″ circular waveguide should be inserted into the 5/8″ hole drilled into the X-band guide. The pipe should be just through the waveguide so that it is parallel with the inside wall of the guide. Solder in place. Also solder a ½″ x 1″ cover plate on the open end of the guide. Install the K-band detector mount and solder in place. Add a cover plate to the open end of this mount, also.

Now slide the horn over the end of the pipe and press down the tooth-like flaps so that they lie flat on the pipe. Match up the end of the horn with the end of the pipe and solder the flaps to the pipe. Use solder sparingly on the inside joint and make it smooth and clean, but build up the solder on the outside to strengthen the joint. Gussets may be added to the outside of the horn and pipe, if desired.

Install the X-band diode by first slipping over the diode a ¼″ solder lug and a ¼″ shoulder washer. The shoulder should face the small end of the diode. Install a 1N53 diode in the K-band mount by first wrapping the diode outer sleeve with one wrap of Saran Wrap, which serves as the dielectric for the choke capacitor. (For the purist: Use a single wrap of 1 mil mylar™.) When this diode is installed, it should be pushed into the mounting hole carefully so that the insulation is not scored. The center pin of the diode should engage in the hole of the pin jack mounted on the ridge. A diode clip should be used to connect to the shank of this diode where it protrudes from the copper tube. Use a razor blade to cut away excess Saran Wrap or mylar™ so that the clip can make contact with the outer diode sleeve.

The diodes may now be connected to the points indicated on the schematic diagram. Care must be used in making these connections. Be sure that there is no power in the circuitry. Do not solder to the diodes; solder to the lug—and then only briefly for the X-band detector diode—and do not solder at all on the K-band diode. Use a diode clip *or make a* small clamp that contacts the diode sleeve.

Assuming that all of the electronics has been constructed as shown in the schematic diagram, it is now time to test individual circuits.

The input circuits to the LM380 audio amplifier can be used as an audio circuit tracer by disconnecting the jumper marked AB at the input of the volume control. Connect a .01 capacitor to this point and use it as a probe to detect the 1-kHz tone at the output of IC3, pin 3. Be sure the audio volume control is half open, as the tone should be present at this point. Also, you should be able to detect a 400-Hz tone at pin 3 of IC4. If this test checks out OK, reconnect the jumper at AB. Now, probably, you will hear both tones. If so, disconnect pin 3 of IC4 and adjust balance pot RB1 so that the tone nulls out. Reconnect pin 3 of IC4 and then adjust balance pot RB2 until the other tone disappears. This completes the electronic adjustments.

The rf adjustments require the use of two signal generators, or your friendly police car. Apply a signal to a horn, or other radiator, from an X-band signal generator, point the Super Scooper antenna toward the generator, and use a fairly strong signal from the generator. Adjust tuning with screws B and C alternately for the strongest tone from the speaker. To use an indicator, connect an ac voltmeter across the speaker leads and adjust the screws for the greatest output. Now turn off the X-band signal generator and radiate a signal from a K-band generator at 24.5 GHz toward the Super Scooper. Adjust screw A for the strongest signal.

The adjustments are now complete, and so off to the highway! You may find that radar used at airports and military bases will be detectable. These units are putting out very strong signals and will saturate your Super Scooper. It will take only a very short time to learn how the Super Scooper works.

No description of the packaging of this device is given here. It is sufficient

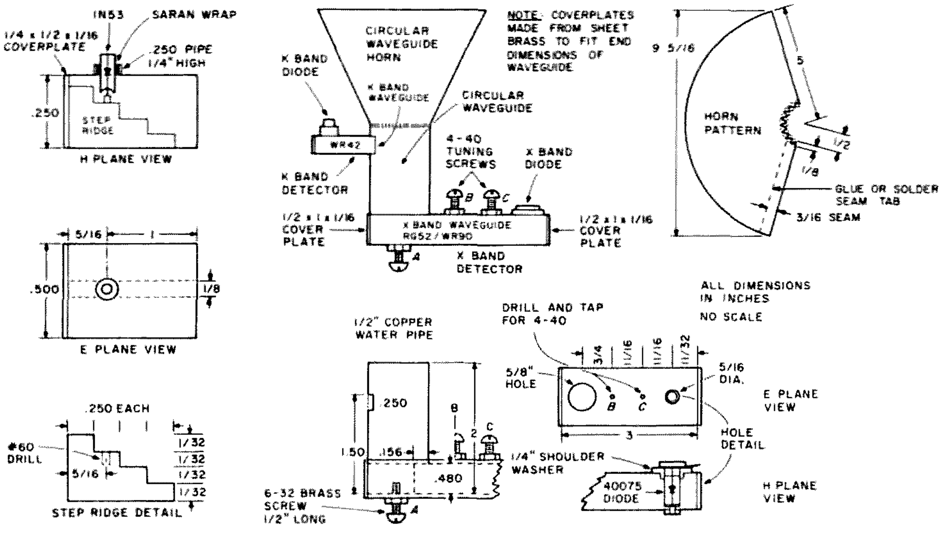

Fig. 3. Super Scooper Smokey Detector, construction details.

to say that the whole device can be enclosed in a plastic package—including the horn antenna. It is better to keep these devices out of sight, since confiscation of them does occur in several states. My unit lies on the dash, looking through the window. It is not a pretty device and does not look like much more than a batch of pipe and a funnel. Eventually, I will enclose it in a fog light to be mounted on the front bumper.

The diodes used are available from several microwave semiconductor manufacturers. Most of them cost too much for the average constructor, so the best bet is to get them through distributors. Names of manufacturers who supply either direct or through distributors appear in the reference at the end of this article.

The requirements for signal generators to tune up this unit must be left to your ingenuity. The possibility of tuning up on police vehicles is not too great, but it is a possibility. If generators are not available, it always is possible simply to try out on the road in hopes that you will find a seed trap to tune up on. Or perhaps you could build a generator. In any case, lots of luck! ■

References

"Mobile Smokey Detector," S. M. Olberg W1SNN, *73 Magazine*, Holiday issue, 1976.

"A Complete X-Band Transmitter," S. M. Olberg W1SNN, *73 Magazine*, August, 1978.

Note: Microwave diodes used in this equipment are available from Alpha Industries, Sylvan Rd., Woburn MA 01801, Parametric Industries, Inc., 742 Main St., Winchester MA 01890, and Microwave Associates, South Avenue, Burlington MA 01803.

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The DXer's Secret Weapon

—costs you nothing

Chart your way to DXCC.

Having recently (finally) received QSLs from all fifty states and applied for my WAS award, I began thinking of other goals to pursue. DX came to mind.

I have been a ham since 1956, but, until a few months ago, I had never given much thought to working DX. From 1956 through about mid-year last year, my total DX was probably less than a dozen contacts (including XEs and VEs)—not an impressive record for some twenty years of casual hamming. Which brings us to my first observation about DXing:

Casual hamming does not produce DX contacts!

"So," I said to myself, "you gotta get serious if you are going to work DX."

Let's see—probably should get a linear so I can run a kW with the big guns. Gonna need a beam to replace my forty/fifteen meter vertical and that means a tower with a good base and heavy-duty guy wires. Oh yeah, some coax, some connectors, etc., etc., etc. Good grief! Getting serious about DX is going to run me into serious financial problems! There has to be another way!

After some head-scratching and a little reading in back issues of ham magazines (mostly *73*), I came up with a secret weapon for DX. With this secret weapon, my DX contacts went from a dozen or so in twenty years of hamming to seventy-four in a period of less than six months (*not* counting XEs and VEs)! If I had been making DX contacts at that rate during my previous twenty years on the air, I would have (can you believe it?) 3,040 DX QSOs to my credit by now. DXCC, here I come!

"What's the secret?" you ask. "How can I get one?!" you continue. Well, you are in luck. I am going to share my "secret weapon" with you for exactly what it cost me—nothing.

That's right, my weapon (shown in Fig. 1) cost not one red cent.

"You gotta be kidding," I can hear you saying, "that's nothing but a chart showing times in various

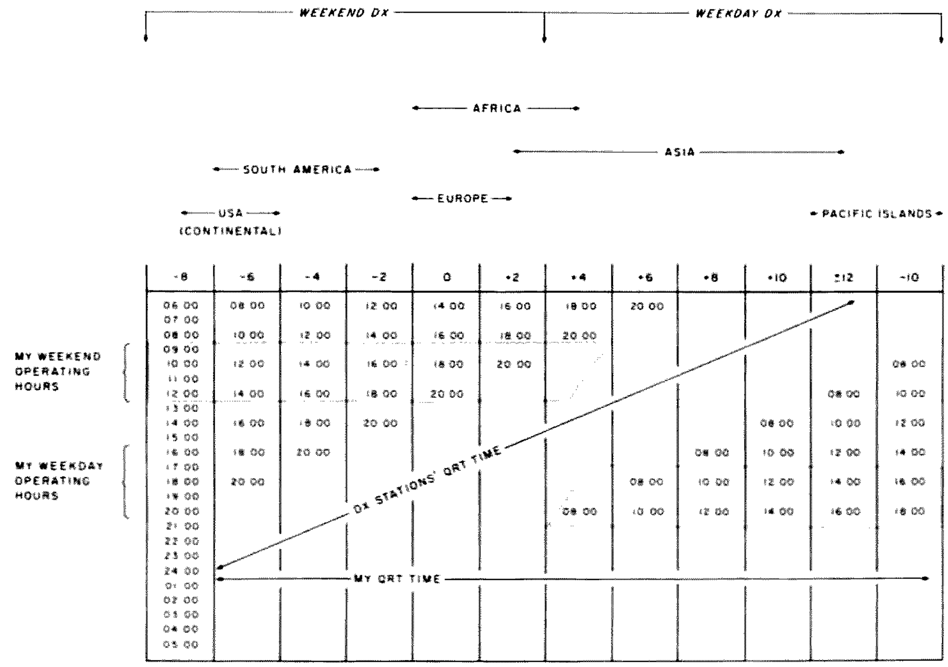

Fig. 1. Shaded areas show DX windows for my usual operating times. See text for details.

places around the world." You got it right!

I am sure that my secret weapon is no secret at all to those guys who have DXCC certificates hanging on their walls, but, for those of us who are DX novices, it can be a real discovery.

"Okay, how does a time chart help with DX?" you ask (if you are one of those who do not already know).

"Glad you asked that," I answer.

While trying to think of low-cost ways to improve my DX abilities, I reasoned that one requirement for working DX is that there have to be some DX stations on the air for me to contact. "Elementary, and obvious to the most casual observer," you say.

"Yes," I reply, "but they must be on the air when band conditions allow contact between their part of the world and my part of the world."

"So," you say, "when are DX stations likely to be on the air at the same time that the bands are open?" Your question can be answered easily, but first we have to make a couple of assumptions.

First assumption: Hams everywhere in the world probably have to hold some sort of jobs in order to buy the groceries and pay the electricity bill. Furthermore, they probably work about the same hours that you and I work: 0800 to 1700 local time, Monday through Friday. This being the case, they probably get on the air during the evenings and on weekends. (There are some DX hams who get on the air before going to work in the morning, and I salute those hardy souls and thank them for being there.)

Second assumption: The bands I work most—forty and fifteen meters—will probably be open from about 0800 to 2000 local time. I know that there are times when they stay alive all night, but these times have been rare in my experience, so I can't depend on that for DX. Besides that, I like a good solid eight hours of sleep every night.

Armed with these two assumptions (which have proven to be good enough to dramatically improve my DXing), I constructed a chart that shows my "DX windows" to various parts of the world. Here are some examples of how I have used the chart.

Let's suppose that I want to work England. Let's suppose, further, that my time zone is Pacific Standard, U.S.A. (which it is). Looking at the chart, we see that England falls on GMT (by definition). Based on my first assumption, the English chaps are going to be on the air from about 1700 to 2000 during the week. This period of time falls between 0900 and 1200 PST—right in the middle of my work day! This means that I must work Englishmen on weekends, which is exactly what I have done several times recently around 1800 GMT.

Here is another example. It has been very difficult for me to work Africa. Looking at the chart, it is easy to see why. Notice that there is only a two-hour window (1900—2000) during my usual weekend operating hours and no window at all during my weekday operating hours. It is obvious that I must get on the air earlier on weekends or stay on the air later during the week if I am going to improve my chances for working Africans. This illustrates how the chart can be useful in pinpointing DX problem areas.

Let's take a look at one more example. Suppose I want to work some DX on Wednesday starting at about 1800 PST. What DX will be available? The chart shows that Asia and the Pacific Islands will probably be in my DX window. This includes Australia, Japan, New Zealand, and Russia. I have found that the Russians get up early to get on the air, and the Japanese are on the air all the time (maybe hams don't have to work for a living in Japan!?). So, the chart says that I can work VKs, ZLs, JAs, and UAs after dinner during the week, which is exactly what I do.

I am sure you get the picture by now. DX is there to be had, and the secret is simple:

Be on the air when DX stations are on the air!

"Yes, but what kind of equipment does it take?" you ask.

Well, my experience has been that the average DX ham is equipped with a rig similar to mine: about 150 Watts input with a vertical antenna. Actually, most of the DX hams I work have better rigs than mine in that they usually have a beam of some kind. Which brings us to another observation:

For working DX, the next best thing to a time chart is a better antenna.

That is where my next investment is going. I figure that a better skyhook is the absolute best dollar investment I can make.

I don't know any big gun DXers personally, so I have not discussed my ideas about DXing with anybody who really knows how it's done. I do know that my DX count has gone up as a result of putting the chart together and using it. If you are a beginner at the DX game, it surely won't hinder you any. So why not *put* together a chart for your own time zone and give it a try?! ■

✓ Reader Service—see page 195

Foiling the Mad Kerchunker

—frustrate him with this circuit

How to give ulcers instead of get them.

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Repeater operators! Arise! Fight back! Show the cads you're in charge! Stop getting ulcers because some refugee from the world of little children is playing with his toy and kerchunking the repeater!

How do you feel about kerchunkers? Does the very first one get you down? Or does it take a few to wear on your nerves? Or can you stand it for hours on end? If you're in one of the first two groups, read on, but if you're in the latter group, take a ride on the Reading, and if you pass GO, collect $200—you deserve it for your patience. This article holds little for you except education about how grouchy much of the rest of the world is about kerchunking.

So what's a kerchunk? Almost everybody who has operated on repeaters for any length of time has a pretty good idea, but there are some who may not yet have been exposed to the VHF-FM equivalent of tuning up the HF-band rig on the air without any identification. It's a poor operating practice designed mostly to allow the kerchunker to see if the repeater is still alive. A more-or-less quantitative definition (one that is necessary for this exposition) of a kerchunk might be stated: "A kerchunk is an unidentified key-up (or transmission) of short duration on a repeater input frequency." Most kerchunks are well under one second duration.

With a decent definition of a kerchunk, we may now think about how to design a kerchunk detector on the repeater. Once you have the ability to detect these strange creatures, it's feasible to try to do something about them. What a guy cares to do depends heavily on the situation, but let's look at a few of the possibilities.

You can ignore them altogether if you can stand it. There is a minor question about the legality of continually repeating unidentified transmissions, but that's not the point. You can listen to the kerchunking for a short time and then shut off the repeater

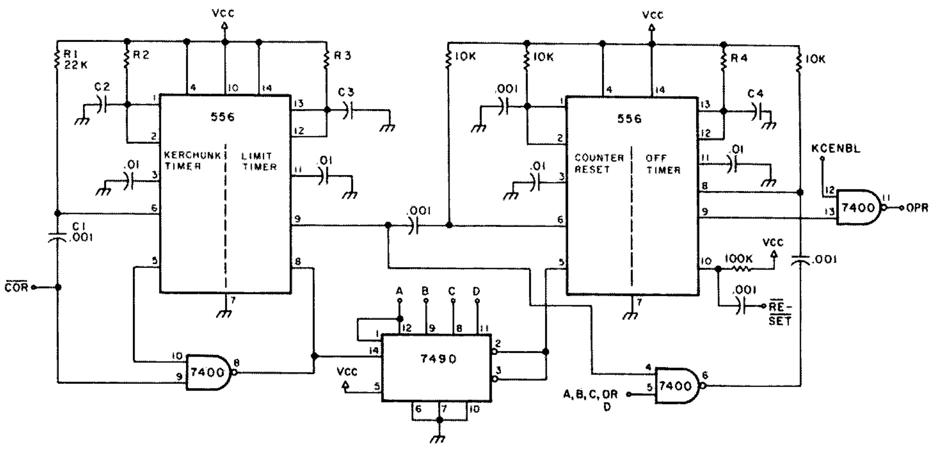

Fig. 1. Schematic diagram.

for awhile. This denies repeater access to everyone, of course, but could result in a certain amount of "peer pressure" on the guilty culprit(s). You could also, on the first kerchunk, measure the incoming frequency (assuming there's a discriminator on the repeater), and then lock out only those incoming signals near that frequency. This solution is still not ideal, but it is already quite difficult to implement unless you have a microprocessor-controlled repeater, so I have chosen the middle course.

Let's suppose, for purposes of discussion, that the control logic in your repeater is TTL-compatible. If not, you will have to use whatever level shifters that are necessary to make this true. Please note in the discussion that I have assumed certain stated active signal levels—yours may have to be inverted.

So, somewhere you have a squelch-operated control signal. I'm assuming that when the squelch is closed you have a TTL high, and when it opens you have a TTL low. Let me call this signal $\overline{\text{SOS}}$, for NOT Squelch-Operated Signal. The overhead bar, or the word NOT, means the active signal is a low. If we capacitively-couple $\overline{\text{SOS}}$ to the input of a 555 timer (or ½ of a 556), that timer will be triggered whenever the squelch opens, and its output will go high. If we NAND the output of the timer with the $\overline{\text{SOS}}$ itself, it's evident that if the squelch closes *before* the timer goes low, we'll get a TTL low out of the NAND gate. Thus we have a kerchunk detector—if the key-up is shorter than the timer period, it's a kerchunk.

I have chosen to do two things with this signal. It increments a counter and starts another timer, which I'll call the limit timer. When the limit timer's period is up, it triggers a third timer which then issues a short reset pulse to the counter. We clearly don't want to shut off the repeater because it was kerchunked once on each of four consecutive days!

However, the output of the limit timer is also NANDed with any one of the four outputs from a 7490 decade counter. If the one output is chosen, only one kerchunk is needed to cause the output of the NAND to go low. If the two, four, or eight output is chosen, then it will take two, four, or eight kerchunks *during the limit timer's period* to cause the output of the NAND gate to go low.

This signal is capacitively-coupled to still another timer, the off timer. This timer gets set when the NAND goes low, and its output stays high during its period, which may be anything you like. I have NANDed this timer's output with a TTL control signal I've called KCENBL (*K*erchunk Circuit *EN*a*BL*e). This is a signal that must be provided by your control circuitry to enable (high) or disable (low) the anti-kerchunk circuit. If you don't want to mess with this sort of thing, just tie that pin to Vcc through a 1k resistor so that the circuit is always on.

The output of this gate might be called OPR, for *OP*e*R*ate. When this output is high, the repeater is allowed to go on and off freely with the squelch, and when the output is low, the repeater is disabled. If you need the opposite polarity to disable your repeater transmitter, it's easy enough to run this signal through an inverter. Note that the fourth NAND gate in the 7400 can be used as an inverter for either the input or the output signal, if necessary.

There is a desirable fourth connection to your repeater-control logic, called $\overline{\text{RESET}}$ (NOT RESET). A TTL low on this line will reset the off timer to zero, independent of how long it has been on (the repeater has been off). This allows a control operator to immediately defeat the anti-kerchunk circuit without disabling it.

Some of you are undoubtedly griping that I did not consider part of my definition of a kerchunk when I designed this circuit. I said a kerchunk is an unidentified key-up. So, in reality, one should check to see whether or not audio is present on the signal before assuming it's a kerchunk. I chose to ignore this aspect because I felt it was not all that important, it would be easy to defeat with a Bronx cheer, and the timing of the kerchunk detector I used is so short that it is unnecessary. If you have read this far you probably have the knowledge to add audio detection if you want. That first gate could be made into a three-input NAND gate and appropriate audio detection circuitry added.

The component values given in Fig. 1 are recommended as a first try and should be satisfactory if you are actually using TTL logic. R1 and C1 may have to be increased to give more reliable triggering if $\overline{\text{COR}}$ is not a good square wave. R2 and C2 form the time constant for the kerchunk detector, which may be anything you like within reason. Choose the Rs and Cs for the timers by the formula $t = 1.1\ R\ C$, where t is the desired time in seconds, R is the resistance in Ohms, and C is the capacitance in farads. My version defined a kerchunk as a key-up of less than about 200 ms, so any audio present is essentially irrelevant.

R3 and C3 define the limit timer period. I chose a value of around 30 seconds, but almost any reasonable period that strikes your fancy is OK. The reset timer period is 10 microseconds and should be adequate for any TTL counter.

How long do you leave the repeater off? R4 and C4 determine this length of time, and I chose five minutes as a reasonable off period.

It is desirable to use good engineering practices when building any logic circuit, particularly when it will be used in what might be called a hostile environment. Be sure to do proper bypassing and shielding, or glitches will be your companion-control operator! Mechanical relays somewhere ahead of the circuit could easily have contact bounce problems that would make *any* transmission appear to be a series of fast kerchunks.

There are two problems I see associated with the use of this sort of thing. It is not desirable to deny everyone the use of the repeater just because someone is discourteous to his fellow amateurs. Some of the worst offenders are likely to get their kicks by using this device to shut off the repeater so others can't use it! It is also undesirable to have a repeater "kerchunked" off by a fluttering mobile signal. Neither of these problems is easily solved unless a microprocessor logic element is available—but that's another story.

I would like to thank Bob Cowan K5QIN, trustee of the Los Alamos Amateur Radio Club repeater (WR5ABU), who kindly permitted a shakedown cruise of this circuit, and the club members and repeater users who put up with the whims of a guy who wanted to see if anything short of murder could effectively discourage kerchunking. Remember CRANK: Courteous Radio Amateurs Never Kerchunk. ■

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Trends in Surplus

—it's not what it used to be

Don't give up hope.

Radio amateurs reaped one of the first big benefits from surplus electronics. This bonus first appeared after WWII, when there was lots of surplus military equipment on the market, and lasted well into the fifties. Many of the rigs sold only needed simple modification to get them on the ham bands. There were plenty of small parts available for the builder, too.

To a large extent, this has changed. There is less of the wartime surplus available, and the prices are not all that great. Also, it is many years old now and behind the field in several cases. We were spoiled by its simplicity. There is no equivalent now. There just is not that much modern surplus military equipment for the ham. And the prices are higher for what there is.

The situation looks bleak. Actually, it looks bleaker than it really is. There is plenty of surplus available, but the field has changed. While there may not be the dream rig just waiting to be picked up for a song, there are entire categories of worthwhile surplus that can be of great benefit to the amateur.

It should also be pointed out that the amateur is no longer the main user of surplus. There are schools and industries, as well as electronics hobbyists, using surplus now. It may help someone who would like to start taking advantage of this to outline the main categories of what is available and where it might fit into his plans.

Many still think of surplus as being synonymous with military surplus. There is still military surplus available, and newer equipment being released, too, but probably the biggest category of surplus is industrial surplus.

Let's start with the military. There are still the older tube rigs available from the war and the fifties. It is mostly the receivers that are eagerly sought, some of them perhaps more eagerly than they warrant. You can pick up a rugged, solidly-built receiver that will do workhorse service for you. You can also buy some that are extremely hard to service. For example, the R-390 series is highly regarded but difficult to maintain. Parts are a real problem.

There are also a number of tube-type components still available. This goes for high-power projects and so forth. You may have problems finding a reliable source for inexpensive small parts for a tube project, though. There is some newer solid-state military surplus coming through, but at a higher price than what makes surplus buying attractive.

The next biggest category of military surplus would be test gear. You can pick up some military versions of civilian gear at a low price. However, this may not be what you need. Much of this is lab-grade gear, which sounds nice, but if it needs any sort of servicing to be put back in order, you may have problems. You could wind up with something that you can't even use. Here you have to weigh your troubleshooting experience and your test bench.

It is schools and smaller industries that benefit the most from this if they can check out the gear themselves. They may wind up with additional equipment at reasonable cost with the addition of just their own time and expertise.

In the same way, there is industrial surplus of ready-built test gear, too. Unless it has been gone over for you by the seller, you have the same problems as with military surplus. If it doesn't work right, can you fix it yourself?

There are a few hidden pitfalls with much of this gear. A lot of the postwar

gear uses the early printed circuit boards. A lot of it received continuous-duty service. That and age have done things to those PC boards.

When you go to work on them, you may find that the board itself has deteriorated to the point where it causes intermittent problems (the foil may be starting to peel), and that adds up to a service headache.

A lot of equipment is of hybrid design—mixed tubes and transistors. Since it is precision gear, the tolerance is important. By this time it is long out of tolerance. The cost to start at the beginning and bring all the sections up to tolerance may be so out of sight as to be impossible. If the cost doesn't get you, the lack of available replacement parts will.

The use of mixed tubes and transistors, particularly circuits that mix both together, represents a careful blend of the worst features of both tubes and transistors. That means you will be trying to make an out-of-tolerance circuit function well. Hybrid circuits are more difficult to service at best. Often these circuits were riding right on the edge of a usable state-of-the-art technology. They were apt to have very little tolerance for variation even when new. Trying to get them to function as out-of-tolerance circuits may not be practical.

The used, unchecked price may look very attractive, but can you fix it? The checked or good condition (working) price may not be that good when compared with a new, or kit, price for gear that may be simpler, but will do the actual job you need. A rule of thumb would be that you should have at least equal or better grade gear and expertise than you are trying to service.

That's the part that looks so bleak. Where is the nice, easy, and cheap part? Well, it's all in how you look at it. There are areas which are electronic heaven for those who can use it. These are in the field of industrial surplus. First of all, how do you feel about solid state? This is where the action is. In fact, the values here are often even better than the values that are fondly remembered from the late forties and fifties.

Solid state is mostly low voltage. It also becomes obsolete almost instantly. Manufacturers dump it by the ton. Just two examples: A 1967 catalog listed the SN7400 for $6.50 each and the SN7490 for $23.20. Now you can get the SN7400 for about 16¢ and the SN7490 for about 45¢. That's a few cents on a dollar. And those 1967 prices had come down quite a bit from the original prices. In that field, individual solid-state devices of all sorts have been priced lower, and the small parts to go with them are available at comparable prices. This takes care of transistors and digital ICs, but there is more. Even though they are newer, consumer-oriented ICs are also on the surplus market. You can not only buy some of the older consumer ICs, but also some that are still in use commercially. This gives you whole sections of equipment.

You are familiar with the audio amps and preamps. There are also rf sections and specialized ICs available, and are they ever cheap.

For what is available, you can often build a transistor or IC circuit for much less than an experimental tube circuit of the same type. Power supplies are always a high-cost item with tube work. With transistors and ICs, there is so much available in parts and built supplies that the cost is not a major factor. There are lots of rf transistors and power types available for the experimenter, so in that area you can work with some reliability.

While tube parts are hard to come by, this is really only in one area. Old-style tube thinking is expensive, but there is one way that you are ahead of the game. Take advantage of the state-of-the-art in tubes. What? You didn't know tubes had changed? Then you haven't had to work with TV sets much lately.

There is a lot of tube technology designed for use in TV sets. This hinges on a line-operated supply (mostly without a transformer) of about 100-200 volts. The TV tubes are built to work well in this range. There are lots of modern compactron multisection tubes that hams and experimenters have yet to touch. And the benefits from them are great. There are plenty of low voltage parts for receiver and TV replacement use around, even in surplus. There are also many power supply transformers and parts available, too. This puts a tube circuit cost on a par with transistor work. The initial capital cost for bench supply and some parts will be slightly higher, but once you have them, you have them, and the difference is only a few dollars.

So you still have the option of going tube or transistor at a reasonable experimenter's price. Keeping to receiver voltage levels is the key. Once you go above that voltage range, the price goes up fast.

There is still more. There are a few areas of specialized surplus to explore. The computer field did not just dump a few measly ICs on us. There is also ready-built computer equipment. To name a few items, there are power supplies, keyboards, video terminal units, and whole sections of standard business equipment oriented towards computer interface. If you know what it is and what to do to get it going, there are bargains for the knowledgeable.

There are some other areas of commercial surplus, too. These are more consumer-oriented. Many brands are really the same or similar equipment bought from other manufacturers. There are lots of hi-fi-type components and semi-complete equipment that can be utilized with little work. These prices are often quite low.

In short, there is another renaissance of surplus upon us, but the times and technologies have changed. With some work to update and upgrade your basic electronic knowledge, much is adaptable to ham or other experimental uses. There are a few gaps that make it a bit rough on some types of building. These make it seem as though there is not much available for building. Hams in particular are bothered by this, as certain key items are just not right at hand at surplus prices. A big headache is tuned circuits. It is hard to get the coil stock which used to be a part of every project. The slug-tuned coils are hard to find, too. There are sources, but the price is at a premium. There are ways around this; however, there is another problem.

The other half of the tuned circuit is a variable capacitor. The usual small variable with a shaft for a knob is not that common or available these days. This makes all sorts of tuned circuits for receivers and transmitters hard to build, particularly when an author uses a specific part in an article. There are ways this might be eased. There are easily-available

sources for toroid cores and information on using them in circuits. They are not that common in construction articles, though.

Tuning can also be done with varactor diodes in many circuits, but this is also not common in many articles. Other parts are also not common. The modern i-f strip parts, such as crystal or ceramic i-f filters, which are quite cheap for manufacturers, have not shown up on the surplus market. The standard receiver i-fs, in particular, are hard to come by. Even the older-style transistor i-f transformers are not common items. Many construction articles use very expensive and hard-to-come-by filters for construction. There are few simple alternatives given. Power stages are always a problem. When the voltage or power goes up, the price goes up and the item becomes hard to come by.

Some ham items have benefited from all of this technology. The frequency counter as a ham item is so new that it is still considered exotic, and yet in the few years since it hit the ham market, the price has dropped steadily. At first, they had to be home-built to get any price break, and they were fairly expensive then. Now you can buy kits and ready-built units for less than you can build your own.

A counter that would have cost industry thousands just a few years ago costs a ham a few hundred. A less-costly unit will still be more accurate than any frequency standard available to hams up to now.

However, we still have the problem that our basic purpose, communications equipment, is not so easily served by the surplus market. The nearest thing to it is the conversion of CB gear to ten meters. That may catch on in quantity, but in the meantime it's more symbolic than a major force.

This apparent lack in modern surplus should not really be such a major problem. What it means is that we have not yet solved some of the technical problems in utilizing what is available for our more common amateur uses.

This is what is called a culture lag. The material is there, but we have just not fully adapted it to our purposes.

It would seem likely that in the next few years there will be some breakthrough in the use of modern surplus that will bring a time of simple but effective home-brew ham gear. This will probably have an effect not unlike that of the coming of the available frequency counter. In particular, it will put equipment within reach of many who are not able to spend much to get started. There is very little simple rugged equipment at a beginner's price, particularly equipment that can compete in real performance with the store-bought.

That's the big problem. Even for the same money, there are few who could build a receiver that would actually work as well as a commercial kit or ready-made unit.

Better utilization of the available surplus now, and what may become available in the next few years, should produce projects where the cost, complexity, and availability vs. performance ratio should be favorable enough so that it will be a tangible inducement for many more hams to build some of their gear again. ■

Reader Service—see page 195

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An 8080 Repeater Control System

—part IV: addenda

Several additions have been made to the control system. The LM309K regulator IC in the +5-volt power supply has been replaced with an LM323K-5, which has a higher current rating. An "old code" command has been added to the program, the Mohawk Message Repeater has been swapped for a standard 8-track player, and a telephone switchover network has been added to share a single telephone line with two repeaters.

2#1 Message

You are hearing an amateur radio repeater. Very simply, a repeater consists of some electronics equipment which boosts radio communications range. A repeater has a receiver and a transmitter operating on different frequencies. They utilize antennas located as high up as possible. Because of the high location and very good quality equipment, repeaters can receive transmissions from much further away than can be normally done and can be heard at a further distance than is commonplace. The repeater retransmits weak signals, permitting walkie-talkies and mobile stations to communicate with each other up to a hundred miles apart or more, when without a repeater, the range may be only several miles or several tens of miles.

Repeater operation is but a small part of what is available to the radio amateur, or ham, as he is commonly called. Hams routinely talk to other hams around the world on the shortwave bands. Some operate the international Morse code and others use single sideband, a modern form of voice communication. Many hams operate radioteletype, and some even transmit pictures across continents. There are some amateurs with fast-scan television stations of their own.

Ham radio is a fascinating hobby. Some hams like to build equipment and some just like to talk, but most do a little of both. Hams keep up with the ever-growing technology of today. Amateurs built several satellites, had them placed into orbit, and can now easily communicate through their very own satellites, called OSCAR (for orbital satellite carrying amateur radio). Some hams even have homemade computers completely running their stations!

Amateurs have a lot of freedom to operate on the air and build their own equipment. This is because each and every ham must demonstrate to the Federal Communications Commission before receiving a license that he has an understanding of both radio law and electronics theory in addition to knowing the international Morse code.

Ham radio is both a fun and an educational hobby. If you think that you could develop an interest in ham radio, contact the Baltimore Amateur Radio Club at PO Box 5344, Baltimore MD 21209. Or dial H-A-M-T-A-L-K, HAMTALK, on your telephone for further information.

This has been the two-pound-one message. Two-pound-two gives general information, two-pound-three supplies current club information, and two-pound-four explains more about the repeaters.

The Old Code Command

The Baltimore Amateur Radio Club changes its autopatch access code annually. I added the old code command to make it clear to users that their touchtones™ were accepted, but that the old access code was used and no longer activates the autopatch. When the old code is used, after the carrier drop, the control system sends "OLD CODE" in CW.

The programming is simple, and Listing 1 shows this routine. The routine calls WCD, loads the HL registers with the message address, and CW is called. In the code table, the old access code now points to OLDCD.

The Tape Loop

The tape machine described in Part I developed a problem, and the opportunity was taken to replace it with a common 8-track tape player. This is most suitable because a loop configuration is required. The primary drawback to the Mohawk Message Repeater was that the recorded message had to be exactly as long as the tape itself. The new system is

```
OLDCD:  CALL    WCD
        LXI     H,OLDMS
        CALL    CW
        JMP     TTON2
;
;
;
OLDMS:  DB      80H     ;SP
        DB      0F0H    ;O
        DB      48H     ;L
        DB      90H     ;D
        DB      80H     ;SP
        DB      0A8H    ;C
        DB      0F0H    ;O
        DB      90H     ;D
        DB      40H     ;E
        DB      80H     ;SP
        DB      0
;
;
;
CODTB:  DB      9
        DB      8
        DB      12      ;#
        DW      OLDCD
```

Listing 1. The "old code" command.

2#2 Message

Welcome to the Baltimore Amateur Radio Club's 07/67 repeater, WR3AFM. The transmitter is located at the old WBAL tower on Park Heights Ave. The repeater has receivers north of the beltway on Old Harford Road, at the WRBS tower near I95 south and the beltway, downtown at 4000 North Charles Street, at the QTH of K3VC and N3JC at the top of the Jones Falls expressway, and a fifth receiver in Randallstown. A voting selector feeds the best signal to the transmitter.

At the transmit site, there is also a duplexed 440-MHz repeater, 444.35 in and 449.35 out.

You will note that a short click is heard after releasing your carrier. This signifies that the repeater timer has been reset and leaves time for breakers. It is not necessary to let the repeater carrier drop. 07/67 has an autopatch limited to travelers and club members, though open to anyone for emergency traffic.

The repeater is set up to block touchtone signals from repeating. There are several codes that anyone is welcome to use after proper identification. One-pound-one links the 67 machine with the 440 repeater. To acknowledge that function, the repeater sends an "R" in Morse. The repeaters remain linked until a star is sent, again acknowledged with an "R". Two-pound-one plays a tape giving a brief introduction to ham radio. Two-pound-two gives this recorded message. Two-pound-three supplies current club information. Two-pound-four gives more information about our repeaters. Tape messages can be activated at most once every ten minutes. Three-pound-three will disable the repeater's blocking function until the carrier is dropped, permitting the tones to be repeated. Any touchtone digits sent after four-pound-four will be verified in Morse after the carrier drop. Five-pound-five will repeat what was sent during a four-pound-four operation, or the telephone number dialed during an autopatch, whichever was last.

The control system for the repeaters is an 8080-based microprocessor which performs the various functions, including multiple identifications as well as redialing telephone numbers for the autopatch.

The Baltimore Amateur Radio Club has another two meter repeater, 34/94, which is a split-site repeater in the Northern Baltimore area. We hope you enjoy the use of our repeaters, and we would like to see you at our meetings the first and third Wednesdays of the month at the Ames Methodist Church in Pikesville at 8 pm. Listen for interesting bulletins weekdays on 67 at 7:30 am and rebroadcast on 94 at 6 pm. Code practice can be heard Mondays at 9 pm on 34/94. Should you desire to contact the club, write the Baltimore Amateur Radio Club, PO Box 5344, Baltimore MD 21209.

2#3 Massage

This is the two-pound-three message. Two-pound-one gives an introduction to amateur radio, two-pound-two supplies a generalized message, and two-pound-four provides information about the repeater equipment.

This repeater is sponsored by the Baltimore Amateur Radio Club, PO Box 5344, Baltimore MD 21209.

Where is the current DXpedition? What is the WWV propagation forecast for the upcoming week? When is the next local hamfest? To find the answers to these and other questions, listen to the BARC bulletins weekdays at 7:30 am on 07/67 and at 6:00 pm on 34/94. Keep up with your hobby.

(In CW at 35 wpm: Hams constantly strive for proficiency with CW.) Code practice sessions are held on Monday evenings at 9:00 on 34/94. Call in your requests next Monday night and test or improve your code speed.

Remember to dial H-A-M-T-A-L-K, HAMTALK, in the Baltimore area for current information. Spread the number around to your non-ham friends.

Don't forget to write an article or two for the club magazine, the *Modulator*. If you can help out with amateur radio classes, contact W3HYY.

Is there something that you can do or suggest for the club? Come to some meetings and volunteer—we'd love to have your participation.

BARC meetings are held at the Ames Methodist Church in Pikesville at 8 pm. Business meetings are held the first Wednesday of the month. General meetings include a presentation and are held on the third Wednesday of the month. Everyone is welcome at both meetings.

The September meeting will be a discussion of spark-gap transmission and ham radio of years past. The October meeting will be a tour of the Emergency Medical Radio Service at Sinai Hospital. November's meeting boasts a talk on radio-controlled models. The January meeting will be the annual BARC auction, the February meeting will have demonstrations of antennas and their patterns, and the March meeting will be all about our repeaters. Try to join us at these meetings, if possible.

more versatile and allows the message to be any length up to the length of the loop itself. Since the tape player is stereo, it is convenient to place the message audio on the right channel and a tone on the left channel to indicate when the message is finished. Standard 40-minute tapes supply 10 minutes per track. The control circuitry activates the drive mechanism upon request, and when the message is done and the tone is encountered, the tape system disconnects itself from the repeater and continues running until the metallized strip signifying the beginning of the tape is reached, shutting off the machine. A bonus is that the tapes can only be activated once every ten minutes. A KILL command has been added to allow termination of the tape message when desired.

The tape player has four pairs of tracks, so this feature was exploited to provide four different tape messages. The original single 2#2 tape request is expanded to four, accessible via the codes 2#1, 2#2, 2#3, and 2#4. The microprocessor remembers which track the tape player is on and advances the head assembly to the requested tape track. The 2#1 message is for non-hams. It briefly explains what amateur radio is all about and is useful when someone asks what your handie-talkie is for. 2#2 is a shortened version of what it was before. 2#3 supplies current club information: net schedules, meeting programs, etc. The relative availability of 8-track recorders permits monthly updates to be made. The 2#4 message is a more detailed description of the repeaters.

Fig. 1 shows the tape loop interface. This circuitry is built into a minibox and mounted to the tape player. The only connection between the tape player and the control system is the 16-pin DIP plug as before. The tape player is a standard 8-track designed for automotive use and operates from a 12-volt power source. Ac-operated players could be used with the addition of a relay to connect the unit to the ac line from a 12-volt coil. The circuit is quite simple. Relays K1 and K2 provide the switching logic. Normally, both relays are de-energized. When the start pulse from the processor grounds the floating half of the K1 coil, the relay pulls in. The SENSE contacts on the

```
;INITIALIZATION PROCEDURE
;
;
BEGIN:  XRA     A
        STA     LCKR
        INR     A
        STA     TRACK      ;TRACK #
RESET:  LXI     H,TIME-1
;
;
;
        ORG     2000H      ;THIRD ROM
TAPE1:  MVI     B,0        ;TAPEX PLAYS
TAPE:   LDA     OUTOM      ;THE TAPE ON
        ANI     2          ;TRACK X
        JNZ     TTON2
TAPC:   LDA     OUTOM
        ORA     A
        JM      TTON2
        CALL    SEEK
        CALL    WCD
        LXI     D,OUT3M
        MVI     B,80H
        CALL    BITS
        OUT     PORT3
        CALL    DELAY
        CALL    BITC       ;PULSE TAPE
        OUT     PORT3
        JMP     TTON2
;
;
;
TAPE2:  MVI     B,1
        JMP     TAPE
TAPE3:  MVI     B,2
        JMP     TAPE
TAPE4:  MVI     B,3
        JMP     TAPE
;
;
;
TAP1:   MVI     B,0        ;TAPX SAME AS
        JMP     TAPC       ;TAPEX BUT FROM
TAP2:   MVI     B,1        ;CONTROL CODE
        JMP     TAPC
TAP3:   MVI     B,2
        JMP     TAPC
TAP4:   MVI     B,3
        JMP     TAPC
;
;
;
SEEK:   LDA     TRACK      ;SEEK ADVANCES
        CPI     4          ;HEAD TO TRACK
        JC      SEEK2      ;SPECIFIED
        SUI     4          ;IN REG B
SEEK1:  STA     TRACK
        JMP     SEEK
SEEK2:  MVI     A,3
        CMP     B
        RC
        LDA     TRACK
        CMP     B
        RZ
        CALL    STEP
        INR     A
        JMP     SEEK1
;
;
;
STEP:   PUSH    PSW        ;STEP ADVANCES
        PUSH    B          ;HEAD ONE TRACK
        LXI     D,OUT4M
        MVI     B,40H
        CALL    BITS
        OUT     PORT4
        CALL    LDELY
        CALL    BITC
        OUT     PORT4
        CALL    LDELY
        POP     B
        POP     PSW
        RET
;
;
;
LDELY:  MVI     A,8        ;LONG DELAY
LDLY1:  CALL    DELAY
        DCR     A
        JNZ     LDLY1
        RET
;
;
;
```

Listing 2. Tape commands.

player are normally open, so the sensing transistor is normally low. This allows K1 to latch, supplying power to the tape player.

The PTT line is grounded only when K1 is activated and K2 is not. Likewise,

2#4 Message

WR3AFM consists of two separate repeaters: a 440-MHz repeater and a two meter repeater. The 444.35/449.35 repeater is a duplexed single-site repeater. The 07/67 repeater consists of five repeaters spread around town with the common input frequency of 146.07 MHz. These satellite receivers transmit via 440-MHz link frequencies to the 146.67 transmitter site. Each link has a Station Master antenna, a 146.07-MHz receiver, a 440-MHz transmitter, a control shelf, and a CW identifier. The IDer is required to satisfy FCC requirements, and for our purposes they continuously identify with a low-level, low-pitch tone. This can be used to determine which receiver has been selected.

At the transmit site, a voting selector chooses the best signal from the five links and sends it to the 146.67-MHz transmitter. The transmitter drives a 250-Watt amplifier, though only a portion of that power reaches the Station Master antenna through about 500 feet of feedline. All of this equipment is of the General Electric MASTR series.

The repeater control is performed by a dedicated 8080 microcomputer system. This consists of 57 integrated circuits and has 3K bytes of ROM, 256 bytes of RAM, seven eight-bit output ports, and three eight-bit input ports. The control program is over 1500 lines long. The 8080 accomplishes the user codes, the autopatch, and permits elaborate control options to be accessed via touchtones remotely.

The 34/94 repeater is also a split-site repeater. The transmitter is in Towson and directly feeds a Station Master antenna. The receiver is co-located with the 07 receive link at the Charles Street site. The 07 and 34 receivers share the same antenna. Therefore, the coverage of 07/67 necessarily engulfs that of 34/94. With the exception of the link transmitter, which is a Progress Line, the 34/94 equipment is all General Electric MASTR. It is necessary to wait for the beep to reset the three-minute time-out timer. Additionally, on 34/94, it is required to let the entire repeater carrier drop once every twelve minutes. This is because the drop delay is on the link transmitter, which causes it less wear and tear.

This has been tape message two-pound-four; two-pound-one gives an introduction to amateur radio, two-pound-two supplies a generalized message, and two-pound-three provides recent club information.

```
KILL:   LDA     OUTOM   ;KILL TAPE
        ORA     A
        JM      TTON2
        LXI     D,OUT4M
        MVI     B,80H
        CALL    BITS
        OUT     PORT4
        CALL    DELAY
        CALL    BITC
        OUT     PORT4
        JMP     TTON2
;
;
;
STEPR:  LDA     OUTOM   ;MANUALLY
        ORA     A       ;STEP HEAD
        JM      TTON2
        CALL    STEP
        CALL    ROGER
        JMP     TTON2
;
;
;
        ORG     3000H   ;RAM BOTTOM
;
TTDIG:  EQU     $
        DS      25      ;SPACE FOR DIGITS
NUMBR:  DS      12      ;TEL #1
IDAD5:  EQU     $
        DS      196     ;SPACE FOR STACK, ID #5
STACK:  EQU     $
OUTR1:  DS      1
OUTR2:  DS      1
OUTR3:  DS      1
TIMER:  DS      4
NOTIM:  DS      1
LCKR:   DS      1
IDS:    DS      1
IDN:    DS      1
TRACK:  DS      1
TIME:   DS      1
MASK:   DS      1
LKROG:  DS      1
OUTOM:  DS      1
OUT1M:  DS      1
OUT2M:  DS      1
OUT3M:  DS      1
OUT4M:  DS      1
OUT5M:  DS      1
OUT6M:  DS      1
OUT7M:  DS      1
;
;
;
CODTB:  DB      2
        DB      12      ;#
        DB      1
        DW      TAPE1
        DB      2
        DB      12      ;#
        DB      2
        DW      TAPE2
        DB      2
        DB      12      ;#
        DB      3
        DW      TAPE3
        DB      2
        DB      12      ;#
        DB      4
        DW      TAPE4
        DB      7
        DB      3
        DB      11      ;*
        DW      KILL
        DB      2
        DB      11      ;*
        DB      1
        DW      TAP1
        DB      2
        DB      11      ;*
        DB      2
        DW      TAP2
        DB      2
        DB      11      ;*
        DB      3
        DW      TAP3
        DB      2
        DB      11      ;*
        DB      4
        DW      TAP4
        DB      8
        DB      8
        DB      11      ;*
        DW      STEPR
```

audio is available only under the same conditions. At this point, the tape is running, the repeater is keyed up, and the tape audio is feeding the transmitter. The right and left audio channels have a 10-Ohm load resistor to protect the audio output stages. The left channel is stepped up in voltage, rectified, and fed to a tone-detect transistor. Most of the left channel is empty. At the end of the message, a tone of almost any frequency is placed on the left channel for five to thirty seconds. The tone-detect transistor detects the tone and activates K2. Immediately, the PTT and audio lines are released and the repeater is freed up. K2 latches through the grounding contact. Both relays remain latched, continuing to power the tape player, until the metal foil on the tape reaches the SENSE contacts. This unlatches K1, which releases K2, and all returns to the rest mode.

The track solenoid in the tape player usually requires several Amperes to drive it. Relay K3 drives the track solenoid and is driven by an open-collector output bit on the processor. This permits the processor to control the track-select mechanism. A ground on the KILL line simulates the beep tone, killing the tape message. A 12-volt power supply is included to power the unit. The tape player must be modified by breaking the leads on the SENSE contacts and the stepping solenoid and bringing them out separately.

A considerable amount of software is necessary to control the multiple-track tape system. The system works by dead reckoning; the processor maintains a memory of which track the machine was last on and advances the track until the desired one is reached. A better arrangement would utilize a tape machine which has individual lamps to indicate the track. These signals could be sent to input ports of the pro-

```
SWTCH:  LXI     D,OUT4M ;SWITCH TO
        MVI     B,2     ;450 RPT
        CALL    BITS    ;ON PHONE
        OUT     PORT4
        CALL    DELAY
        CALL    BITC
        OUT     PORT4
        JMP     TTON2
;
;
;
CODTB:  DB      5
        DB      9
        DB      11      ;*
        DW      SWTCH
```

Listing 3. Switch command.

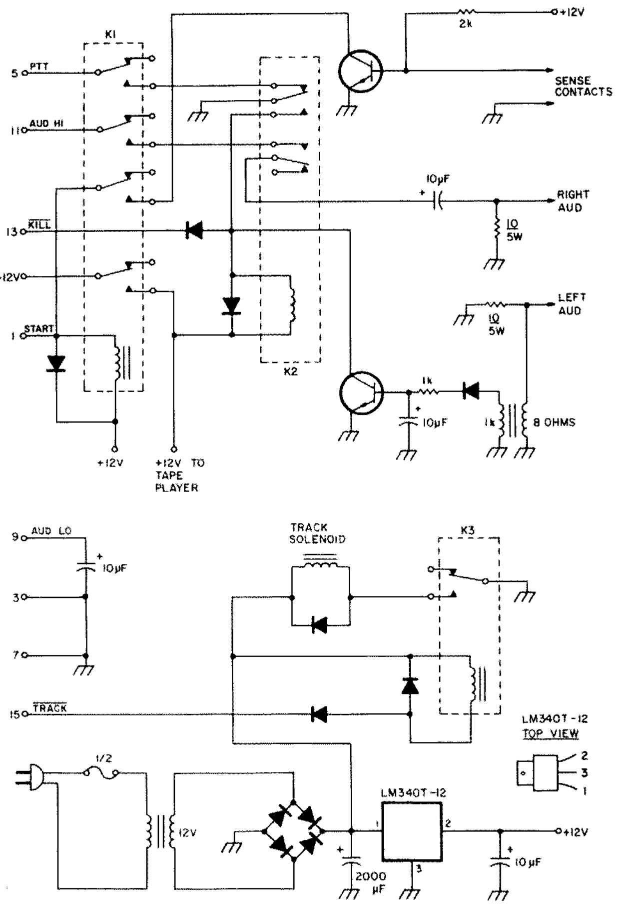

Fig. 1. Tape loop interface.

cessor, and it could advance the assembly until the desired lamp was activated. I chose not to use this approach because the tape players with the added track lamps are not as readily available as the

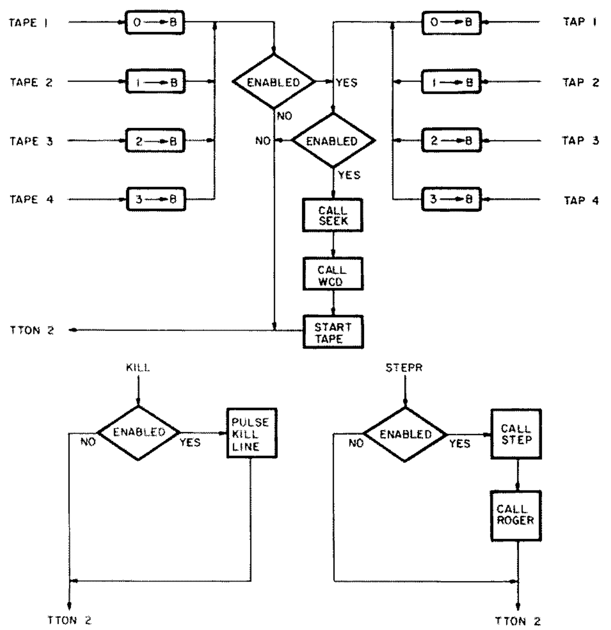

Fig. 2. Tape commands.

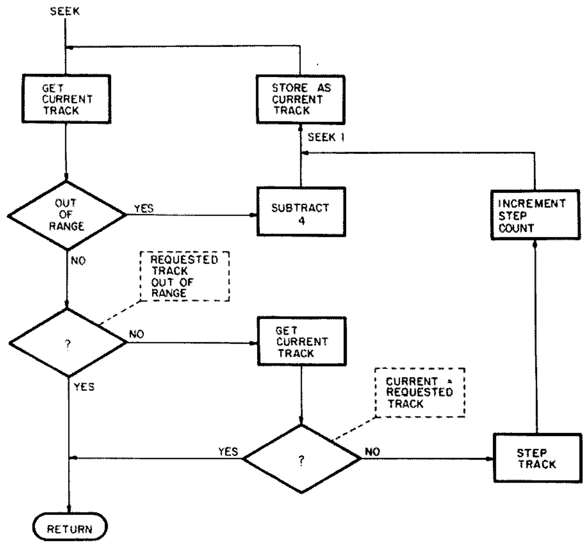

Fig. 3. The SEEK subroutine.

ones which do not have them. There has been little problem with incorrect track selection.

Listing 2 shows the tape-handling software. The four commands, TAPE1, TAPE2, TAPE3, and TAPE4, correspond to the 2#1, 2#2, 2#3, and 2#4 codes. Commands TAP1 through TAP4 correspond to the 2*1 through 2*4 codes for use by control operators. TRACK is the variable which specifies the current track. Upon initialization, TRACK is set to 1, corresponding to track 2. This is because 2#2 is the most commonly used message, and, after a power failure, presetting the program to that track gives the highest probability that the processor and the machine are in synchronization.

Fig. 2 shows the various tape commands. Register B specifies the desired track for the SEEK subroutine. The KILL command pulses the KILL line to the tape circuitry, stopping the message. The STEPR command steps the tape track and acknowledges with an "R". This is used to resynchronize the machine and the processor.

The SEEK subroutine is shown in Fig. 3. SEEK advances the head assembly until the desired track, passed in register B, is reached. Validity checks are made to prevent possible erroneous requests from pulsing the track line for long periods of time.

The Switchover Board

Our 449.35 repeater has separate autopatch circuitry, and we had been using a second telephone line for it. To economize, we decided to utilize the main 146.67 autopatch line for the other repeater. The telephone switchover board decides which repeater is to have access to the telephone line. The phone line rests on the main control system, allowing control over the system via the telephone and permitting two meter autopatches. When an autopatch is requested on 444.35, if the line is not in use, the line is switched to that machine. The line remains there until the autopatch is terminated. The telephone line will only be given to a repeater if the other one is not using it at that time. If the request is not granted, a simulated busy tone is generated and sent to the second requesting repeater. To accomplish the remote base function on the 449.35 repeater,

after dialing into the control system, the code 59* is sent. This switches the telephone line to the 449.35 repeater for 10 seconds. During this period, signals present on 444.35 will be heard on the telephone. If the autopatch code is sent before the ten seconds elapse, the autopatch will be activated, the remote base function is realized, and the line remains latched until killed.

The switchover board is shown in Fig. 4. The relay is normally relaxed and passes the phone line to the control system. Two 555s generate the busy signal. The 10k potentiometer sets the level of the busy tone to the repeaters. A single D-type flip-flop handles the switching logic. The flip-flop is CMOS and drives a Darlington transistor which drives the switchover relay. The numbered connections go to the phone connector on the main control system. If the processor grounds the GRAB line, the telephone line will remain on the control system no matter what. When the processor pulses the 450 REQUEST low, the ten-second timer is actuated, switching the phone line to 449.35. When an autopatch request is made on 444.35, +12 volts is present on the 450 AP line. The AP+RB+PHC line coming from the processor board signifies that the phone line is in use.

The software to implement the 59* command is shown in Listing 3. The 450 REQUEST line is pulsed low, and the command exits.

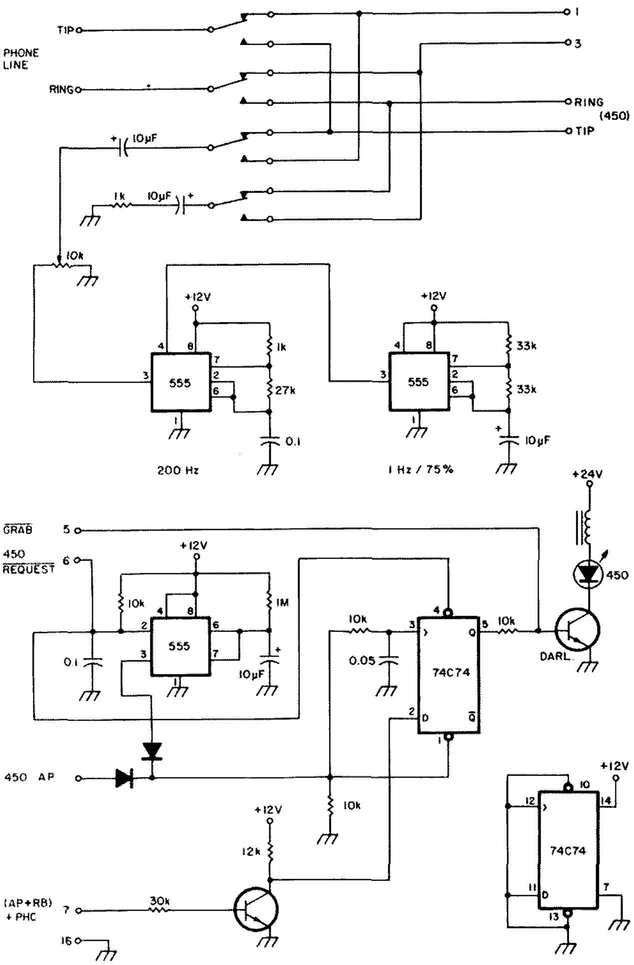

Fig. 4. Switchover board.

Main Board Modifications

A small amount of wiring must be added to the main board to permit the new circuitry to operate. The new connector wiring is shown in Fig. 5. Two diodes are used to create the AP+RB+PHC signal required.

Software

The software patches described may be included in full or in parts. It may be possible to fit the additions in the space remaining in the second ROM, depending upon how much space is taken up by the four different IDs and the single-digit telephone numbers. However, for us, it was necessary to expand to a third ROM. The last ROM is only about one-third utilized, so much more can be added before it becomes necessary to wire in a socket for a fourth ROM.

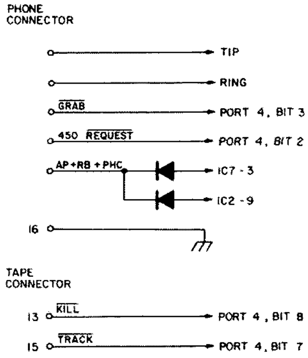

Fig. 5. Modifications to processor board.

Acknowledgements

Thanks go to Ed Mester WA3HQX for his help in wiring the tape unit and for taking over the responsibility of preparing the tapes. Appreciation is also given for the golden voices of Matt de Rouville K3MR, Denise Oliver, Deborah Yost, Jim Harding K3DRJ, and Pat Biggs KB3CE, who have recorded tapes for us. ■

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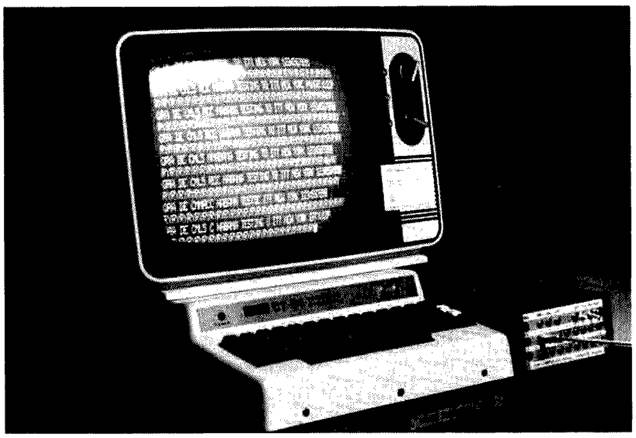
RTTY Transceive for the KIM-1

—requires video terminal and AFSK generator

No noise, no oil.

Several good articles have appeared here in the pages of *73 Magazine* concerning the use of the KIM-1 microprocessor for RTTY work.[1,2,3] This article describes an easy-to-use program for RTTY transceive when teamed with WA5DXP's article.[1] It requires no additional memory for the KIM. It is also designed as a "stand-alone" program for RTTY transmission at all standard amateur RTTY speeds.

Basically, what we desired was a complete RTTY station without the need or bother of mechanical printers, TDs, or reperforators. The resultant system sends and receives RTTY at 60, 66, 75, and 100 wpm and has a built-in buffer for "auto-start" transmissions, auto-shift between Baudot letters and figures, and, finally, a built-in ID for the end of transmission. The program does not need to be manually stopped to switch between transmit and receive and back again. The resultant system is straightforward to use and totally silent.



Computer-generated RTTY station: Note use of inexpensive black and white portable TV, SWTPC CT-64 video terminal, and home brew interfacing box.

What will you need to make use of this program? Basically, you'll need a KIM-1 interfaced to a moderate-speed video terminal. We use 1200 baud, but find that the receive program has to be slightly modified to allow it to operate at this slow speed. Higher speed terminals will require no modifications to the receive program. Of course, to use this program for transmit, any terminal will work regardless of how slow. As long as you're interfaced through the standard KIM-1 TTY pins, the speed of input won't matter. The program will simply convert the input ASCII to Baudot and output it at any desired speed. We've found, though, that, on receive, the terminal doesn't have time to output the decoded character and get back in time for the next start bit. WA5DXP mentions running his terminal at 4800 baud; we simply don't have anything that fast! At 1200 baud, we've found that simply removing the last JSR DEHALF (change his line 0267 to EA EA EA) will allow his receive program to work on slower terminals. Comments would be welcomed if you have other ideas.

You'll also need an AFSK to convert the output of the transmit program to the proper tones. The program defines a mark as pin PB7 high, a space as PB7 low. This TTL level output can be used to drive an AFSK directly. We use a couple of sections of a 7404 hex inverter as a buffer. If you have a reason to interface directly to a standard 60 mA loop, you might consider the optoisolator approach used in an earlier article on this subject (see the references at the end of this article).

The transmit program

Char.	Baudot	ZP Loc.	S	52	53	$	4A	24
			T	06	54	&	2E	26
A	62	41	U	72	55	'	1A	27
B	4E	42	V	3E	56	(	7A	28
C	3A	43	W	66	57	)	26	29
D	4A	44	X	5E	58	;	3E	3B
E	42	45	Y	56	59	:	3A	3A
F	5A	46	Z	46	5A	,	6A	2C
G	2E	47	1	76	31	.	1E	2E
H	16	48	2	66	32	/	5E	2F
I	32	49	3	42	33	?	4E	3F
J	6A	4A	4	2A	34	c/r	0A	0D
K	7A	4B	5	06	35	l/f	22	0A
L	26	4C	6	56	36	space	12	20
M	1E	4D	7	72	37	figs	6E	06 Note 1
N	1A	4E	8	32	38	ltrs	7E	0C Note 1
O	0E	4F	9	0E	39	-	62	2D
P	36	50	0	36	30	stop	16	2B Note 2
Q	76	51	!	5A	21	bell	52	2A Note 3
R	2A	52	"	46	22			

Table 1. Code conversion. Note 1: "Figs" and "ltrs" were included in this chart so that you can manually produce them with an ASCII keyboard. The program produces them automatically whenever needed. They are included for testing only. Note 2: The "stop" or British pound symbol (depends on the receiving machine) can be sent by typing a "+" on your ASCII keyboard. Note 3: The "bell" can be sent by typing a "" on your ASCII keyboard. Other ASCII keys are "illegal" and will not produce a Baudot equivalent.*

deserves some comment on the methods used. After initialization of the ltrs/figs flag, the computer awaits input from an ASCII keyboard. Upon receiving that, it JSRs to a subroutine called STATUS where the incoming data is tested. If bit 6 is found to be a zero, the ASCII data was either a number or punctuation. In either case, the computer must check whether the last character sent was also in uppercase Baudot. If not, then the computer will have to send the figures command before it sends the character just input. If it determines that the last character was indeed uppercase, then all it needs to do is output the new character.

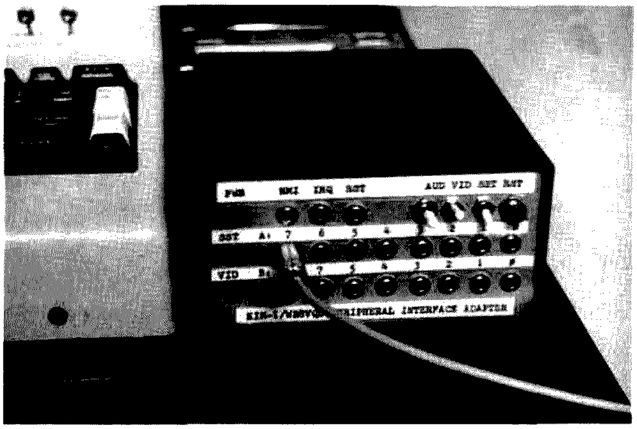
The same method holds true for lowercase, but in the reverse sense. The computer is initialized in the "ltrs" mode, since your first input will probably be a letter. Should you type a number or punctuation first, the computer will sense this and output a Baudot figures control and then your character.

Since we have chosen PB7 as the output pin for the transmit program, a 10k pull-up resistor will need to be added. PB7 on the KIM-1 has no internal pull-up (to permit collector-ORing with other devices). Simply connect a 10k ¼ W resistor from PB7 (A-15) and VCC (A-A).

Even before the computer has checked the status of the incoming character, it first rules out three special characters: space, line feed, and carriage return. A "space" produces the same effect as "unshift on space" in some mechanical printers. It's necessary as you're not going to have any idea of the kind of printer the other station will be using. If you type a string of numbers and then space to another string of numbers, the computer will shift down on the space and back up on the second string of numbers. The result to the user of this program or the station copying on the other end is insignificant. In other words, type whatever you want and you can be sure the other guy will copy regardless of the setup of his printer!

So why do we also disregard the line feed and carriage return as far as whether or not to send the figs/ltrs command? The main reason is that it simply does not matter whether a Baudot printer is in upper- or lowercase when either of these commands are sent. So the computer leaves you in the mode you are in.

After the status of the input character has been determined and figs/ltrs commands sent (if necessary), the character input is converted to Baudot, stored away, and then picked up by the XMT subroutine. Transmission of the resultant Baudot is accomplished in much the same manner as by a mechanical printer. The character is sent out, bit by bit, with a start bit (a space), five data bits, and a stop bit (a mark). The lengths of both the start and data bits are determined by the value loaded into the on-board KIM timer at location 03CD. Depending on the speed of transmission desired, load the value contained in Table 2. Likewise, since the stop bit is longer than a start/data bit, location 03E8 must have this delay constant loaded. The program is set for 60 wpm as written, since this is by far the most common speed for amateur RTTY trans-

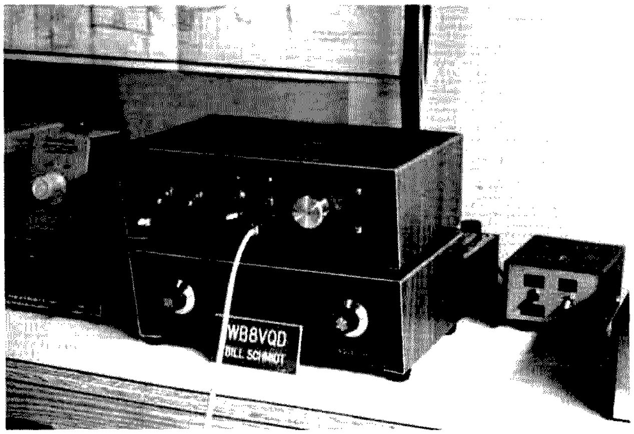


Close-up of home brew interface box. Others might consider bringing all peripheral pins out to miniature phone jacks and all controls to outboard switches.

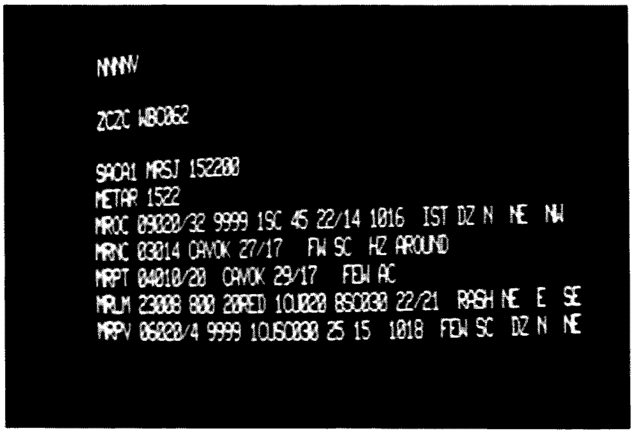
	60 wpm	66 wpm	75 wpm	100 wpm
Baud rate	45.5	50.0	56.9	74.2
Start data (t = ms.)	22	20	18	13.33
Stop (t = ms.)	31	30	25	19
Normal total char. time (t = ms.)	163	150	133	99
KIM total char. time (t = ms.)	159.74	153.60	135.17	99.33
Percent error (Allow ± 5%)	− 2.0	+ 2.4	+ 1.6	+ 0.3
Hex to load at 03CD	15	14	12	0D
Hex to load at 03E8	1E	1E	18	13

Table 2. RTTY timing table and delay constants. This table supplies data used by the RTTY transmit program. The values supplied for locations 03CD and 03E8 must be loaded if you want to transmit at a speed other than 60 wpm (the program is preset for this speed). Delay constants for receive are covered in WA5DXP's article.[1]

missions. Change the above locations only if you desire another speed. Upon transmission of the complete character, the program loops to the beginning where the next input is awaited.



Terminal unit provides both 60 mA loop for mechanical machine when we want hard copy and TTL level signals for the computer.



Example of weather broadcasts you'll be able to receive with the KIM. They are usually highly coded as this one is, but decoding manuals are available and we've found the NWS most helpful.

Note that, when you type a character requiring a shift, there is a quick two-step sound as first the command for figs/ltrs is sent and then the character, separated only by a stop bit. You'll probably get comments on this from people with mechanical printers, as they'll be used to "live" typing which won't usually produce this effect. Also, if you're a very fast typist, you may have to pause slightly since the computer won't be ready for your next character until it's completed the above operation. Normal typists and pick-and-punchers can disregard this warning!

The program does more than just allow real-time transmission of RTTY. It also incorporates a buffer so you can type a short message into the computer and have it output the entire message at full speed. This is accomplished in the BUFFR section of the program. Getting into this mode requires only that you type "Control B" (that is, push the control key down and hold it down while you type a letter "B"). You'll notice that further typing is no longer output to your AFSK. Instead, anything you type is stored away in memory for "full speed ahead" transmission. How do you know if the buffer becomes full? Every character you type will return with a bell sounding if you're using a mechanical ASCII printer or a tone if you're using an electronic terminal. The program is set up to allow about a three-line (at 64 characters per line) buffer. You can change this at location 0332. Whenever you're finished typing your message into the buffer, it can be sent by typing "Control T." Remember to turn on your AFSK and transmitter first, though! When your entire message has been sent, the program again loops to the beginning and awaits your next input.

You can also load your ID into a special ID buffer which is always ready to be sent when you type "Control I." See Table 3 for initial loading instructions. Since you'll certainly dump this program to audio tape, every time you load, your program and also your ID will be ready to go. You can use the ID as we do or make a slight change. Since we send the ID at the end of our transmissions, we have completion of the ID automatically jump us into the receive program. This is accomplished at line 0321. If you want to use this program without WA5DXP's receive program, then you'll need to change only this one line (see Table 4). This ID is in RTTY, so you'll need to either ID verbally or in Morse to satisfy FCC requirements.

A few notes should be made about the actual ASCII-to-Baudot code conversion table (see Table 1). This table takes into account all normal Baudot characters. Figs and ltrs commands are included for testing, but, since the

Step 1:	Decide what you want sent. Example: "DE WB8VQD c/r c/r l/f"		
Step 2:	Convert it to ASCII using the chart below:		

A-41	N-4E	1-31
B-42	O-4F	2-32
C-43	P-50	3-33
D-44	Q-51	4-34
E-45	R-52	5-35
F-46	S-53	6-36
G-47	T-54	7-37
H-48	U-55	8-38
I-49	V-56	9-39
J-4A	W-57	0-30
K-4B	X-58	space-20
L-4C	Y-59	c/r-0D
M-4D	Z-5A	l/f-0A

Step 3: Place your ID into memory beginning at 0100. Example:

0010	D	44
0011	E	45
0012	space	20
0013	W	57
0014	B	42
0015	8	38
0016	V	56
0017	Q	51
0018	D	44
0019	c/r	0D
001A	c/r	0D
001B	l/f	0A

Step 4: Tell the computer how long your ID is. This number, in hex, is loaded at 031E. If you're not familiar with hex, take the last location of your ID, add one, and use only the last digit. Example: My ID ends at 001B. If I add one, that's 001C. Using only the last digit, I get "0C" as the hex number to load at 031E. Disregard the number already at 031E.

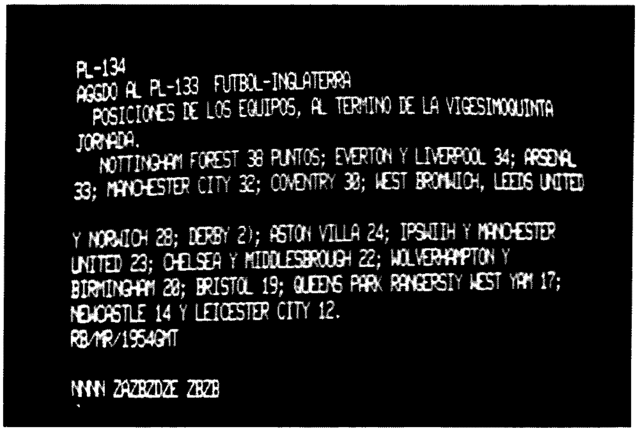
Table 3. How to load the ID with your call.

Change:

0249	4C	D0	02	JMP
024C	EA	EA		NOP
Add:				
02D0	2C	40	17	BIT SAD
02D3	30	03		BMI
02D5	4C	00	03	JMP Transmit
02D8	A9	80		LDAimm
02DA	2C	00	17	BIT PAD
02DD	4C	4E	02	JMP Back to Rcv.

Table 4. Changes to WA5DXP's program to adapt it to this transmit program to allow transceive. WA5DXP's program appears in the October, 1977, issue of 73 Magazine. The above changes allow switching back and forth from receive to transmit without manually resetting the computer each time (see the article for details). If you want this program for transmit only and do not want to incorporate WA5DXP's receive program into it, only one line needs to be changed:

0321 F0 E1 EA BEQ BEGIN (plus an NOP)



The computer won't mind foreign languages as this apparent sports broadcast proves. With the computer's ability to copy any speed, you'll be able to print much—but not all—of what you hear.

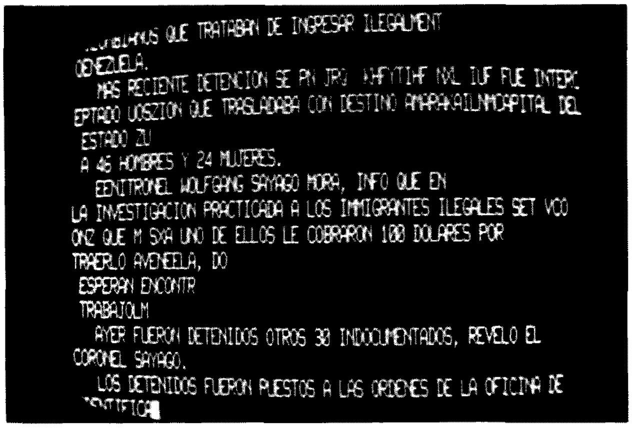
program supplies them automatically, you'll probably never use them. A Baudot "figs" is produced by typing "Control F" and a "ltrs" command by "Control L." If you are in the "ltrs" mode and type a "figs" command, you'll really get two of them, as the STATUS subroutine will supply one of its own! The same applies to typing the "ltrs" command when in the "figs" mode. Take this into account if you're inclined to experiment.

Delay constants for the transmit program appear in Table 2. Since only four speeds are legal on amateur bands, only constants for those are published. Percents of error are also included, as minor timing errors have not been corrected by the program. There's simply no need to, as any printer, mechanical or electronic, can handle errors up to 5%. Since we used the divide-by-1024 position of the KIM timer, even increments of milliseconds are not possible. Correction factors can be programmed in, but we found these constants plenty accurate for any use you'll probably ever encounter. One thing's for certain: A mechanical printer isn't going to care either way.

The receive program which we've referred to many times has performed well here for some time. We had considered writing one, but found this one to work so well we could see no sense in reinventing the wheel. We've copied everything from 60 to 100 wpm with no difficulty. If you're so inclined, the WX transmissions at 14.395 (LSB, 850 shift, 100 wpm) are a good deal of fun. Although the data is heavily coded, you'll see some plain English. This frequency is also one available quite near the top of a ham band and is accessible for those without a general-coverage receiver. You might also check out 7.405 (USB, 850 shift, usually 66 wpm) if you'd like to catch Spanish language telegrams. It's interesting and unusual to see the KIM decoding Spanish.

If you're in a QSO and want to get from receive back into transmit, type a space. At high speeds, the computer may not pick it up the first time. Try again. This is the sole purpose of the modification to WA5DXP's program appearing in Table 4. We didn't want to have to reset every time we wanted to send or receive. With this change, the computer is able to do all the work for you.

These programs have been used on the air in



News agencies, especially transmitting in Spanish, abound on the low bands. Copy is not perfect, but then we use a PLL-based TU and no filtering. A better TU should produce perfect copy!

numerous QSOs and have been found to create a quiet and efficient RTTY station. Aside from the advantage of saving the output from a mechanical printer, we're inclined to think this is the RTTY of the future—no noise, no oil. There's an obvious plus to being able to send and receive at any speed without changing gears. Changing speeds is as easy as typing in a couple of sets of numbers.

Comments are welcomed and inquiries will be answered if you'll include an SASE. Our thanks also to K8NLM who spent countless hours on the air helping with operational tests and to WB8ZVL whose suggestions led to many of the ideas incorporated into the program. ■

References

1. "Try Your KIM-1 On RTTY," WA5DXP, *73 Magazine*, Oct., 1977.
2. "RTTY With The KIM," K4GCM, *73 Magazine*, Sept., 1977.
3. "KIM-1 Can Do It," W4COI, *73 Magazine*, Feb., 1978.

KIM-1 Sources/Information

1. KIM Customer Service, Commodore International, 950 Rittenhouse Road, Norristown PA 19401.
2. Johnson Computer, P.O. Box 523, Medina OH 44256.
3. Computer Warehouse Store, 584 Commonwealth Ave., Boston MA 02215.

Books and Newsletters

1. "The First Book of KIM," ORB, P.O. Box 311, Argonne IL 60439, $9.00 postpaid, 176 pgs.
2. 6502 User Notes, PO Box 33093, N. Royalton OH 44133.


```
0300  A9 01       INIT     LDAimm       Initialize in
0302  85 04                STAzp         "ltrs" mode.
0304  20 5A 1E    BEGIN    JSR GETCHAR  Get ASCII data
0307  85 00                STAzp        Store data
0309  20 58 03             JSR STATUS
030C  4C 04 03             JMP BEGIN
030F  A2 00       ID       LDXimm       Clear X
0311  B5 10       ID+1     LDAzp,X      Start read at 0010
0313  85 00                STAzp        Store character
0315  86 01                STXzp        Save X
0317  20 58 03             JSR STATUS
031A  A6 01                LDXzp        Get X
031C  E8                   INX
031D  E0 0C                CPXimm       Done with ID?
031F  D0 F0                BNE ID+1
0321  4C 00 02             JMP RECEIVE
0324  A2 00       BUFFR    LDXimm       Clear X
0326  20 5A 1E    GETB     JSR GETCHAR  Input to buffer
0329  C9 14                CMPimm       Control "T"?
032B  F0 13                BEQ XMTB
032D  9D 00 01             STAabs,X     Store character
0330  E8                   INX
0331  E0 BF                CPXimm       Buffer full?
0333  B0 03                BCS BUFUL
0335  4C 26 03             JMP GETB
0338  A9 87       BUFUL    LDAimm       ASCII "Bell"
033A  20 A0 1E             JSR OUTCHAR   and ring it!
033D  4C 26 03             JMP GETB
0340  86 03       XMTB     STXzp        Store buffer limit
0342  A2 00                LDXimm       Clear X
0344  BD 00 01    XMTB+1   LDAabs,X     Read buffer
0347  86 02                STXzp        Save X
0349  85 00                STAzp        Store character
034B  20 58 03             JSR STATUS
034E  A6 02                LDXzp        Get X
0350  E8                   INX
0351  E4 03                CPXzp        Buffer limit reached?
0353  F0 AF                BEQ BEGIN
0355  4C 44 03             JMP XMTB+1
0358  A5 00       STATUS   LDAzp        Check character
035A  C9 20                CMPimm       "Space"?
035C  F0 14                BEQ LTRS
035E  C9 0A                CMPimm       "Line Feed"?
0360  F0 14                BEQ EXIT
0362  C9 0D                CMPimm       "Carriage Return"?
0364  F0 10                BEQ EXIT
0366  C9 09                CMPimm        Control "I"?
0368  F0 A5                BEQ ID
036A  C9 02                CMPimm        Control "B"?
036C  F0 B6                BEQ BUFFR
036E  24 00                BITzp         Test character
0370  50 29                BVC FIGS      Bit 6 = zero?
0372  A5 04       LTRS     LDAzp         Test Status Flag
0374  F0 0B                BEQ SETL      If "figs", reset.
0376  A5 00       EXIT     LDAzp         Get character
0378  AA                   TAX           Put in X register
0379  B5 00                LDAzp,X       Look-up Baudot
037B  85 00                STAzp         Store conversion
037D  20 BE 03             JSR XMT        and send it.
0380  60                   RTS
0381  A9 01       SETL     LDAimm        Set flag to "ltrs"
0383  85 04                STAzp
0385  A5 00                LDAzp         Retrieve character
0387  85 05                STAzp         Temp. Char. Store
0389  A9 7E                LDAimm        Baudot "ltrs" command
038B  85 00                STAzp         Store it
038D  20 BE 03             JSR XMT        and send it.
0390  A5 05                LDAzp         Retrieve character
0392  AA                   TAX           Put in X register
0393  B5 00                LDAzp,X       Look-up Baudot
0395  85 00                STAzp         Store it
0397  20 BE 03             JSR XMT        and send it.
039A  60                   RTS
039B  A5 04       FIGS     LDAzp         Test Status Flag
039D  F0 1A                BEQ XNORM-2
039F  A9 00                LDAimm        If "ltrs", reset.
03A1  85 04                STAzp
03A3  A5 00                LDAzp         Retrieve character
03A5  85 05                STAzp         Temp. Char. Store
03A7  A9 6E                LDAimm        Baudot "figs" command
03A9  85 00                STAzp         Store it
03AB  20 BE 03             JSR XMT
03AE  A5 05                LDAzp         Retrieve character
03B0  AA          XNORM-1  TAX           Put in X register
03B1  B5 00                LDAzp,X       Look-up Baudot
03B3  85 00                STAzp         Store conversion
03B5  20 BE 03             JSR XMT
03B8  60                   RTS
03B9  A5 00       XNORM-2  LDAzp         Retrieve character
03BB  4C B0 03             JMP XNORM-1
03BE  A0 00       XMT      LDYimm        Clear Y
03C0  A9 80                LDAimm        Define PB7= output
03C2  8D 03 17             STAabs PBDD
03C5  A5 00       LETR     LDAzp         Get stored Baudot
03C7  29 80                ANDimm        Clear bits 6-Ø
03C9  8D 02 17             STAabs PBD
03CC  A9 15       SETT     LDAimm       Time= 22ms.
03CE  8D 07 17             STAabs
03D1  2C 07 17    TCHK-1   BITabs       Time-out?
03D4  10 FB                BPL TCHK-1   No? wait.
03D6  C8                   INY          Set up next bit
03D7  C0 06                CPYimm       Start/Data done?
03D9  F0 05       DONE     BEQ STPBT
03DB  06 00                ASLzp        Get next bit
03DD  4C C5 03             JMP LTR
03E0  06 00       STPBT    ASLzp        Get stop bit
03E2  A5 00                LDAzp
03E4  8D 02 17             STAabs PBD   Stop bit @ PB7
03E7  A9 1E                LDAimm       Time= 31ms.
03E9  8D 07 17             STAabs
03EC  2C 07 17    TCHK-2   BITabs       Time-out?
03EF  10 FB                BPL TCHK-2   No? Wait.
03F1  60                   RTS

END

Reserved Locations:

0000      -    Character Store (Primary)
0001      -    Save X #1
0002      -    Save X #2
0003      -    Buffer Limit Store
0004      -    Ltrs/Figs Status Flag
0005      -    Character Store (Temporary)

0010-001F-     ID Storage Area (Maximum Length= 16 characters)
               (See Table 3 for instructions)

. . . and see Table 1 for other reserved zero page locations.
```

Fig. 1. Program listing.

Keyboard Konvenience

—simplify entry of BASIC programs

Throw in an LED for good measure.

Rod Hallen WA7NEV
Road Runner Ranch
PO Box 73
Tombstone AZ 85638

I recently replaced my uppercase-only keyboard with one that generates both upper- and lowercase letters because word processing is one of my personal computing goals. However, this necessitates constantly shifting when entering BASIC and assembly language programs. The two circuits here (Figs. 1 and 2) allow either uppercase only or both upper- and lowercase operation at the flip of a switch. Numbers, punctuation, etc., are still under the control of the shift key. Both circuits are different methods of implementing the same function depending on what type of IC gates you have available.

The LED indicates upper- and lowercase operation, but it can be eliminated since the position of the switch or the operation of the keyboard will indicate which mode has been chosen. I just like lots of lights.■

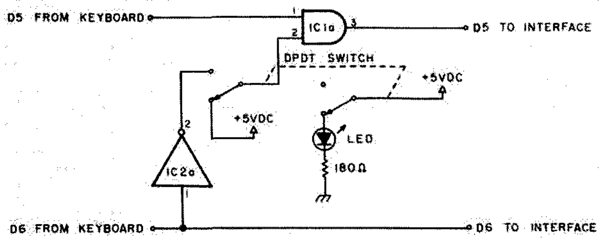


Fig. 1. IC1a = SN7408N AND gate. IC2a = SN7404N inverter. Pin 14 is + 5 V dc on both ICs and pin 7 is ground.

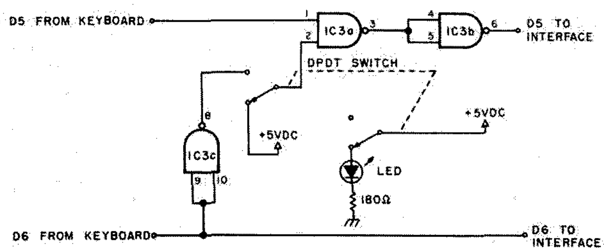


Fig. 2. IC3a, b, and c = SN7400N. Pin 14 is + 5 V dc and pin 7 is ground.

DXCC in One Sitting

—know your prefixes

You don't even need a ticket.

Gary H. Toncre WA4FYZ
13764 SW 54th Lane
Miami FL 33175

Chris Wiener N2CR
10 Elm Street
Tenafly NJ 07670

Would you believe it's possible to work DXCC when the band isn't open? Well, you can work DXCC even if you don't have a ham license. It's not

```
10 PRINT 'DXCC PROGEAM - WRITTEN BY GARY TONCRE WA4FYZ.'
20 PRINT 'REVISED BY CHRIS WIENER N2CR  EX - WA2AYY.'
30 PRINT 'QRZ';
40 INPUT H$
50 FOR B = 1 TO 30
60      PRINT
70 NEXT B
80 PRINT 'OK, '; H$; '.  THIS IS A GAME DESIGNED TO TEST YOUR'
90 PRINT 'ABILITY TO IDENTIFY PREFIXES AND COUNTRIES THAT'
100 PRINT 'MAY BE WORKED ALONG THE WAY TOWARD RECEIVING THE'
110 PRINT 'AMERICAN RADIO RELAY LEAGUES''S DX CENTURY CLUB'
120 PRINT 'AWARD.  YOU MAY SELECT THE CLASS OF DXCC THAT YOU'
130 PRINT 'WANT TO TRY FOR ACCORDING TO THE FOLLOWING'
140 PRINT 'NUMBER NUMBERS OF COUNTRIES:'
150 PRINT
160 PRINT TAB(8); 'NOVICE DXCC','15 COUNTRIES'
170 PRINT TAB(8); 'GENERAL DXCC','25 COUNTRIES'
180 PRINT TAB(8); 'ADVANCED DXCC','35 COUNTRIES'
190 PRINT TAB(8); 'EXTRA CLASS DXCC','50 COUNTRIES'
200 PRINT
210 PRINT
220 PRINT 'THE NUMBER CONFIRMED IS THE NUMBER RIGHT.'
230 PRINT 'DXCC WILL BE AWARDED FOR 90% CORRECT.'
240 PRINT 'YOU WILL GET TWO CHANCES TO ANSWER CORRECTLY.'
250 PRINT
260 DIM S$(4)
270 FOR I = 1 TO 4
280      READ S$(I)
290 NEXT I
300 DATA NOVICE DXCC, GENERAL DXCC, ADVANCED DXCC, EXTRA CLASS DXCC
310 PRINT 'WHICH CLASS OF DXCC DO YOU WANT TO TRY FOR?'
320 PRINT 'ENTER THE CLASS EXACTLY AS LISTED ABOVE';
330 INPUT C$
340 IF C$ = S$(1) THEN 380
350 IF C$ = S$(2) THEN 400
360 IF C$ = S$(3) THEN 420
370 IF C$ = S$(4) THEN 440 ELSE 310
380 N = 15
390 GOTO 445
400 N = 25
410 GOTO 445
420 N = 35
430 GOTO 445
440 N = 50
445 FOR I = 1 TO 30 PRINT
450 PRINT 'IF THE COUNTRY IS AN ISLAND, THEN THE WORD ''ISLAND'' IS';
460 PRINT ' NOT IN THE NAME.'
470 PRINT 'ALL COUNTRY NAMES ARE TAKEN FROM THE ARRL''S DXCC LIST.'
475 FOR I = 1 TO 4 PRINT
480 L$(0) = 'WRONG, LID.  THERE IS A BAND OPENING.  TRY AGAIN.'
490 L$(1) = 'SURE YOU WOULDN''T RATHER TRY FOR WAS? THE CORRECT ANSWER:'
500 W = 0
510 X = 0
520 FOR I = 1 TO N
530      READ Q$, A$
540      T = 0
550      PRINT Q$
560      INPUT G$
570      IF A$ = G$ THEN 650
580      IF T = 0 THEN PRINT L$(0)
590      IF T = 1 THEN PRINT L$(1);
600      T = T + 1
610      IF T = 1 THEN 550
620      PRINT A$
630      W = W + 1
640      GOTO 680
650      PRINT 'CORRECT. NICE GUESS.'
660      W = W + 1
670      X = X + 1
680      PRINT 'YOU NOW HAVE'; W; '/'; X; 'WORKED / CONFIRMED.'
690      FOR K = 1 TO 4 PRINT
700      P = 0.9 * N
710      IF X>= P THEN 760
720 NEXT I
730 PRINT 'LID.  SUGGEST YOU TRY NEXT LOWER CLASS'
740 PRINT 'OR TAKE UP COMPUTER PROGRAMMING.  BETTER YET, GO CB.'
750 GOTO 850
760 PRINT 'AFTER CAREFUL SCRUTINIZATION OF YOUR APPLICATION, THE WRITERS'
770 PRINT 'OF THIS PROGRAM TAKE GREAT (NOT ALL THAT GREAT) PLEASURE'
780 PRINT 'IN AWARDING YOU '; C$; '.'
790 Y = X / W * 100
800 PRINT 'YOU HAVE ACHIEVED A '; Y; '% WORKED / CONFIRMED RECORD.  FB!'
810 PRINT 'YOU RETIRE WITH'; W; '/'; X; ' WORKED / CONFIRMED.'
820 PRINT 'SINCE YOU DID SO WELL, WHY HAVEN''T YOU MADE DXCC'
830 PRINT 'FOR REAL?  NO, YOU CAN''T DO IT ON 2 METERS.'
840 PRINT GOSUB 1020
850 PRINT '73, '; H$
860 PRINT 'UNIVAC 1100 IS CLEAR AND QRT.'
870 GOTO 9999
880 DATA GUANTANAMO BAY, KG4, CANADA, VE, TI, COSTA RICA, FRANCE, F
890 DATA KP4, PUERTO RICO, W, UNITED STATES OF AMERICA, G, ENGLAND,
  BELGIUM, ON
900 DATA XE, MEXICO, DK, FEDERAL REPUBLIC OF GERMANY, YV, VENEZUELA,
  ITALY, I
910 DATA KZ5, CANAL ZONE, COLUMBIA, HK, PY, BRAZIL, SPAIN, EA
920 DATA OE, AUSTRIA, AUSTRALIA, VK, HB, SWITZERLAND, JA, JAPAN
930 DATA CE, CHILE, FINLAND, OH, KL7, ALASKA, NETHERLANDS ANTILLIES, PJ
940 DATA HC, ECUADOR, BULGARIA, LZ, ZS, SOUTH AFRICA, URUGUAY, CX
950 DATA FC, CORSICA, WAKE, KW6, GW, WALES, LIBERIA, EL
960 DATA YO, RUMANIA, LIECHTENSTEIN, HBO, ZD8, ASCENSION, FORMOSA, BV2
970 DATA JT, MONGOLIA, BRITISH PHEONIX, VR1, JY, JORDAN, NAVASSA, KC4
980 DATA ST, SUDAN, GREECE, SV, VP1, BELIZE, ANDORRA, C31
990 DATA VU, INDIA, IVORY COAST, TU, KP6, PALMYRA, TURKEY, TA
1000 DATA AP, PAKISTAN, CLIPPERTON, PO8
1010 GOTO 9999
1020 PRINT 'AND NOW FOR YOUR CERTIFICATE SUITABLE FOR FRAMING.......'
1030 PAGE
1040 FOR I = 1 TO 66
1050      PRINT '-';
1060 NEXT I
1070 PRINT
1080 PRINT TAB(11); 'GARY TONCRE WA4FYZ AND CHRIS WEINER N2CR'
1090 PRINT TAB(13); '    AWARD '; H$; ' AN HONORARY COMPUTER'
1100 PRINT TAB(26); C$
1110 PRINT
1120 PRINT TAB(10);'DDDDDDDDD    XX      XX     CCCCCC       CCCCCC'
1125 PEINT TAB(10);'DDDDDDDDDD   XX      XX     CCCCCC       CCCCCC'
1130 PRINT TAB(10);'DD       DD    XX  XX     CC       CC  CC       CC'
1135 PRINT TAB(10);'DD       DD    XX  XX     CC       CC  CC       CC'
1140 PRINT TAB(10);'DD       DD      XX       CC           CC'
1145 PRINT TAB(10);'DD       DD      XX       CC           CC'
1150 PRINT TAB(10);'DD       DD      XX       CC           CC'
1155 PRINT TAB(10);'DD       DD      XX       CC           CC'
1160 PRINT TAB(10);'DD       DD      XX       CC           CC'
1165 PRINT TAB(10);'DD       DD      XX       CC           CC'
1170 PRINT TAB(10);'DD       DD    XX  XX     CC       CC  CC       CC'
1175 PRINT TAB(10);'DD       DD    XX  XX     CC       CC  CC       CC'
1180 PRINT TAB(10);'DDDDDDDDDD   XX      XX     CCCCCC       CCCCCC'
1185 PRINT TAB(10);'DDDDDDDDD    XX      XX     CCCCCC       CCCCCC'
1190 PRINT
1200 FOR I = 1 TO 66
1210      PRINT '-';
1230 NEXT I
1240 FOR I = 1 TO 4
1250      PRINT
1260 NEXT I
1270 RETURN
1280 GOTO 9999
1290 FOR Y = 1 TO 30
1300      PRINT
1310 NEXT Y
9999 END

RUN

DXCC          11:49:37      3 APR 78


DXCC PROGRAM - WRITTEN BY GARY TONCRE WA4FYZ
REVISED BY CHRIS WEINER N2CR  EX - WA2AYY.
QRZ?  >WA2GMO
```

Fig. 1. Program listing.

easy, but the award is commensurate with the effort put forth. So jump in with both feet and try your luck with Computer DXCC. If you don't want to use this program as is, read on. It is adaptable to many other uses.

The original program was adapted from a quiz program in *Basic Programming* by Kemeny and Kurtz. Over a period of some six months, we have updated the program again and again. Somehow, every time we work a new country, it ends up being in the program!

The Program

The program as listed gives complete instructions in the opening lines. Line 30 asks for your name or call, and it is stored as H$.

The program allows you to select a "class" of DXCC, which is determined by the number of countries that you play. The maximum is 50 countries for the Extra Class DXCC. The countries are arranged in the data statements in an increasing order of difficulty.

You automatically win if you answer 90% correct. Thus, if you answer correctly the first 45 out of the 50 Extra Class countries, the program will go directly to the certificate awarded to the winners.

If a country name is given, you must supply the prefix. If the prefix is given, then you must supply the name of the country as it appears on the ARRL DXCC Country List. You are given two chances to answer each question without penalty. The number that you answered correctly is considered worked and confirmed. Wrong answers are considered as worked only. The program keeps track of your worked/confirmed record, as well as a percentage computed from them. A certificate is awarded to those who make the grade.

Program Breakdown

Lines 10 to 150 supply information on how to play the game. Lines 160 to 440 set up the computer for the number of countries that you want to work (variable N in lines 380 to 440). Lines 500 and 510 set variables W (for your worked countries tally) and X (for those confirmed) equal to zero.

The main body of the program starts at line 520. The loop is completed at line 720 and is executed N times. Line 530 reads the first two pieces of data from line 880— in this case, "Guantanamo Bay" and "KG4." Notice that the data is set up to alternate the country's prefix and the country's name as the question.

Line 540 sets up variable T to keep track of whether your answer is the first or second try. Line 550 prints the country or prefix, and your answer is recorded in 560 as G$. If your answer is right, the program jumps to 650 and your worked and confirmed tallies are incremented by one each. The current record is

```
OK, WA2GMO.  THIS IS A GAME DESIGNED TO TEST YOUR
ABILITY TO IDENTIFY PREFIXES AND COUNTRIES THAT
MAY BE WORKED ALONG THE WAY TOWARD RECEIVING THE
AMERICAN RADIO RELAY LEAGUE'S DX CENTURY CLUB
AWARD.  YOU MAY SELECT THE CLASS OF DXCC THAT YOU
WANT TO TRY FOR ACCORDING TO THE FOLLOWING
NUMBERS OF COUNTRIES:

        NOVICE DXCC           15 COUNTRIES
        GENERAL DXCC          25 COUNTRIES
        ADVANCED DXCC         35 COUNTRIES
        EXTRA CLASS DXCC      50 COUNTRIES

THE NUMBER CONFIRMED IS THE NUMBER RIGHT.
DXCC WILL BE AWARDED FOR 90% CORRECT.
YOU WILL GET TWC CHANCES TO ANSWER CORRECTLY.

WHICH CLASS OF DXCC DO YOU WANT TO TRY FOR?
ENTER THE CLASS EXACTLY AS LISTED ABOVE?  >NOVICE DXCC


IF THE COUNTRY IS AN ISLAND, THEN THE WORD 'ISLAND' IS NOT IN THE NAME.
ALL COUNTRY NAMES ARE TAKEN FROM THE ARRL'S DXCC LIST.


GUANTANAMO BAY? >KG4
CORRECT, NICE GUESS.
YOU NOW HAVE 1 / 1 WORKED / CONFIRMED.

CANADA? >VE
CORRECT, NICE GUESS.
YOU NOW HAVE 2 / 2 WORKED / CONFIRMED.

TI? >COSTA RICA
CORRECT, NICE GUESS.
YOU NOW HAVE 3 / 3 WORKED / CONFIRMED.

FRANCE? >F
CORRECT, NICE GUESS.
YOU NOW HAVE 4 / 4 WORKED / CONFIRMED.

KP4? >PUERTO RICO
CORRECT, NICE GUESS.
YOU NOW HAVE 5 / 5 WORKED / CONFIRMED.

W? >UNITED STATES OF AMERICA
CORRECT, NICE GUESS.
YOU NOW HAVE 6 / 6 WORKED / CONFIRMED.

G? >ENGLAND
CORRECT, NICE GUESS.
YOU NOW HAVE 7 / 7 WORKED / CONFIRMED.

BELGIUM? >ON
CORRECT, NICE GUESS.
YOU NOW HAVE 8 / 8 WORKED / CONFIRMED.

XE? >MEXICO
CORRECT, NICE GUESS.
YOU NOW HAVE  9 /  9 WORKED / CONFIRMED.

DK? >GERMANY
WRONG, LID.  THERE IS A BAND OPENING.  TRY AGAIN.
DK?  FEDERAL REPUBLIC OF GERMANY
CORRECT, NICE GUESS.
YOU NOW HAVE 10 / 1C WORKED / CONFIRMED.

YV? >VENEZUELA
CORRECT, NICE GUSSS.
YOU NOW HAVE 11 / 11 WORKED / CONFIRMED.

ITALY? >I
CORRECT, NICE GUESS.
YOU NOW HAVE 12 / 12 WORKED / CONFIRMED.

KZ5? >PUERTO RICO
WRONG, LID.  THERE IS A BAND OPENING.  TRY AGAIN.
KZ5? >NAVASSA
SURE YOU WOULDN'T RATHER TRY FOR WAS?  THE CORRECT ANSWER: CANAL ZONE
YOU NOW HAVE 13 / 12 WORKED / CONFIRMED.

COLUMBIA? >HK
CORRECT, NICE GUESS.
YOU NOW HAVE 14 / 13 WORKED / CONFIRMED.


AFTER CAREFUL SCRUTINIAZTION OF YOUR APPLICATION, THE WRITERS
OF THIS PROGRAM TAKE GREAT (NOT ALL THAT GREAT) PLEASURE
IN AWARDING YOU NOVICE DXCC.
YOU HAVE ACHIEVED A 92.85714 % WORKED / CONFIRMED RECORD.  FB!
YOU RETIRE WITH 14 / 13 WORKED / CONFIRMED.
SINCE YOU DID SO WELL, WHY HAVEN'T YOU MADE DXCC
FOR REAL?  NO, YOU CAN'T DO IT ON 2 METERS.
AND NOW FOR YOUR CERTIFICATE SUITABLE FOR FRAMING.......
_____________________________________________________________
            GARY TONCRE WA4FYZ AND CHRIS WEINER N2CR
               AWARD WA2GMO AN HONORARY COMPUTER
                          NOVICE DXCC

        DDDDDDDDD   XX      XX    CCCCCC      CCCCCC
        DDDDDDDDDD  XX      XX    CCCCCC      CCCCCC
        DD      DD    XX  XX    CC      CC  CC      CC
        DD      DD    XX  XX    CC      CC  CC      CC
        DD      DD      XX      CC          CC
        DD      DD      XX      CC          CC
        DD      DD      XX      CC          CC
        DD      DD      XX      CC          CC
        DD      DD      XX      CC          CC
        DD      DD      XX      CC          CC
        DD      DD    XX  XX    CC      CC  CC      CC
        DD      DD    XX  XX    CC      CC  CC      CC
        DDDDDDDDDD  XX      XX    CCCCCC      CCCCCC
        DDDDDDDDD   XX      XX    CCCCCC      CCCCCC
_____________________________________________________________

73, WA2GMO
UNIVAC 1100 IS CLEAR AND QRT.
```

Fig. 2. Sample program run.

printed and the confirmed figure is compared to the 90% figure of the countries worked of your class. If they are equal, or if the confirmed figure is greater, a jump is made out of the loop at line 710 to line 760. Otherwise, the loop repeats.

Assuming that you answered wrong just once, line 580 sends you to line 480, which is printed. T is incremented by one and you go back to line 550. If you goof again, line 590 sends you to line 490, which is printed; L=2, so line 610 is skipped and the answer is printed via line 620. Line 630 increments only your worked tally. A jump is made to the print of-your record in line 680, and the rest proceeds as noted above.

If you haven't jumped out of the loop by the time you have gone through it N times, you haven't made 90% correct. In that case, the program goes to line 850 by way of 750 and ends at 9999. If you did win, the program goes through lines 800 to 840 and into the certificate subroutine. The program then returns to line 850 and ends at 9999.

Modifications

This program was written on a Univac 1100 at the University of Miami. It should run as is on most large college and high school computers. If you want to run it on your micro, some changes might have to be made in the interests of conserving memory. You can eliminate lines 10 to 260, but, if you eliminate H$ in line 40, it won't be there to print your name or call on the certificate in the subroutine. You could also decide on just one class and eliminate everything up to line 450, except for giving N some value equal to the number of countries in your list. You could also eliminate the subroutine, but the certificate is nice, especially if you can get a hard copy of it. Of course, you can change the data to any countries or prefixes that you want, except those beginning with a number such as 5Z4—variables like those won't be accepted by the computer. If you don't want to alternate country-prefix-country, you can set up the data to print either the country or the prefix alone as the question. You can also make the game easier to win by changing the winning percentage on line 700 and also the print statement on line 230.

One of the nicest features of the program is that, by changing the data statements, you can adapt DXCC into a quiz, such as naming the capitals of the states. Just rewrite the data lines to read state-capital-state-capital and so on. The number of different quizzes that can be derived from this format is endless.

Note that our Univac accepts line 1030, the command "page." This allows our printer to print the certificate on a separate page. You might have to make a loop of print statements if you want this feature but lack the page command.

Conclusions

We have spent many happy hours writing and playing DXCC. If you really want to get into it, try randomizing each class and making a large data list. We hope you enjoy DXCC, and, if you come up with any more modifications, send us a list of your version. We would like to see what you're doing. ■

Reader Service—see page 195

A Low-Cost Circuit Board Holder

—price tag: 45¢

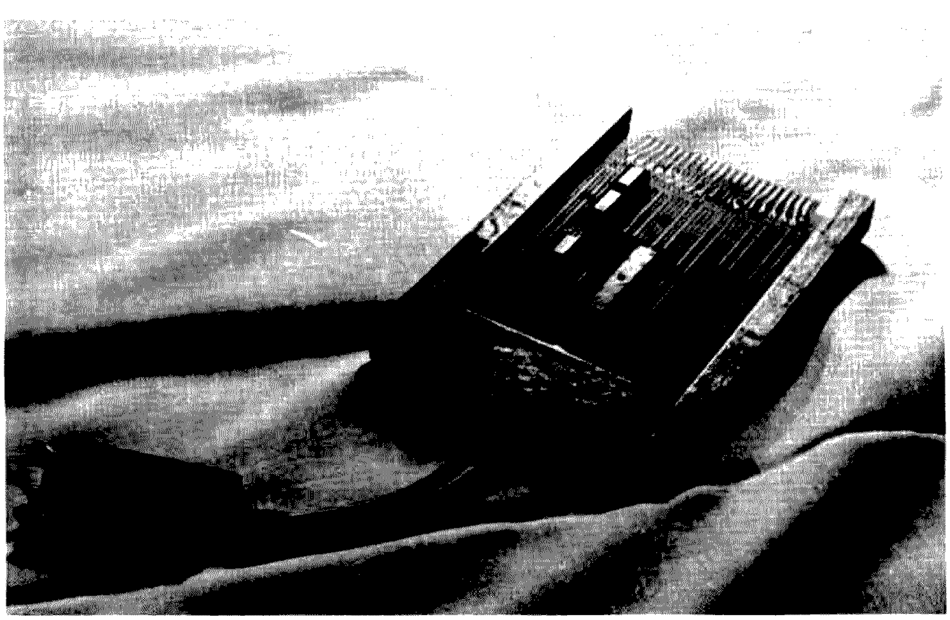
The stingy solution.

Russell W. Steele
838 Gayle St.
Papillion NE 68046

If you are still chasing PC cards across your workbench, you may be interested in a cheap card holder for PC boards. I was bitten by the computer bug this last winter and decided to build a system from scratch, using MSI and LSI chips and standard 44-pin prototyping boards. After evaluating a number of CPU chips and "one-board" systems, I decided to build a system based on the *Popular Electronics* ELF.

My goals were: to learn as much as possible, to keep the project within my limited budget, and to end up with an expandable system. The ELF was less than $100, and I felt it would be easy to expand with other hand-wired boards. I didn't feel competent to make my own PC boards, so I chose the prototype board and wiring-pencil method.

After collecting the necessary parts and designing a layout, my first problem was holding the PC board so that I could use a wiring pencil in one hand and a soldering iron in the other. My first thought was to locate a professional card holder and vise (such as the PANA-VISE), but it came down to a choice between using my limited cash for expensive equipment or buying computer hardware. I chose the latter, electing to solve the card-holding problem with my junk box and some leftover ingenuity.



A $.45 card holder.

After making sketches of my idea (Fig. 1), the next task was to collect parts. Rummaging among my bits of this and that stored in the garage, I spotted a hardwood stave from a shipping crate (2" x ¾" x 18") and a short length of threaded rod (¼" x 12"). In one coffee can I found five 1½" screws left over from a curtain-hanging project (I used molybolts after the curtain fell down), and in another coffee can were five washers and two wing nuts from a TV antenna that blew down long ago. It pays never to throw anything away!

That left me with some T-nuts to pick up at the local hardware (a package of five for 45¢). With this collection of bits and pieces, I hoped to make a PC card holder for a standard prototype board (4" x 6" or 4" x 9"). The size of the holder can be selected to suit your own needs. The small Radio Shack boards will fit if they are slipped in sideways.

To build the holder, I cut two pieces of hardwood

(½" x ¾" x 8") and then put a 1/16" kerf down the length of each piece. This kerf was to hold the card once the wooden fingers were securely fastened to the buttblock with the four 1½" screws. I cut the 1½" x ¾" x 4-3/8" buttblock from the remaining hardwood and beveled one end. The bevel allows adjustable tension for one finger, permitting a snug fit on a variety of similar-sized cards. (I find small variations in different manufacturers' cards.)

Before fastening the fingers, I drilled a 5/16" hole in the center of the block and two pilot holes for the screws at each end. Next, I turned the buttblock up so the narrow side faced me and drove a T-nut into the 5/16" hole.

I then selected a 2" x ¾" x 2" section of the remaining hardwood, drilled a 5/16" hole through the center, and drove a T-nut into the hole. I now had two blocks with T-nuts.

Next, I fastened the fingers on the 2" x 4-3/8" block, one to each end. I found it advisable to pre-drill the screw holes in both the buttblock and the fingers. I drilled the finger holes so they would just fit over the screws. This made the buttblock holes snug enough to keep a good grip on the screws.

I assembled the holder by threading a wing nut about three inches onto one end of the rod, with the wings toward the center. Then I put a washer on the rod and then threaded on the card holder. I then threaded the remaining block on the rod with the T-nut facing the wing nut. Twisting it until the end protruded below the end of the block, I slipped on a washer and a wing nut.

At this point I put the bottom block in the vise and bent the rod approximately 70°. In this position I can swing the holder in an arc or set it in position by tightening the wing nut at the bottom of the 2" x 2" block. I can position the holder at any 360° position on the end of the rod by tightening the wing nut behind the buttblock.

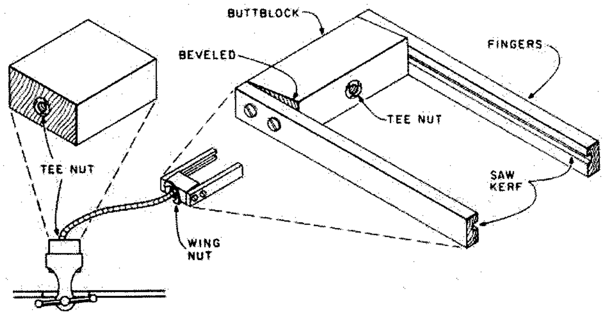


Fig. 1.

A coat of varnish finished the job. A PC card holder for less than 45¢! That is not counting the threaded rod (about $1.00) and the vise—which every hobbyist should have on hand.

In using the "cheap card holder," I find it useful to place a small mirror on the workbench under the PC card so that it is easy to see if wires pushed through from the other side are positioned correctly. It is not difficult, however, to flip the holder over to check wire position and flip it back again. I hope you find this as useful a tool as I do. ■

User Report: the IC-245

—good things come in small packages

Only two reservations.

R. Stanley Dicks W8YA
Box 331, RD2
Triadelphia WV 26059

As many amateurs now are doing, I recently decided to upgrade from a crystal-controlled two-meter rig to a synthesized transceiver. I wanted an all-mode rig, but one which also was compact enough to use on FM from my small foreign car. After surveying the current market, I decided to try the Icom IC-245 with sideband adapter, and I definitely have not been disappointed! The compactness of the rig is truly amazing: It contains a fully-synthesized two-meter FM transceiver, a digital display, and a sideband/CW adapter, all in a box not much bigger than most two-meter FM rigs alone. Crammed into this box are 47 transistors, 8 FETs, 24 ICs, and 61 diodes, and one heckuva two-meter rig!

The 245 is fully synthesized from 144 to 148 MHz. From 146 to 148 MHz, it tunes in 5-kHz steps, and from 144 to 146 MHz in 100-Hz steps. There is, however, a button which allows one to tune in 5-kHz steps below 146 MHz, making sweeps of the band more rapid. Tuning is accomplished with a single large knob, eliminating the two or three switches and knobs which often must be turned on other synthesized rigs. The knob has a solid feel and has a click-stop mechanism so that it clicks and holds firm at each increment. This prevents possible drift due to jostling in the mobile, and also allows for tuning in heavy traffic without having to look at the rig. If one is on .76, for example, one can go to .79 simply by counting six clicks on the dial (at 5 kHz each).

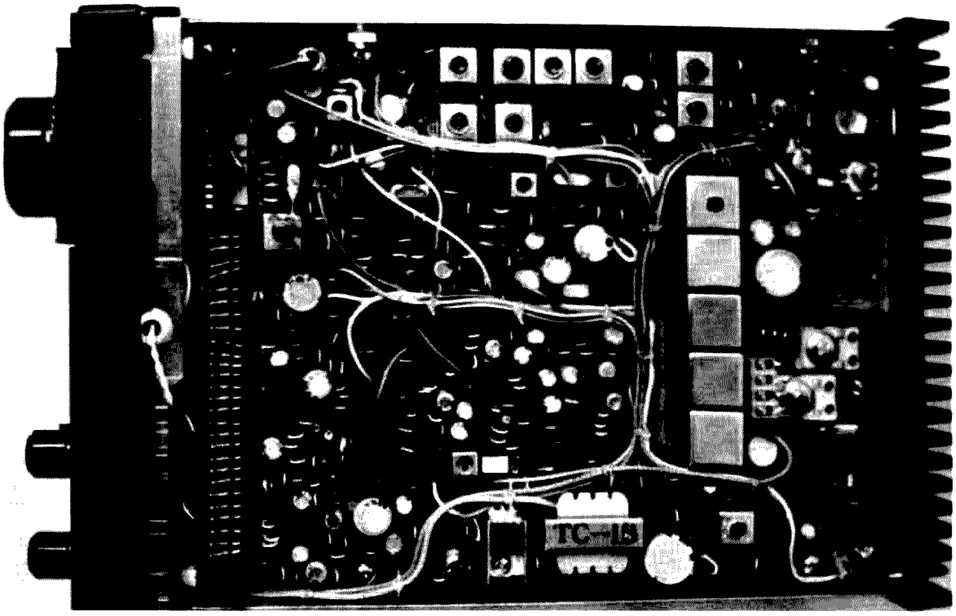
This is the Icom IC-245.

The rig comes with a quick-tuning adapter knob which easily can be slid onto the main knob, allowing rapid tuning across the band—especially on SSB. The digital display is large and easily readable, with four digits (146.52 reads out as 6.520), and an automatic dimmer so that the digits are dimmed in a dark environment (in the car at night) and bright in high ambient light. They shine brightly enough to read in all but very strong, direct sunlight. The meter indicates relative power on transmit and signal strength in receive.

The unit has an ingenious dual vfo system, also in use in Icom's 701 and 711, which allows almost total versatility in setting up offset frequencies. Under normal circumstances, one lines up the vfos 600 kHz apart, and they then track together for the routine repeater split. However, it is possible to program any split desired from 5 kHz to 955 kHz. The in-

 May 1979

struction manual says that the unit has an automatic reverse circuit so that when tuning from 146 to 147 MHz, the 600-kHz split will automatically reverse, making it unnecessary to throw a switch to reverse transmit/receive frequencies above 147 MHz. A note accompanying the manual, however, states that, "due to customer requests," this automatic reversal system has been defeated by the addition of a single shorting wire. The note says that the wire must not be removed while the rig is in warranty. As soon as my warranty expires, I intend to remove the wire and see what happens; if the reversal system functions, it would make repeater access possible anywhere from 146 to 148 MHz without the necessity of throwing a single switch. Nifty?



A bottom view of the IC-245 shows the five connected cans containing the helical resonators which are responsible for the rig's excellent selectivity. The final transistor is in back.

The 245 runs 10 Watts on FM (true FM) and CW and 10 Watts PEP on upper sideband. Local stations report that the audio is crisp and clean on both FM and SSB, and that the CW note is excellent, with no chirping or clicking. They also report that carrier suppression is excellent; even when I am over S9, no one can hear any carrier at all.

The receiver section of the rig has the quality for which Icom has become renowned. Even in the presence of strong local signals, I have never heard any cross modulation or front-end overload. The audio sounds sharp for a two-meter rig, and a rear panel jack allows plug-in of an external speaker. The receiver seems to be quite sensitive on both SSB and FM. An FM signal of S1 will be full-quieting, and sideband signals are regularly copied which are out of range of the rig's 10-Watt transmitter. In fact, the receiver's sensitivity causes some frustration; I hear many stations I can't reach with only 10 Watts!

On FM, the 245 has a conventional double-conversion system with i-f stages at 10.7 MHz and 455 kHz, and on SSB/CW it has a single-conversion i-f at 10.7 MHz. Sensitivity is rated at 0.5 uV for a 10-dB (S+N)/N ratio on SSB/CW, and 0.6 uV for 20 dB of quieting on FM. If anything, the rig appears to be more sensitive than its ratings. The noise blanker for SSB/CW reception is quite effective at cancelling the occasional hash-type noises I have tried it on, and the rig is considerably more impervious to auto ignition noise than was my previous rig. No matter what I did to try to suppress ignition noise with the old rig, I had about S4 QRN; with the 245, the ignition noise is barely discernible. The receiver has a switch to select a slow agc rate for SSB reception, and the result is SSB which sounds as smooth as low-band SSB on my Drake receiver.

One can cite features and specifications all day, but the proof, as they say, is in the punch. The 245 is a delightful rig to own and operate. It is compact and therefore easily transferred from auto to house and back. Recently, I stuck it in my suitcase along with a small 12-volt supply and a whip antenna and took it on a business trip. Try that with other multi-mode rigs! Two-meter SSB operation from the 14th floor of a hotel is fun!

At home, with an 11-element, vertically-polarized beam at 70 feet, I can hear literally hundreds of repeaters on the synthesized rig and can regularly call into machines as far out as 150 miles. This is one of the real joys in store for the crystal-controlled operator who changes to synthesization; the number of accessible repeaters is staggering. The vertically-polarized beam doesn't do well on SSB and CW where most other stations are using horizontal antennas, but even with cross-polarization, the Icom's 10 Watts and sensitive receiver provide regular contacts out to about 100 miles. The 245 gives one full flexibility on two meters: FM work on any repeater or simplex frequency, satellite work, weak signal CW and SSB DXing, mobile and portable work, and so on.

I can cite only two reservations about the 245. First, it operates only USB, and thus cannot be used for mode J OSCAR work on SSB; maybe Icom will come out with an LSB filter. Second, the photosensitive cell which controls the automatic LED readout dimmer is located right beside the tuning knob. This means that when the operator reaches up to tune the knob, often he blocks light from the cell, causing the readout to dim. It is only a minor nuisance, and one soon learns to move the hand slightly when tuning so that this doesn't happen.

These reservations are negligible when compared to the flexibility and performance which such a small package provides. I can hardly wait to get a horizontal beam up and a small linear amp to tack on to the rig, and I am working on OSCAR antennas now. See you on 144.200! ■

Eric Shalkhauser W9CI
527 Spring Road
Washington IL 61571

The History of Ham Radio

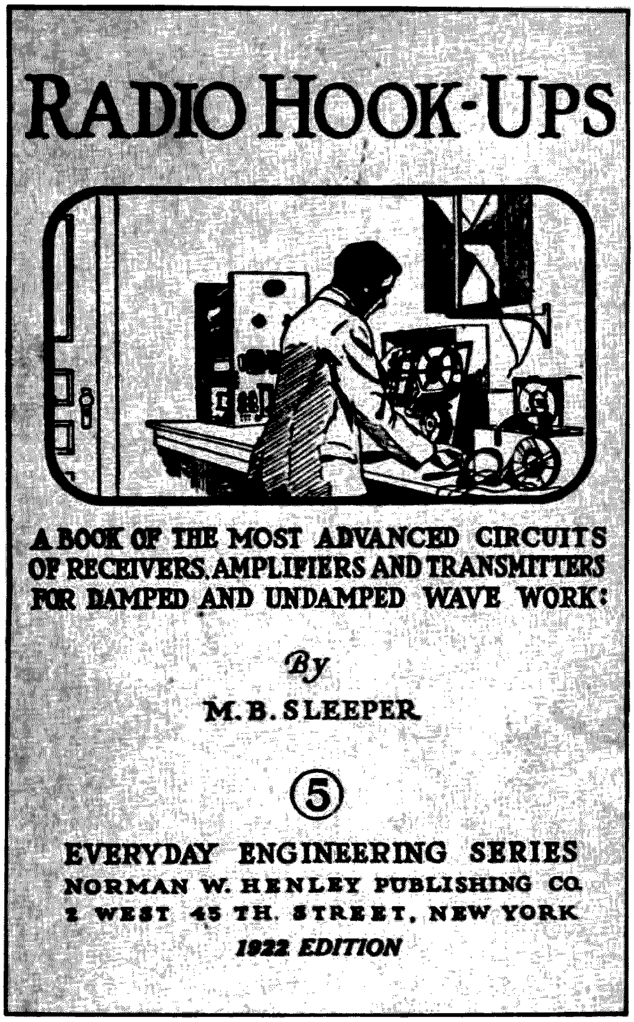
—part VIII

The early '20s.

Reprinted from QCC News, a publication of the Chicago Area Chapter of the QCWA.

The evolution of radio before, and to a great extent during, the 1918 war year was for the most part in the hands of radio amateurs and the experimenters. The development of the vacuum tube and its utilization required much time for laboratory research. The quenched-gap and crystal detector were still very much in use. Considerable effort was being put forth by commercial companies together with government engineers, notably the Navy, to develop reliable means of generating undamped waves along semi-mechanical electrical lines. The culmination of these efforts was the Alexanderson alternator, providing high frequency energy with power up to 200 kilowatts to satisfy navigational and overseas communication demands.

Following the evolution of radio art, two major patent-issuing corporations emerged in America, undertaking research toward larger and better vacuum tubes to replace the quenched-gap and the alternator. They were Radio Corporation of America, a group consisting of General Electric Company, Westinghouse Electric and Manufacturing Company, and American Telephone and Telegraph Company, which



pooled patent licenses, and then Hazeltine Corporation, an independent licensing holder. This was a time when many patent applications were flooding the patent office covering circuit designs, and many component parts were entering into the assembly of radio receivers and transmitters. The two companies acted initially as holders of patent rights and issued licenses. Many individuals and small organizations, doing private research, were filing patent applications on hundreds of ideas pertaining to radio, thus leaving the budding industry wide open to massive confusion. The license holders tried to meet this avalanche of new developments by issuing warnings to developers, inventors, and all those who were active in the field, including those who purchased radio parts from dealers and jobbers. The warnings read, "the assembly of a receiver is only for your own private, experimental use, which includes broadcast reception of music and entertainment, not for broadcast transmission and NOT FOR SALE." In other words, licenses had to be obtained first by dealers or jobbers, manufacturers, or assemblers to go into business. With such regulations, back-door trading became commonplace, and many instruments found outlets designed to circumvent the restrictions.

It was to be expected that to satisfy the demand of the listening public, there would be concerns engaged in building and assembling receivers. During this period, it was not possible to standardize any specific design because of the extremely high rate of turnovers and obsolescence. The radio amateur was busily building and assembling sets for his friends and neighbors, who reaped the benefits of his expertise in wireless.

The market mushroomed with the proliferation of broadcast transmitters throughout the United States and the rapidly increasing availability of radio receivers. Improvements in quality and reliability also contributed to lowered costs. Vacuum tubes were produced by the thousands, gradually improving their function but remaining far from being a uniform product. The UV-200 detector and the UV-201 amplifier were the mainstays. All others were either experimental or leftovers from previous designs.

The year 1921 saw a rapid growth of broadcast radio service. Electric manufacturing companies, universities, newspapers, and many individuals obtained permission from the Department of Commerce to become broadcasters. Radio amateurs had permission to transmit news, music, and items of interest over their stations. Broadcasting received the attention and guidance of various government departments. Interest in radio was universal.

This rapid expansion also had its reverse effects. Interest waned when disturbances occurred. The reason—general news and entertaining music was relegated to one wavelength, i.e., 360 meters. Official government stations broadcasting information, weather, and market news were on a wavelength of 485 meters. Not all stations held to these wave assignments accurately. Deviations gave some stations advantages over others. There was not enough room for all to communicate without excessive crossovers. The 1921-1922 receivers were not built to be selective or to avoid overlapping signals. Unless stations geographically close together decided by agreement to broadcast at different times of the day or were located some distances apart, the listener was denied satisfactory reception.

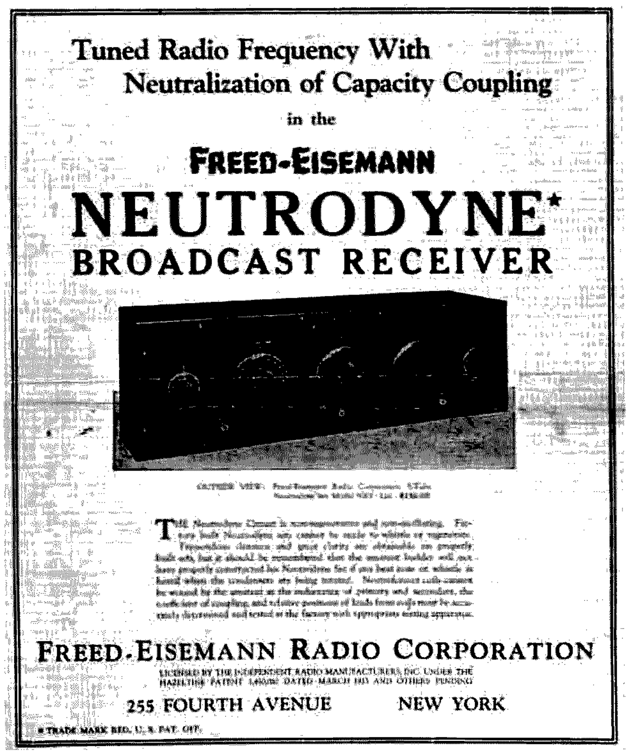
This troublesome problem of interference became so acute that in February, 1922, the Department of Commerce drew up plans which rearranged wavelengths to the broadcaster and to other services as follows:

Public Broadcasting, signifying broadcasting from universities, public institutions, and stations licensed for the purpose of dissemination of information and for educational services, was assigned 485 to 495 meters.

Private Broadcasting, signifying broadcasting by a newspaper, private or public organization, or person licensed for that purpose, including amateurs, was assigned 100 to 150 meters and 285 to 485 meters.

Other wavelengths were intended for commercial ship to shore and overseas communication.

General broadcasting stations were on wavelengths sufficiently different so as not to be heard when a receiving set was tuned to another station. This was to be determined by the broadcaster himself, using his own equipment. Amateurs were supposed to operate mostly late at night, using wavelengths below 275 meters. The early receivers had practically no selectivity. They were



very broad tuning, unstable, and consumed a great deal of energy, operating from dry cells and storage batteries. Radio receivers which could be operated from the standard 115-volt circuit had not yet arrived.

In 1914, Major Edwin H. Armstrong invented a radio receiver circuit known as the regenerative circuit. He obtained a patent from the government on October 6, 1914. This circuit described the use of the vacuum tube in a detector-oscillator combination. Vacuum tubes were at that time only in the experimental stage, crudely constructed, unreliable, and not readily available. Consequently, very little development took place before 1917 to test the unique application of the Armstrong circuit wireless signal reception.

The regenerative principle in the circuit is most simply described by stating that when energy is applied at the input terminals of a circuit connected to a vacuum tube in oscillation, the circuit presents either a more negative or a more positive reaction. The objectionable feature of a regenerative circuit was self-oscillation, which was uncontrollable in the hands of the average user. The whistles and howls coming from the loudspeaker or headphones were shocking and became unbearable.

Under such unstable conditions, the radio amateur came up with novel innovations, especially when tuning to continuous wave signals. When using his audiotron tube or his Marconi, De Forest, Donle, or Connecticut "vacuum bottle" for that critical adjustment to bring the reception under control, the presence of a magnet in the proper vicinity of the tube, held at certain angles to the bulb, would increase the intensity of the signal. Close adjusment of the magnet gave excellent results.

Early in August, 1919, the De Forest Company announced one of the first receivers for the monitoring of phone and/or continuous wave signals. It covered 160 to 450 meters and was designated the three-coil ultra-audion. It was designed as a shortwave regenerative instrument composed of a series of individually-wired sections and was hooked up as a composite assembly. Hardly a receiver for use by the general public.

Receivers could be assembled following the circuits illustrated in handbooks like the one issued by M. B. Sleeper entitled *Radio Hook-Ups*. The illustrations basically used a coil or two, a tuning condenser, and either a crystal or vacuum tube detector plus a pair of headphones. The tubes available were leftovers, designed during the war by French, German, English, and American laboratories.

They were not very reliable and rarely gave uniform results. It was not uncommon to find a backroom laboratory coming up with some exotic tube design. The intent was to try to improve such undesirable characteristics as excessive filament current drain, objectionable interelectrode capacitances, and short-lived filament emission.

The radio literature of the 1920s carried instructions on how to assemble receivers utilizing various types of coils (these included universal, honeycomb, unilateral, duolateral, bi- and multilattice), tuning condensers (of the straight line wavelength, straight line frequency, book-type design), variometers, and variocouplers tied to a vacuum tube or two in cascade.

In 1920, the radio amateur and the avid listener had available receivers manufactured under license. They were known as Grebe CR instruments. These receivers were not the type to place into the hands of the uninitiated. They were meant for the radio amateur and experimenter.

For shortwave reception, which included broadcast, the internal capacity of the tube proved a bar to any straightforward solution. Realizing that the vacuum tube was at the heart of the problem, Major Armstrong came up with a solution in the circuit principle named the heterodyne and superheterodyne. It is based on the mixing together of two frequencies in order to produce two frequencies which are equal to the sum and difference of the other two. In so doing, an intermediate frequency was produced which could be more effective and responsive to the characteristics of the available tube. The resultant amplification was a comparison of the voltage applied to a second detector in the circuit to that of the incoming terminal voltage.

A receiver built along these lines required a series of 6 to 8 tubes and gave excellent amplification. It required skilled manipulation of the controls, since adjustments had to be made at numerous positions to track the frequencies of the incoming signal. Sensitiveness of the superheterodyne receiver was proven by Paul Godley while at Androsen, Scotland, in December, 1920, when he logged numerous American stations during the transatlantic initial DX contest, related in part V of "The History of Ham Radio."

In analyzing the various circuit combinations of the heterodyne, it was found that the operation of the system proved a little too critical, especially since, to avoid interaction, individual tubes were required for detection and for rectification. As a

result, tuning became more complicated. Engineers remarked that if some way could be found for tuning adjustments to be set and sealed in the laboratory by skilled engineers leaving relatively simple adjustments to the operator, the receiver would be the ideal.

The main difficulty which had to be overcome was the instability from the combination of high amplifications desired. The solution hinged on overcoming the generated oscillations when the number of tubes of the 1921-1922 vintage were hooked to one another in cascade. Much effort was expended in designing intertube transformers of air-core, special iron-core, special couplings, and windings, to balance the impedances from stage to stage. Instability was the problem, again depending on the tubes available.

Well known, in 1922, was a receiver called the neutrodyne. It was designed around a non-regenerative and non-oscillating configuration. When properly constructed and assembled, the one thing this circuit did not do was emit objectionable whistles. The neutrodyne relied on straightforward cascade amplification of the incoming signal. It started with one or two stages of radio frequency amplification, then detection and reinforcement with one, two, or even three stages of audio frequency amplification. It was a popular receiver in its day. The set suffered from an undue amount of internal noise, generated and amplified due to mismatched component parts, internal tube disturbances, and lack of sufficient tuning controls to balance out the inherent design faults.

About this time in the era of wireless evolution, the amateur's thoughts were directed toward mobile and portable gear. ■

W2NSD/1
NEVER SAY DIE
editorial by Wayne Green

from page 4

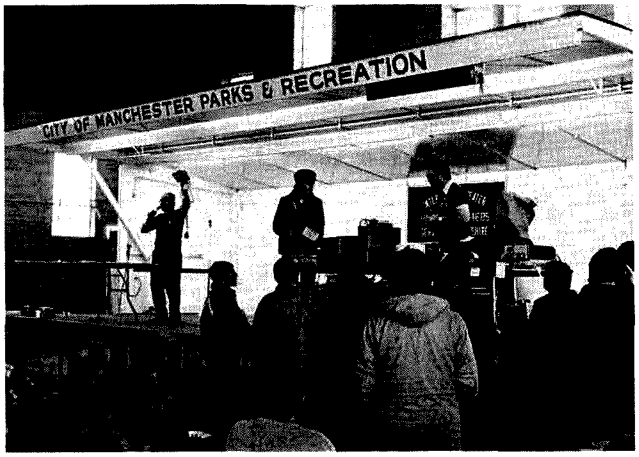
initials of that club) mounted their second annual auction in Manchester just before Lincoln's birthday. Chancy time of year for something like this, as they found out last year when Mother Nature dumped a bunch of snow on New England the day before the auction, effectively keeping most everyone home.

The crowd was excellent this year, and the Roving Camera was there to catch all the action. The auction brought out tons of vintage ham gear for a yearly change of ownership. I haven't seen so many Gonset Communicators all in one place in years . . . I wonder what the new owners *do* with them?

Manchester is only 35 miles from Peterborough, but then, New Hampshire is a very small state and most towns are not very far apart. Sherry and I often drive up to Manchester for a business lunch or dinner. The shopping is good there, too, particularly since there is no sales tax in New Hampshire. After visiting other states, it feels funny to buy things and pay only the price marked.

There is a particularly good

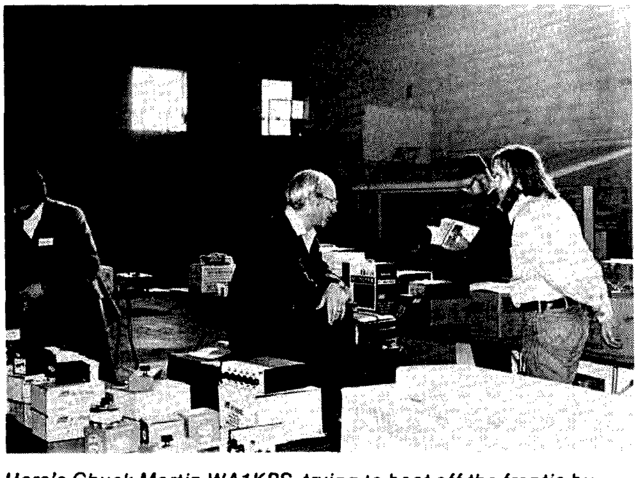
An excited mass of bidders, vying for every piece of gear, no matter how useless, is here letting its enthusiasm run away with itself over a particularly exotic rig.



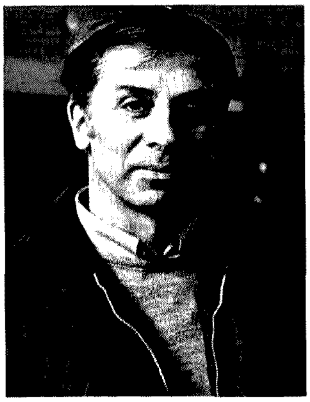
The auction is held in an armory in downtown Manchester, a cavernous place.

Much of the crowd wandered off to visit the tables of ham gear brought in by dealers such as Tufts Electronics, a carpetbagger from Massachusetts—a state known to most New Hampshire people for the tons of beer cans brought up by thousands of world-famous Massachusetts drivers and dumped alongside New Hampshire roads on weekends. Here is aging, paunchy Wayne in the center, listening to John Seeney of Cushcraft tell why his new magnetic-mount two meter antenna is selling so well. John had a display set up in one corner of the Tufts booth and kept a lot of hams enthralled with his hyperbole.

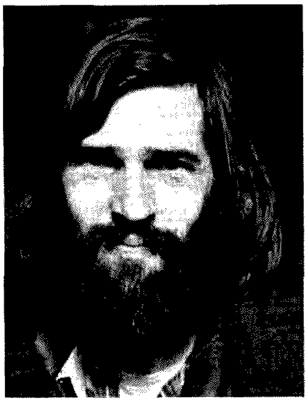
Jeff DeTray, the assistant editor and publisher of 73 *and* Kilobaud MICROCOMPUTING, *managed to contain himself through some of the more frantic bidding, returning with naught but pleasant memories of underbidding on equipment for which he would have no earthly use.*



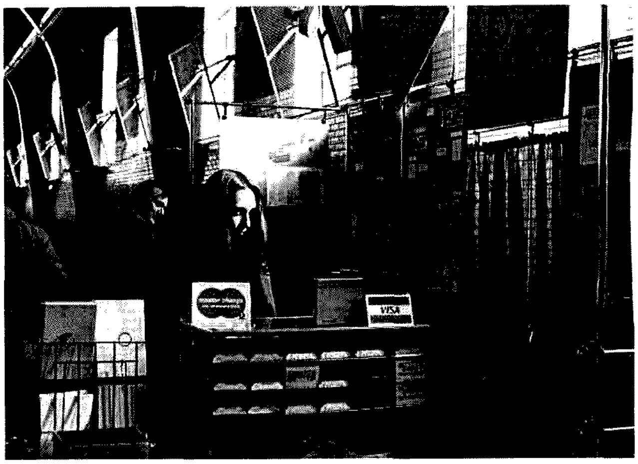
Here's Chuck Martin WA1KPS trying to beat off the frantic buyers of ham gear. Actually, I'm not kidding about the auction doing well for some of the commercial exhibits. Tufts did their best day of the entire month in sales as a result of the sales made this day . . . lots of 520s found happy homes. Chuck, who would much rather be skiing, gave in to commercial pressures and brought a truckload of stuff to New Hampshire, thus ensuring more healthy signals from this relatively rare state.



Over visiting, looking for microwave gear bargains, was Judson Snyder K2CBA, whom I've known for over 30 years. As a matter of fact, he used to bootleg with my ham rig before he got his own call. Jud is a big gun on UHF from the Troy area of New York.



This is Steve Murray K1KEC, who apparently lost his razor and scissors a few years ago. Steve is another skier, though he missed the yearly pilgrimage to Aspen this January. Steve has been deeply involved with repeater frequency coordination for about ten years.



A computer store from Boston had a display at the auction, attracting computerist Hal Chamberlin . . . one of the earliest publishers in the field. Hal put out The Computer Hobbyist *from North Carolina before wising up and moving to New Hampshire. His work with cassette systems lives on in many of the commercial systems today. Hal, by the way, was one of the first people I contacted when I thought up the idea for starting* Byte *magazine. He didn't seem to think that a magazine would do well for microcomputers, so I next tried Hal Singer, another editor of an excellent hobbyist newsletter. He didn't think much of the idea either, so I tried Bob Albrecht, etc., finally getting down to the chap I eventually picked, Helmers. I understand that Helmers has been sort of "retired" by* Byte, *so perhaps those who turned down the job made a better decision for the long run.*

supermarket in Manchester, too—Ferretti's—so I stopped by and found they had some fresh Chinese noodles! Now, how often do you see those in a supermarket? A few days later I got busy and made up a batch of spareribs with black bean sauce on soft noodles. This is a dish which I always get when I visit Hong Fat restaurant in Chinatown in New York (63 Mott Street). It's so good, you can become addicted to it. Imagine my surprise when I found that I could make it even better than Hong Fat! It's easy, once you figure out how to do it.

Not to turn *73* into a cookbook, but there are a few dishes which I've learned to make which are first rate, if you are adventurous in your eating. Oh, you're not? Okay . . . forget it.

SOFTWARE SURPRISE

One of the more pleasant surprises in the new software publishing business has been the sales of Instant Software's Ham Package I. This is a group of eight different programs for the Radio Shack TRS-80 microcomputer. These programs permit you to make most of the ordinary ham slide rule calculations quickly and easily—calculations such as Ohm's Law, frequency vs. reactance, series capacitances, parallel resistances, voltage dividers, etc. There are also programs which give you the dimensions for dipole and yagi antennas.

One of the more useful aspects of computerized calculations is the ability of the TRS-80 to draw the schematics of the circuits and antennas, complete with the dimensions.

With approximately 30% of the computer hobbyists also being radio amateurs, the sales of the Ham Package I programs were not expected to be low, but sales reports from Instant Software marketing show that this package of programs has consistently been one of the very best sellers. Only the Space Trek II and the Air Flight Simulator program packages have consistently been outselling the Ham Package! Space Trek II has been running about 40% ahead of the Ham Package, and Air Flight Simulator has been running about 15% ahead.

At $7.95 for the eight programs, the Ham Package has to be one of the better program values—and perhaps a harbinger of things to come as far as the publishing of programs in bulk is concerned. These are available from many of the computer stores, a few Radio Shack stores, and from Instant Software, Inc. A few ham stores are starting to set up computer program sales centers. Tufts Electronics is carrying the full line of Instant Software program packages.

JANUARY WINNER

John Murray W1BNN was the overwhelming winner in our January Most Popular Article contest. He will be receiving a $100 bonus check for his article, "SOS! Ship in Trouble!"

WE COOK, TOO!

On the left is Lynn Panciera-Fraser, the production manager for both 73 *and* MICROCOMPUTING *magazines. She's working with Sherry Smythe, our Executive Vice President, in making some Chinese steamed dumplings. I was not too busy making my spareribs with black bean sauce on soft Chinese noodles to snap this picture.*

Ham Help

I need a schematic and/or manual for a Sideband Engineers model SBE33. I will pay for photocopying and shipping.

Jeff Taylor W0NLU
R #1, Box 40A
St. James MO 65559

I need help with the digital multimeter article authored by WA4AIH in the April, 1978, issue of *73*. I need the source for the General Instruments AY-3-3550 IC and the Intersil ICL 8052 ACPD.

Ed McKenzie WA3PHL
Millersville State College
Millersville PA 17551

Social Events

Listings in this column are provided free of charge on a space-available basis. The following information should be included in every announcement: sponsor, event, date, time, place, city, state, admission charge (if any), features, talk-in frequencies, and the name of whom to contact for further information. Announcements must be received two months prior to the month in which the event takes place.

SHREVEPORT LA
MAY 4-5

The Shreveport Amateur Radio Association will hold its annual hamfest on May 4-5, 1979, at the Louisiana State Fairgrounds. Pre-registration is $3.00; $4.00 at the door. This is an ARRL sanctioned hamfest.

NEENAH WI
MAY 5

The 3-F Amateur Radio Club will hold its annual swapfest on Saturday, May 5, 1979, from 8:00 am to 3:00 pm, at the Neenah Labor Temple, 157 S. Green Bay Road, Neenah, Wisconsin, just off Highway 41 at the Highway 114 or 150 exit. Facilities include a large parking area and a large indoor swap area with a free auction at the end of the day. Food and beverage will be available. Advance admission for tickets and tables is $1.50; $2.00 at the door. Talk-in on 52/52. For reservations, write to Mark Michel W9OP, 339 Naymut Street, Menasha WI 54952.

BINGHAMTON NY
MAY 5

The Southern Tier NY Amateur Radio Clubs will hold their 20th annual hamfest and dinner on May 5, 1979, at the Lutheran Fellowship Recreation Center, 3.7 miles north of NY Rte. 17, Exit 71 N., on Stella Ireland Road, Binghamton, New York. There will be technical talks, prizes, displays, exhibits, refreshments, and free flea-market parking. Tickets are $2.00 for general admission and $7.00 for the banquet (including general admission). Inside tables are $5.00 each, by reservation only. For tickets and information, write to STARC, PO Box 11, Endicott NY 13760.

DULUTH MN
MAY 5

The Arrowhead Radio Amateur Club will hold its annual swapfest on May 5, 1979, from 11:00 am to 3:00 pm at the First United Methodist Church, 230 E. Skyline Parkway, Duluth, Minnesota. Admission is $1.50 and tables are $1.50. Refreshments are available on the grounds. An auction will be held at 2:00 pm. Talk-in on .34/.94. For more information, write Harold Simmerman N9AMA, Swapfest Chairman, Route 1, Box 7, Lake Nebagamon WI 54849, or call (715)-374-3231.

DEKALB IL
MAY 6

The Kishwaukee Radio Club and the DeKalb County Amateur Repeater Club will hold their 21st annual indoor/outdoor hamfest on Sunday, May 6, 1979, from 8:00 am to 3:00 pm at the Notre Dame School, 3 miles south of DeKalb between Highway 23 and South 1st St. on Gurler Rd., DeKalb, Illinois. Tickets are $1.50 in advance; $2.00 at the door. Indoor tables are available or you may bring your own. The outdoor setup is free. Talk-in on 146.13/.73 and 94. For tickets and directions, send an SASE to Howard Newquist WA9TXW, PO Box 349, Sycamore IL 60178.

LOGANSPORT IN
MAY 6

The Cass County Amateur Radio Club will hold its second annual hamfest on Sunday, May 6, 1979, from 7:00 am to 4:00 pm at the 4-H fairgrounds, Logansport, Indiana. Go north of Logansport on Highway 25, turn right at Road 100, and follow the QSY signs. Admission is $1.50 in advance and $2.00 at the gate. Outside setup is free and undercover setup is $1.00. Bring your own tables. There will be overnight camping, refreshments, ladies' bingo, and door prizes. Talk-in on 146.52 and Logansport repeater 147.78/.18. For information, write Dave Rothermel K9DVL, RFD 4, Box 146G, Logansport IN 46947.

WARMINSTER PA
MAY 6

The Warminster Amateur Radio Club will hold its fifth annual "Ham-Mart" flea market and auction on Sunday, May 6, 1979, from 9:00 am until 4:00 pm, at the William Tennent Intermediate High School, Street Road (Route 132), two miles east of York Road (Route 263), Warminster, Bucks County, Pennsylvania. A registration fee of $1.00 per car includes one ticket for door prizes. Tailgating is $2.00 additional. Indoor tables are available for $3.00 each. Talk-in on 146.16/76 and 146.52. For further information, please write Horace Carter K3KT, 38 Hickory Lane, Doylestown PA 18901, or phone (215)-345-6816.

SACRAMENTO CA
MAY 6

The North Hills Radio Club, Inc., of the greater Sacramento area, is having their 7th annual Ham Swap on Sunday, May 6, 1979, from 9:00 am until 3:00 pm at the Machinists Hall, 3081 Sunrise Blvd., Rancho Cordova, California. Take Hwy. 50 to Sunrise, turn left, and go to the signs. For information, write Cecilia Pringle WB6PBS, Publicity Chairman, North Hills Radio Club, PO Box 701, Fair Oaks CA 95628.

ELLICOTT CITY MD
MAY 6

The Potomac Area VHF Society will hold its eighth annual hamfest on Sunday, May 6, 1979, from 8:00 am to 5:00 pm at the Howard County Fairgrounds, approximately 15 miles west of Baltimore, at the intersection of I-70 and Rte. 32, Ellicott City, Maryland. A registration fee of $3.00 includes flea market or tailgate sales. Professional food and beverage catering and unlimited parking will be available. Talk-in on .52. For further information, contact Paul H. Rose WA3NZL, 25116 Oak Dr., Damascus MD 20750.

IRVINGTON NJ
MAY 6

The Irvington Radio Amateur Club will hold its annual hamfest on May 6, 1979, from 9:00 am to 4:00 pm at the PAL Building, 285 Union Ave., Irvington, New Jersey. Take the Garden State Parkway to Exit 143 north or 143A south. There will be refreshments and prizes. Tables are $3.00. Talk-in on .34/.94 and .52. For information, contact Ed Surmaitis WA2MYZ at (201)-687-3240 evenings, or write to Irvington Radio Amateur Club, 285 Union Ave., Irvington NJ 07111.

FRESNO CA
MAY 11-13

The 37th annual Fresno Hamfest will be held on May 11-13, 1979, at the Sheraton Inn, Clinton and Highway 99, Fresno, California. The program includes technical talks, swap tables and flea market, transmitter hunt on 2 meters (146.52), QLF contest, ARRL CD appointees meeting, ARRL-FCC forum, commercial exhibits, prizes, eyeball QSOs, prime rib banquet, and more. For full registration and eligibility for pre-registration prize, send in $17 before April 27, 1979; it's $19 and no pre-registration prize after that date. Talk-in on 146.34/146.94. For more information, contact the Fresno Amateur Radio Club, Inc., PO Box 783, Dept. HF, Fresno CA 93712.

DEERFIELD NH
MAY 12

The Hosstraders Net will hold its 6th annual tailgate swapfest on Saturday, May 12, 1979, at the Deerfield Fairgrounds, Deerfield, New Hampshire. There will be covered buildings, in case of rain. Admission is $1.00, with no commission or percentage. Commercial dealers are welcome at the same rate. Excess revenues will benefit the Boston Burns Unit of the Shriners' Hospital for Crippled Children. Last year we donated over $1100.00. Talk-in on .52 and 146.40-147.00. For more information, send an SASE to Joe DeMaso K1ROG, Star Route, Box 56, Bucksport ME 04416, or Norm Blake WA1IVB, PO Box 32, Cornish ME 04020, or check the Hosstraders Net on Sundays at 4:00 pm on 3940 kHz.

VANCOUVER WA
MAY 12-13

The Fort Vancouver Hamfair will be held on Saturday and Sunday, May 12-13, 1979, at Clark County Fairgrounds, Vancouver, Washington. Registration is $4.00 per person, which includes a drawing ticket. Tickets are also available at the door. Activities will include contests, seminars, commercial and amateur displays, family events and a large ham radio flea market. Many prizes will be awarded, with the grand prize being an Icom IC-701 HF transceiver and power supply. The fairground facilities include trailer parking and ample car parking. A catered buffet dinner is scheduled for Saturday night, with musical entertainment included. Price of the dinner ticket is $5.00 for adults. For registration, contact Ken Westby W7DYX, Registration Chairman, 606 Miami Court, Vancouver WA 98664.

DAYTONA BEACH FL
MAY 12-13

The Daytona Beach Amateur Radio Association, Inc., will hold its first hamfest on May 12-13, 1979, at the Holiday Inn Surfside, Daytona Beach, Florida. For Mom and the kids, there is the "drive-on" ocean beach, and shopping in the oceanside plaza. Advance registration is $3.00 per family and $3.50 at the door. For more details, contact Funfest chairman David Rusler WA4ZTT, 1725 Hope Drive, Ormond Beach FL 32074.

SALINE MI
MAY 13

The ARROW Repeater Association will hold its annual Swap and Shop on Sunday, May 13, 1979, at the Saline,

Michigan, fairgrounds. Admission, including parking on the fairgrounds, is $1.50 in advance and $2.00 at the door. There will be food, prizes, and a covered area for trunk sales, as well as indoor tables. Because of Mother's Day, wives will be given free admission. Talk-in on 146.37/97, 223.18/224.78, and 448.5/443.5 MHz. For additional details, write ARROW, PO Box 1572, Ann Arbor MI 48106, or call George Raub AD8X at (313)-485-3562.

WAUKESHA WI
MAY 13

The Milwaukee UHF Society, Inc., will hold its second annual Spring Swapfest on Sunday, May 13, 1979, starting at 7:00 am on the grounds of the Waukesha County Exposition Center, Waukesha, Wisconsin. There will be prizes and refreshments. Admission is $1.50 in advance and $2.00 at the gate. Some indoor space is available. Dealers and exhibitors are welcome. For information, write Swapfest, Box 49, North Prairie WI 53153. Please include an SASE.

CADILLAC MI
MAY 19

The Wexaukee ARA will hold its 19th annual swap and shop on Saturday, May 19, 1979, from 9:00 am until 4:00 pm at the National Guard Armory, 415 Haynes Street, Cadillac, Michigan. Tickets are $2.00. There will be free parking and lunches available. Talk-in on 146.37/.97. For more information, contact Robert Bednarick WD8RZL, Publicity Director, Wexaukee ARA, Cadillac MI 49601.

BENSENVILLE IL
MAY 19

The Radio Amateur Megacycle Society will hold its third Antenna Measuring Contest on Saturday, May 19, 1979, starting at 10:00 am on the grounds of the Flick-Reedy Corporation, corner of Thorndale and York Roads, Bensenville, Illinois. Equipment will be available to measure the gain and swr of 2 meter, 1¼ meter, and 70 cm antennas. Equipment for higher frequencies will be brought if advance request is made. Prizes will be awarded for the highest-gain antenna in each category. Refreshments will also be sold. For further details, including directions, write Joe LeKostaj WB9GOJ, 2558 N. McVicker Ave., Chicago IL 60639. Please enclose an SASE.

BIRMINGHAM AL
MAY 19-20

The Birmingham Amateur Radio Club, Inc., will hold its Birminghamfest '79 and Alabama State Convention on May 19-20, 1979, at the Birmingham-Jefferson Civic Center Exhibition Hall, Interstate 20/59 at 22nd Street north (downtown Birmingham, 3 minutes from the airport). There will be air-conditioned exhibit space and an indoor air-conditioned flea market. Tentative forums are planned on a wide range of topics, from ARRL to microprocessors. Meetings will include MARS, ARRL, Alabama section nets/ARPSC, and others. On-site FCC exams will be administered on Saturday morning. Prizes include a Drake TR/DR-7 solid-state transceiver, a Kenwood TS-820, and a Drake UV-3 (complete). There will be a banquet on Saturday night at the Exhibition Hall, with special guest entertainer Jerry Clower. Family activities include games, movies, and bus tours of area sights. For information, contact Birminghamfest '79, PO Box 603, Birmingham AL 35201.

DURHAM NC
MAY 19-20

The Durham F.M. Association will hold its annual Durhamfest on Saturday and Sunday, May 19-20, 1979, at the South Square Mall, Durham, North Carolina. Plenty of prizes, exhibits, and programs will be offered, and the XYLs can enjoy shopping. Ladies' bingo will be held on Sunday. Free tailgating spaces, under a covered, drive-in-and-sell flea market, come with a one-time $3.00 general registration ticket, with vendors and dealers included. Electrical power will be available. Harmonics and unlicensed XYLs are admitted free. Talk-in on 147.825-.225, 146.34-.94, 222.34-3.94. For more information, write DFMA, Box 8651, Durham NC 27707.

BURLINGTON KY
MAY 20

The Kentucky Ham-O-Rama will be held on May 20, 1979, at the Boone County Fairgrounds, Burlington, Kentucky. For easy access, take the Burlington exit off I-75 south. There will be a chance for prizes included with the $3.00 gate ticket. There will also be hourly drawings, exhibits, a flea market, and refreshments. Talk-in on 146.19/79 and 52/52. For more information, contact NKARC, Box 31, Ft. Mitchell KY 41017.

WEBSTER MA
MAY 20

The Eastern Connecticut Amateur Radio Club will sponsor an electronics flea market from 9:00 am until 6:00 pm, with an auction at 1:00 pm, on May 20, 1979, at Point Breeze Restaurant, Webster, Massachusetts. It will be held rain or shine. For more information and flyers, contact Richard Spahl K1SYI at (617)-943-4420 after 8:00 pm.

EASTON MD
MAY 20

The fifth annual Easton Amateur Radio Society Hamfest will be held on May 20, 1979, from 10:00 am to 4:00 pm, at the Easton Senior High School cafetorium on Rt. 50, just south of Easton at mile marker 66. From the Baltimore or DC areas, go across the Chesapeake Bay bridge; the mile marker is about 27 miles from the bridge. There will be hamfest signs on Rt. 50, north and south. Refreshments will be available. There will be a donation of $2.00 with an additional $2.00 for tables or tailgaters. Talk-in on 52 and 146.445/147.045. For more information, write Charles C. Walgren WA3ZWX, Box 7, Trappe MD 21673, or the Easton Amateur Radio Society, Inc., Box 781, Easton MD 21601.

TRENTON TN
MAY 20

The Humboldt ARC will hold its annual hamfest on Sunday, May 20, 1979, at Shady Acres City Park, Trenton, Tennessee. There will be a flea market, prizes, ladies' activities, and food. For further information, contact Ed Holmes W4IGW, 501 N. 18th Ave., Humboldt TN 38343.

EVANSVILLE IN
MAY 20

The Tri-State Amateur Radio Society will hold its annual hamfest on May 20, 1979, at the Vanderbugh 4-H Rural Center, Evansville, Indiana. Grounds for the hamfest will be open at 8:00 am CST Sunday morning. There will be no admission charge. Tickets will be on sale for door prizes, which are a Kenwood 520S and a Yaesu 227R. In addition, there will be many other lesser prizes awarded for hamfest attendance. Exhibit tables inside the hall will be $2.50 each, and a 4-by-8-foot space in a covered area adjacent to the hamfest will be available for $1.00 per space. Food and beverage will be available. Saturday overnight camping space is available for those so equipped. Talk-in on .75/.15 through the Evansville repeater.

STIRLING NJ
MAY 20

The Tri-County Radio Association will hold its annual indoor hamfest/flea market on May 20, 1979, at the Passaic Township Youth Center, Valley Road, Stirling, New Jersey, from 10:00 am to 5:00 pm. Admission is $2.00 and tables are $5.00. Among the many door prizes will be a Tempo S1 and a fully-synthesized 2 meter transceiver. Talk-in on 147.855/.255 or 146.52. For information, write Tri-County Radio Association, Box 412, Scotch Plains NJ 07076, or call Herb Klawunn at (201)-647-3461.

CROWNSVILLE MD
MAY 20

The Maryland Mobileers Amateur Radio Club, Inc., will hold its annual hamfest on May 20, 1979, at Camp Barrett, Crownsville, Maryland, just west of Annapolis. The gates will open at 10:30 am. Tickets are $3.00. Prizes will be awarded. Talk-in on 146.52 and 146.10/.70. For information, contact MMARC, Inc., PO Box 784, Severna Park MD 21146.

ROCHESTER NY
MAY 25-27

The 46th annual Rochester Hamfest and the New York State ARRL Convention will be held on May 25-27, 1979, at the Monroe County Fairgrounds, Route 15A, Rochester, New York. Advance registration is $3.75; registration at the gate is $4.00. The Saturday evening annual awards banquet tickets are $9.50 each. Unlimited outdoor flea market space is available at $1.00 per parking space. It will open at noon on Friday and operate until closing on Sunday. The indoor flea market space is $5.00 per table per day and is open Saturday and Sunday only. A limited number of camper hookups are available free on a first-come, first-served basis. Commercial exhibits and most programming is located at the Dome Center and will open at 8:30 am Saturday. FCC tests for Technician and higher classes will also begin at 8:30 am on Saturday at the fairgrounds. The ladies' shopping tour and program are free, but all must have a registration ticket. Children under 12 are also admitted free. For information, write Rochester Hamfest, PO Box 1388, Rochester NY 14603, or phone (716)-424-1100. For tickets, write Rochester Hamfest —Tickets, 737 Latta Rd., Rochester NY 14612.

PORTLAND ME
MAY 26

The Portland Amateur Wireless Association and the University of Southern Maine Radio Club will hold a tailgate flea market on May 26, 1979, from 9:00 am to 5:00 pm on the campus of the University of Southern Maine, Portland, Maine. Admission is one dollar. Food will be available. Talk-in on 146.73 and 146.52. For further details, contact John Taylor N1SD, 44 Mitton St., Portland ME 04102, or phone (207)-773-2651.

HAMBURG PA
MAY 27

The Reading Radio Club will

hold its annual hamfest on Sunday, May 27, 1979, beginning at 9:00 am, at the Hamburg Field House in Hamburg, Pennsylvania. There will be door prizes, food, tailgate sales, and dealer space available. The hamfest will be held rain or shine. Talk-in on .31/.91 and 146.52. For more information, write The Reading Radio Club, Hamfest Committee, PO Box 124, Reading PA 19603.

SALEM VA
MAY 27

The Roanoke Valley Amateur Radio Club will hold its annual hamfest on Sunday, May 27, 1979, at the American Legion Building, Apperson Drive, ½ mile west of the intersection of South 11 and 419, Salem, Virginia. There will be fine prizes, including a first prize of a Ten-Tec 540 transceiver. Inside flea market tables are $3.00 and tailgaters are $2.00. Tickets are $2.00 each or 3 for $5.00 in advance. All tickets are $2.50 at the door. Talk-in on 146.88, 146.985, and 146.52. For advance tickets, send an SASE to George Moore WA4GFX, 701 Apperson Drive, Salem VA 24153.

LOUISVILLE KY
JUN 29-JUL 1

The Louisville Area Computer Club will hold its 4th annual Computerfest™ 1979 from June 29 through July 1, 1979, at the Bluegrass Convention Center, Louisville, Kentucky. Activities include a flea market, seminars, and exposition, as well as activities for the entire family. Seminar and exposition admission is $4.00. Pre-registered Ramada Inn guests ($29.00, single; $34.00, double) receive free admission. For advance mail information, write Computerfest '79, Louisville Area Computer Club, PO Box 70355, Louisville KY 40270, or phone Tom Eubank, Chairman, at (502)-895-1230.

UPPER HUTT NZ
JUN 1-4

The 1979 Annual Conference of the New Zealand Association of Radio Transmitters will be held on June 1-4, 1979, at Upper Hutt, New Zealand. Visitors are welcome to attend this conference. For registration forms, contact the Secretary, 1979 Conference Committee, PO Box 40-212, Upper Hutt NZ.

ST. PAUL MN
JUN 2

The North Area Repeater Association, Inc., will hold its Amateur Fair '79 on Saturday, June 2, 1979, at the Minnesota State Fairgrounds, St. Paul, Minnesota. This is a swapfest and exposition for amateur radio operators and computer hobbyists. There will be free overnight parking for self-contained campers on June 1st only. You may sell from your car in the giant flea market or from the available inside space. There will be AMSAT and microprocessor exhibits, FCC, ARRL, Minnesota Repeater Council booths, and many prizes. Admission is $2.00. For information or reservations for commercial space, write Amateur Fair, PO Box 30054, St. Paul MN 55175.

WENATCHEE WA
JUN 2-3

The Apple City Amateur Radio club will hold its Ham Fest on June 2-3, 1979, at Rocky Reach Dam, 7 miles north of the city on Highway 97, Wenatchee, Washington. Registration fee for amateurs is $3.00 (which includes one ticket for the prize drawing), $1.00 for non-amateurs, and children under 12 are free. A banquet dinner will be held on Saturday night at $5.00 per person. Free camp/trailer space will be provided at the park. Featured will be equipment displays, a VHF tune-up clinic, an arts and crafts show/sale, a swap shop, a photography display, exhibits, a tour of the Power House, a film on the Life of Thomas Edison, and a potluck dinner on Sunday at 1:00 pm. For information and reservations, contact the Apple City Amateur Radio Club, 713 Grandview Avenue, Wenatchee WA 98801.

MANASSAS VA
JUN 3

The Ole Virginia Hams Amateur Radio Club, Inc., will hold its annual hamfest on June 3, 1979, at the Prince William County Fairgrounds, located ½ mile south of Manassas, Virginia, on Rte. 234. Gates will open at 8:00 am but tailgaters may enter at 7:00 am. General admission is $3.00 per person, with children under 12 admitted free. Tailgating is $2.00 per vehicle, with over 300 spaces available. Prizes include a 5-band SSB transceiver, a synthesized 2 meter transceiver, and a Bird 43 wattmeter, plus many more. Breakfast and lunch are available on the premises. Featured will be an FM clinic, a YL program, a children's program, CW proficiency, and QSL bureau programs. Indoor exhibit space for dealers and manufacturers is available. For information, write to Sam Lebowich WB4HAV, OVHARC, PO Box 1255, Manassas VA 22110.

WEST HUNTINGTON WV
JUN 3

The Tri-State ARA will hold its 17th annual hamfest and family picnic on June 3, 1979, starting at 10:00 am, at the Camden Amusement Park, West Huntington, West Virginia. There will be a planned program for the XYL and kids, or you can enjoy the amusement park if you prefer. There is a possibility the FCC will administer amateur exams. There will be major prizes, a large flea market, exhibitors, and displays. Dealers are always welcome to space in the covered pavilion. Talk-in on 34/94 or 16/76. For more information, write TARA, PO Box 1295, Huntington WV 25715.

ISLIP LI NY
JUN 3

The Long Island Mobile Amateur Radio Club, Inc., will hold its Long Island Hamfair '79 on June 3, 1979, from 9:00 am to 4:00 pm at the Islip Speedway, on Islip Avenue (Rte. 111), just one block south of the Southern State Parkway, Exit 43, or south on 111 from Exit 56 of the Long Island Expressway, Islip, Long Island, New York. There will be over 250 exhibitors. General admission is $1.50 and exhibitors' admission is $3.00 per space. Wives, sweethearts, and children under 12 are admitted free. There will be many door prizes available for all ticket holders. Talk-in on 146.25/.85 and .52. The rain date will be June 10, 1979. For information, contact Henry Wener WB2ALW, 53 Sherrard St., East Hills NY 11577, or phone (516)-829-5880 days or (516)-484-4323 nights.

STEVENS POINT WI
JUN 3

The Central Wisconsin Radio Amateurs, Ltd., will hold its swapfest picnic on Sunday, June 3, 1979, starting at 10:00 am at Bukolt Park, Stevens Point, Wisconsin. There will be a picnic area, refreshments, equipment sales, and prizes. For information, write to Frank L. Guth W9BCC, Secretary-Treasurer, Central Wisconsin Radio Amateurs, Ltd., 1632 Ellis Street, Stevens Point WI 54481.

PRINCETON IL
JUN 3

The Starved Rock Radio Club will hold its annual hamfest on Sunday, June 3, 1979, at the Bureau County Fairgrounds, Princeton, Illinois. The fairgrounds are centrally located and easily reached via routes 80-6-34-89-26. Watch for the large yellow "Hamfest" signs. There will be lots of room for the free swappers' area and parking. New equipment dealers, manufacturers, and their representatives are invited to request details on reserving space in our inside display area. There will be food and refreshments available during the day. Camper, van, and trailer spaces are available for a nominal fee and should be reserved in advance. Please include an SASE for map, motel information, and advance reservations at $1.50, if postmarked before May 20 ($2.00 at the gate). For more information, write W9MKS/WR9AFG, Starved Rock Radio Club, RFD #1, Box 171, Oglesby IL 61348, or phone (815)-667-4614.

CHELSEA MI
JUN 3

The Chelsea Swap 'n Shop will be held on Sunday, June 3, 1979, at the Chelsea Fairgrounds, Chelsea, Michigan. Gates will open for sellers at 5:00 am and for the public from 8:00 am until 3:00 pm. Admission is $1.50 in advance or $2.00 at the gate. Children under twelve and non-ham spouses are admitted free. Talk-in on 146.52 and 146.37/.97. Proceeds will benefit the Dexter High School Radio Club and the Chelsea Communications Club.

ALLENWOOD PA
JUN 3

The 8th annual Milton Amateur Radio Club Hamfest will be held on June 3, 1979, rain or shine, at the Allenwood Firemen's Fairgrounds, located on US Rte. 15, 4 miles north of Interstate 80, Allenwood, Pennsylvania. Hours are from 8:00 am to 5:00 pm. Registration for sellers is $2.50 advance or $3.00 at the gate. XYLs and children are free. Featured will be a flea market, an auction, a contest, cash door prizes, a free portable and mobile FM clinic, and supervised children's activities. There will be an indoor area available, plus food and beverages. Talk-in on .37/.97, .34/.94, and .52. For further details, call or write Kenneth Herling WA3IJU, RD #1, Box 381, Allenwood PA 17810, or phone (717)-538-9168.

BEMIDJI MN
JUN 9

A hamfest will be held on June 9-10, 1979, at Bemidji Fairgrounds, on the west side of town on Highway 2, Bemidji, Minnesota. There will be a complete program for hams, non-hams, and kids. Camping will be available on Saturday night. Tables are available at no charge. Tickets are $1.50. Talk-In on 146.34/.94 and 3935. For more information, write Jerry Pottratz WBØMSH, Rte. 2, Box 239B, Bemidji MN 56601.

MEADVILLE PA
JUN 9

The Crawford Amateur Radio Society will hold its fifth annual hamfest on Saturday, June 9,

1979, at Crawford County Fairgrounds, Meadville, Pennsylvania. Admission is $2.00. Gates will open at 8:00 am. Bring your own tables. The cost to display is $2.00 for an inside area and $1.00 for an outside area. There will be door prizes, refreshments, and commercial displays. Talk-in on .04/.64, .81/.21, .63/.03. For details, write CARS, Hamfest Committee, PO Box 653, Meadville PA 16335.

GUELPH ONT CAN
JUN 9

The Central Ontario Amateur Radio Flea Market will be held on Saturday, June 9, 1979, from 8:00 am until 4:00 pm at Centennial Arena, College Ave. W., Guelph, Ontario, Canada. Commercial displays will open at 10:00 am. Admission is 75¢ per person with children 12 years and under admitted free. Admission for vendors is an additional $2.00. There will be a large indoor and outdoor flea market, commercial exhibits, free balloons, free handouts, and operating ham stations. Talk-in on .52/.52, .37/.97 VE3KSR, and .96/.36 VE3ZMG.

SENATOBIA MS
JUN 9-10

The fourth annual Tri-State Hamfest will be held on June 9-10, 1979, in the coliseum of Northwest Junior College, Senatobia, Mississippi. Indoor air-conditioned space will be available for manufacturers, dealers, and distributors. For information, contact Joel P. Walker, 1979 Hamfest Chairman, PO Box 276, Hernando MS 38632; (601)-368-5277.

AKRON OH
JUN 10

The Goodyear Amateur Radio Club will hold its 12th annual hamfest picnic and flea market on Sunday, June 10, 1979, from 10:00 am to 5:00 pm at Goodyear Wingfoot Lake Park, near Rtes. 224 and 43, east of Akron, Ohio. There will be five main prizes, including a Yaesu FT-101ZD, a Midland 13-510, a Wilson Mark II, a Drake MN-4C, and a Bird wattmeter. Featured will be a large flea market, auction, and picnic area. Tickets are $3.00 each or two for $5.00. Talk-in on 146.04/.64. For more information, contact D. W. Rogers WA8SXJ, 161 South Hawkins Ave., Akron OH 44313.

MONROE MI
JUN 10

The Monroe County Radio Communication Association will hold its annual hamfest Swap and Shop on June 10, 1979, from 8:00 am to 4:00 pm at the Monroe County Community College on Raisinville Rd. off M-50, Monroe, Michigan. Donation is $1.00 at the gate. There will be plenty of free parking, free trunk sales and indoor table space. Features will include a contest, an auction, commercial displays, and UHF, VHF, and HF technical sessions and demonstrations. Talk-in on 146.13/.73 or .52. For reservations and information, contact Fred Lux WD8ITZ, PO Box 982, Monroe MI 48161.

OAK RIDGE TN
JUN 14-15

The Oak Ridge Amateur Radio Club will hold the Oak Ridge Amateur Radio Convention and Hamfest '79 on July 14-15, 1979, at the Oak Ridge Civic Center, Oak Ridge, Tennessee. Admission is $1.00. There will be commercial and flea market exhibitors. FCC exams will be given on Saturday at 8:00 am. Features for the ladies and kids include movies, a tour of the Museum of Science and Energy, or the pool, picnic, and playgrounds at the Civic Center. Camping facilities, motels, and restaurants are conveniently located. The week of July 9-16 will be proclaimed Amateur Radio Week in Oak Ridge by the Mayor. Talk-in on 146.88, 147.72, and 146.82. Local talk-in on 146.52. Anyone interested should contact Charles Byrge WB4OBE, PO Box 291, Oak Ridge TN 37830.

DUNELLEN NJ
JUN 16

The Raritan Valley Radio Club will hold its eighth annual hamfest on Saturday, June 16, 1979, from 8:00 am to 4:30 pm at Columbia Park, Dunellen, New Jersey. For details, write Raritan Valley Radio Club, RD 3, Box 317, Somerset NJ 08873, or phone WB2MNE at (201)-356-8435.

MIDLAND MI
JUN 16

The Central Michigan Amateur Repeater Association will hold its fifth annual Swap & Shop on June 16, 1979, at the Midland County Fairgrounds, Midland, Michigan. There will be computer demonstrations and door prizes. Donation is $2.50 at the door. Talk-in on 146.73 WR8ARB and 146.52. For tickets and information, send an SASE to R. L. Wert W8QOI, 309 E. Gordonville Road, R #12, Midland MI 48640.

CROWN POINT IN
JUN 17

The Lake County Amateur Radio Club will hold its 16th annual Dad's Day Hamfest on June 17, 1979, from 8:00 am until 5:00 pm at the Lake County Fairgrounds, Crown Point, Indiana. The event is all indoors. Donation is $1.50 in advance and $2.00 at the door. Table space is available on a first-come, first-served basis. There will be refreshments, a picnic area, ample parking, and a zoo and playground area for the children. Talk-in on 147.84/.24. For information and advanced tickets, write LCARC, PO Box 1909, Gary IN 46409.

BARNESVILLE PA
JUN 17

The Schuylkill Amateur Repeater Association will hold its 2nd annual hamfest on Sunday, June 17, 1979, at Lakewood Park, Barnesville, Pennsylvania, along Rte. 54, 3 miles east of Exit 37E on Interstate 81. Gates open at 9:00 am, rain or shine. Registration is $2.00, with XYL and children free and tailgaters $1.00 additional. Indoor tables are available at $2.00 per table. There will be large indoor and outdoor display areas, prizes, plenty of parking space, amusement rides, picnic tables, and refreshments. Talk-in on 147.78/.18 and 146.52. For more information, write SARA Hamfest, PO Box 901, Pottsville PA 17901.

TORRINGTON CT
JUN 17

The CO Radio Club will hold its first flea market, rain or shine, on June 17, 1979, at the Torrington Fish and Game, Torrington, Connecticut. Undershelter tables, tailgate space, light lunches, a raffle, and a YL bake sale will be featured. Talk-in on 147.84/.24 and 146.52. For information, contact Bob W1FHP at (203)-266-7232, Ed W1JSU at (203)-482-1837, Everett K1AQE at (203)-482-0523, or write Dave Johnstone WB1COB, 19 Margerie St., Torrington CT 06790, or phone (203)-482-7348.

BELLEFONTAINE OH
JUL 1

The Champaign Logan Amateur Radio Club, Inc., will hold its annual hamfest on Sunday, July 1, 1979, at the Logan County Fairgrounds, South Main Street and Lake Avenue, Bellefontaine, Ohio. There will be free admission and door prizes. Trunk and table sales are $1.00, and there will also be a bid table. Talk-in on 146.52. For more information, contact John L. Wentz W8HFK, Box 102, West Liberty OH 43357, or Frank Knull W8JS, 402 Lafayette Ave., Urbana OH 43078.

DUNKIRK NY
JUL 1

The Northwestern New York Repeater Association and the Northern Chautauqua Amateur Radio Club will hold their Lake Erie International Hamfest on Sunday, July 1, 1979, at the fairgrounds in Dunkirk, New York. A large flea market area and plenty of free parking will be provided. Tickets are $4.00 at the gate or $3.00 in advance. RV hookups are available. For information on advance sales or for a map showing easy directions from I-90, write to Dick Brinkerhoff WB2HEF, 123 5th St., Dunkirk NY 14048.

INDIANAPOLIS IN
JUL 8

The Indianapolis Amateur Radio Association will sponsor the Indianapolis Hamfest on Sunday, July 8, 1979, at the Marion County Fairgrounds, on the southeast corner of Indianapolis at the intersection of Interstates 74 and 465, Indianapolis, Indiana. There will be commercial exhibitors and dealer displays for a fee of $30.00 per booth. The commercial building will be open from 12:00 noon until 9:00 pm on Saturday and will reopen at 7:00 am on Sunday. Camper hookup facilities are available on the fairgrounds for overnight parking if you arrive on Saturday. A food and drink vendor will have a setup outside, while a professional caterer will have facilities inside. For more information, write to the Indianapolis Hamfest, PO Box 1002, Indianapolis IN 46206.

CANTON OH
JUL 15

The fifth annual Hall of Fame Hamfest will be held on Sunday, July 15, 1979, at Stark County Fairgrounds, Canton, Ohio. Tickets are $2.50 in advance and $3.00 at the gate. Mobile check-in on .19/.79 or .52/.52. For information, contact Max Lebold WA8SHP, 10877 Hazelview Ave., Alliance OH 44601.

PITTSFIELD MA
JUL 21-22

The NoBARC Hamfest will be held on July 21-22, 1979, at Cummington Fairgrounds, Pittsfield, Massachusetts. There will be tech talks, demonstrations, and dealers. Flea market admission is $1.00. Advance registration is $3.00 single and $5.00 with spouse, and $4.00/$6.00 at the gate. Gates open at 5:00 pm on Friday for free camping. Talk-in on 146.31/.91. For reservations, contact Tom Hamilton WA1VPX, 206 California Ave., Pittsfield MA 01201.

ESSEX MT
JUL 21-22

The International Glacier-Waterton Hamfest will be held on July 21-22, 1979, at the Three Forks Campground, ten miles east of Essex, Montana, on US Highway 2. Registration is at 9:00 am. Talk-in on .52 and

.34/.94. For more information, write Glacier-Waterton Hamfest, PO Box 2225, Missoula MT 59806.

EUGENE OR
JUL 21-22

The 4th annual Lane County Ham Fair will be held on July 21-22, 1979, at the Oregon National Guard Armory, 2515 Centennial Blvd., Eugene, Oregon. Registration is $3.00, and an extra drawing ticket is given with advance registration. There will be displays, lectures, contests, swapshop, transmitter hunt, and entertainment. The facilities provide plenty of free parking for motor homes and trailers.

For information and advance reservations, phone or write Wanda or Earl Hemenway, 2366 Madison, Eugene OR 97405 at (503)-485-5575.

MARSHALL MO
JUL 22

The Indian Foothills Amateur Radio Club will hold its 4th annual hamfest on July 22, 1979, at the Saline County Fairgrounds, Marshall, Missouri. Tickets are $2.00 each or 3 for $5.00 in advance; $2.50 at the door. Registration is at 8:00 am, with lunch at 11:30 pm (all you can eat) and the drawing at 2:30 pm. Prizes include a Tempo S1, a Dentron Jr. Monitor™ tuner, and many more. There will be flea markets for the OM and XYL. There is no charge for flea market tables this year, but reservations are requested. There will also be old and new equipment displays, a 10-X booth, and other activities for the XYLs. Talk-in on .52, .28/.88, and 147.84/.24. For information and tickets, write Norman Gibbins WB0SZI, 692 North Ted, Marshall MO 65340.

MOOSE JAW SASKATCHEWAN CAN
JUL 27-29

The Moose Jaw Amateur Radio Club will hold its 1979 Hamfest (Particifest 79) on July 27-29, 1979, at the Saskatchewan Technical institute, 600 Saskatchewan St. W., Moose Jaw, Saskatchewan, Canada. Registration will be held on Friday evening with a full day of activities on Saturday culminating in a banquet and dance. Most of the meetings and workshops will be held on Sunday. There will also be a busy schedule for the XYLs.

OLIVER BC CAN
JUL 28-29

The Okanagan International Hamfest will be held on July 28-29, 1979, at Gallagher Lake KOA Kampsite, 8 miles north of Oliver, B.C., Canada. Registration starts at 9:00 am Saturday. Activities start at 1:00 pm Saturday and continue until 2:00 pm Sunday. Ladies may bring their hobbies and items for a white-elephant sale. Featured will be prizes, a flea market, bunny hunts, entertainment, a home-brew contest, and more. A potluck lunch will be served Sunday at noon. Call-in on 3800, .34/.94, and .76 simplex. For information, write John Juui-Andersen VE7DTX, 8802 Lakeview Dr., Vernon, B.C., Canada V1B 1W3, or Lota Harvey VE7DKL, 584 Heather Rd., Penticton, B.C., Canada V2A 1W8.

BOWLING GREEN OH
JUL 29

The Wood County Amateur Radio Club will hold its 15th annual Wood County Ham-a-Rama on July 29, 1979, at the Bowling Green Fairgrounds, Bowling Green, Ohio. Gates will open at 10:00 am, with free admission and parking. Dealer tables and space are available. Trunk sale space and food will also be available. Tickets are $1.50 in advance and $2.00 at the door. Prizes will be awarded. Talk-in on .52 K8TIH. For information, write Wood County ARC, c/o Eric Willman, 14118 Bishop Road, Bowling Green OH 43402.

JACKSONVILLE FL
AUG 4-5

The Jacksonville Hamfest Association is pleased to announce the 1979 Jacksonville Hamfest and ARRL North Florida Section Convention to be held on August 4-5, 1979, at the Jacksonville Beach Municipal Auditorium, Jacksonville, Florida. The location is just one block from the beach, where U.S. 90 meets the sea.

Advanced registrations are available at $3.00 per person from R. J. Cutting W2KGI/4, 303 10th St., Atlantic Beach, Florida

Continued on page 165

Improving the Sabtronics 2000

—make a good DMM even better

Easier maintenance is a bonus.

James D. Powell II N8AMR/4
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Blacksburg VA 24060

Shortly after the ad for the Sabtronics Model 2000 digital multimeter appeared in *73 Magazine*, I sent in my check for one. I suspect that quite a large number of other people did the same, since my order was delayed several weeks. When the DMM finally arrived, I assembled the kit and, to my surprise, it worked the first time I turned it on. After calibration, using the supplied resistors as references, the meter's performance compared quite favorably to that of a more expensive DMM.

I was pleased with the meter for its performance, and pleased with myself for taking advantage of a good deal, until I noticed the meter would not zero on the ac scales. With the input leads shorted, the display would eventually settle down at about 0.5 volts on the 10.0-volt scale. A quick check showed that all of the ac voltage and current scales were affected.

At first I assumed that I had made some mistake in construction, but checking with two other owners of the Model 2000, I found that they noticed the same problem.

Fortunately, the design error is easy to correct. I will describe the necessary modification, plus a relocation of the fuse holder and installation of nicad batteries and a charger for convenience.

After I studied the board layout and schematic for the DMM, I tried a few things that looked as if they might correct the trouble. I found that if I unhooked the +6 volts that powered the decimal points, the meter would zero properly. Apparently, the high level dc line that feeds the decimal points is located too near the low level ac lines on the main PC board. You can see there is quite a mess of traces carrying the various signals to the range and function switches if you check the layout diagrams in the manual.

Before I describe the modifications I made to the circuitry, I want to say that I have had no contact with Sabtronics on this matter. I hope they corrected the problem in later model runs, but I do not know. Obviously, you can check to see if your meter has the problem by simply

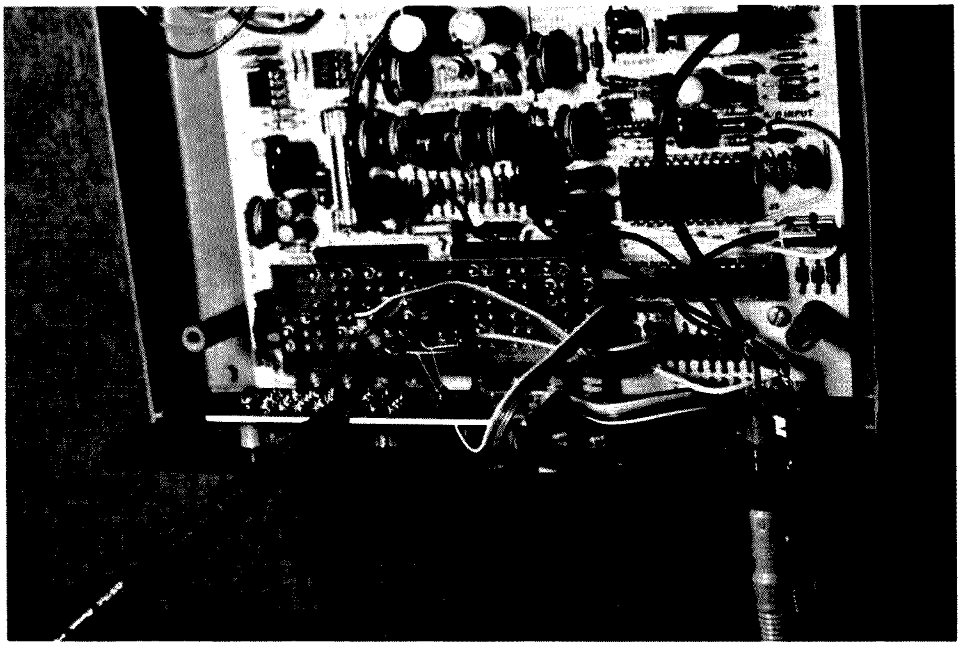


Photo 1. This is the display board of the Model 2000 DMM, showing the added transistors that drive the decimal points.

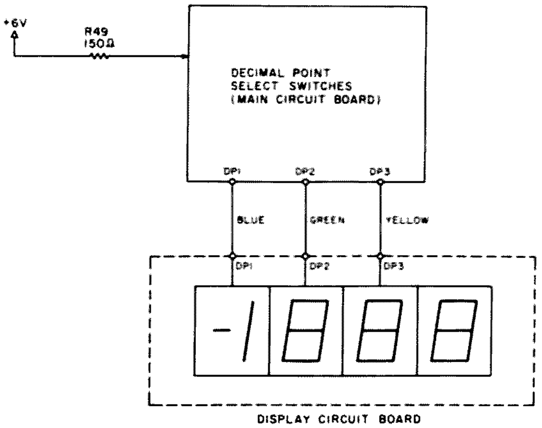


Fig. 1(a). Block diagram of decimal point driver circuitry of the Model 2000 DMM before modification.

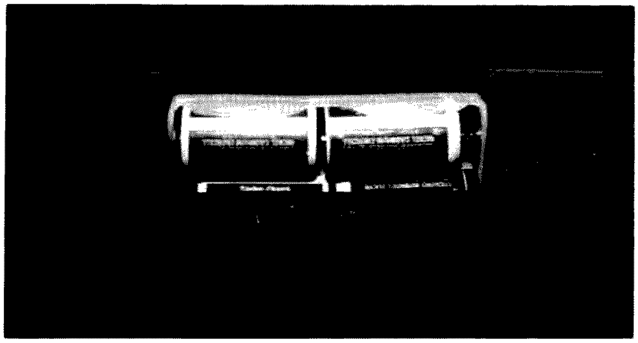


Photo 2. This pictures the rear of the DMM, showing the added fuse holder on the right and the charging jack and components on the left.

shorting the input leads and punching up the 10.0-volt ac range.

If you refer to Fig. 1(a) and compare the simplified diagram with the schematic in your manual, you will see that the range and function switches drive the decimal points directly off the +6.0-volt line through R49 (150 Ohms). Fig. 1(b) shows a block diagram of the circuit after modification. The modification requires only three garden-variety PNP transistors and three ½- or ¼-Watt resistors. You do not have to cut or modify any of the traces on the PC boards.

Fig. 2 shows the actual schematic of the added circuitry. The transistors drive the decimal points; the switching arrangement on the DMM main PC board is now near ground potential and carries only the small base current needed to drive the transistors. Although a small PC board would have allowed a neat installation, I did not think it was necessary for so few parts. In the following steps, refer to the diagrams of the PC boards in your Sabtronics manual as well as to the diagrams and photographs I have supplied.

Photo 1 shows how the transistors are mounted on the display board. First, unsolder the end of R49 that is nearest the edge of the main PC board. Bend this resistor straight up so that it is perpendicular to the board. Solder a short length of hookup wire from the hole where you just removed R49 to the ground lug on the input terminals of the front panel. Now remove the three wires on the display board marked DP1, DP2, and DP3. You can do this without removing the board if you are careful. Prepare the three driver transistors by bending the base lead of each one back over the case so that it is parallel to the other leads but pointing in the opposite direction. Solder one of the resistors to each base lead. I used 10k-Ohm resistors with the junk box transistors I had, but you may need to use smaller values (on the order of 2k) with some transistors.

Working on the back (side of the board with traces) of the display board, solder the collector lead of one of the prepared transistors in the hole marked DP1 where you re-

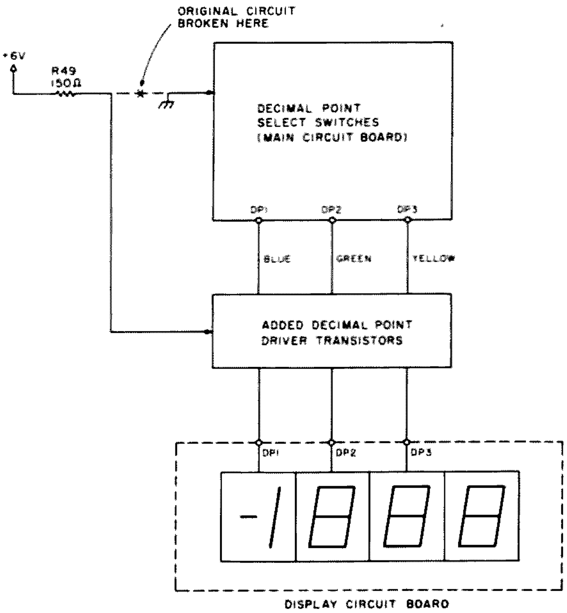


Fig. 1(b). Block diagram of the decimal point driver circuitry of the Model 2000 DMM after modification.

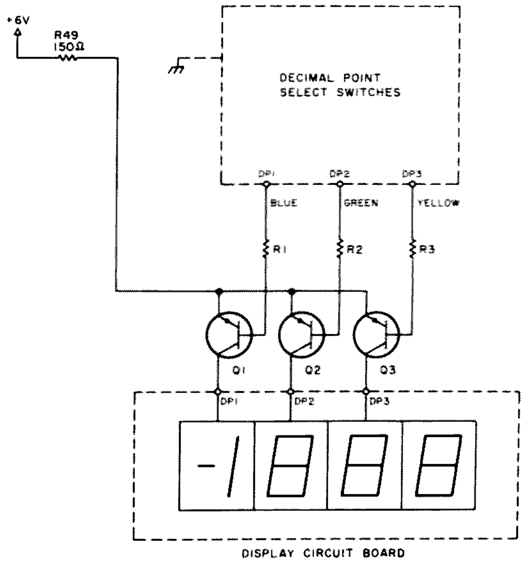


Fig. 2. Schematic of decimal point driver circuitry. R49 is part of the original DMM circuit. The transistors are added to the back of the display PC board. R1, R2, R3: 2.2-10kΩ (see text), ¼ to ½ Watt. Q1, Q2, Q3: any silicon PNP general purpose transistor, such as Radio Shack 276-1604.

moved the wire previously. Install the other two transistors in the holes marked DP2 and DP3. Solder the emitter leads of all three transistors together and attach a wire from the emitter leads to the free end of R49 on the main PC board. Finally, solder the free ends of the wires you removed from the display board to the corresponding resistor on the driver transistors you installed. This completes the decimal point modification and the meter should zero properly on all the ac scales after a few seconds. After you are sure everything is working properly, you may want to insulate the transistors with some silicone rubber or tape.

The second modification to the Model 2000 was simply the moving of the fuse holder. I manage to blow the fuse in my DMM about once a month by punching the current button with the leads connected to a battery. Since the fuse is mounted inside the Sabtronics meter, changing it requires that the case be disassembled. Unfortunately, I could not train myself not to blow the fuse, so I did the next best thing—I mounted a panel-type fuse holder on the right rear of the meter (Photo 2). I chose a Radio Shack (270-365) fuse holder since it extends only 0.5 cm on the back of the panel. If you install a fuse holder, short out the old one on the PC board. A short piece of a potentiometer shaft works very nicely for this. You must use shielded cable running to the fuse holder since the power supply of the meter generates considerable noise and the longer input lead will pick this up.

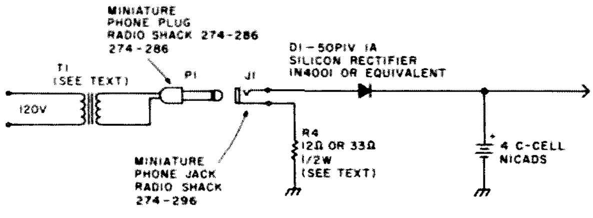


Fig. 3. Charging circuit for nicad batteries installed in the Model 2000 DMM. Adjust R4 for 100-mA charging current.

The last thing I did to the DMM was install rechargeable batteries. If you use your meter very much, you will find that replacing batteries is not only a nuisance but also expensive. I used some surplus nicad C cells that I ordered for $1.50 each. In order to charge the batteries without opening the case, I installed a miniature phone jack in the other panel on the rear of the meter (see Photo 2). For charging, I used one of the little transformers with which the phone company powers the dial lamps in some phones. The simple charging circuit is shown in Fig. 3. If you have one of these transformers (who doesn't?), a 12-Ohm, ½-Watt resistor for R4 will give the proper charge current for 1-Ah cells. If you don't have a transformer, a Radio Shack 12.6-volt transformer (273-1385) will give the proper 100-mA current with a 33-Ohm, ½-Watt resistor. Do not try to measure the charge current with the batteries installed in the meter unless you use another meter.

If you make these modifications to your DMM, you will have improved performance on the ac scales and the unit will be easier to maintain. I will be glad to answer any questions accompanied by an SASE.■

Turn Signal Timeout

—eliminates two-wheeled embarrassment

Thirty seconds is the limit.

Howard R. Worthington K1OTW
17 Fremont St.
Oxford MA 01540

Is there a motorcyclist who has not felt dumb and hazardous after discovering that he has had his turn signals on for five minutes after making a turn? Here's a simple circuit to time them out in thirty seconds, if you forget. A few new bikes have a similar device; some riders install an audible indicator—but this is not dignified, honking away.

The 555 is used as a standard monostable timer from the *Motorola Linear I.C. Data Book*. Refer to the schematic. When the turn signal switch is turned on, pins 2 and 4 go high, which starts the timer and begins to charge C2. Pin 3 is high, keeping the relay off. When C2 is charged to 2/3 Vcc—thirty seconds in this case—pin 3 goes low and sinks the relay coil which opens the turn signal circuit. When the turn signal switch is turned off, pins 2 and 4 go low, which resets the 555; at this time Q1 turns off and prevents C2 from being charged, so you will have a full 30 seconds of flashing time at the next intersection.

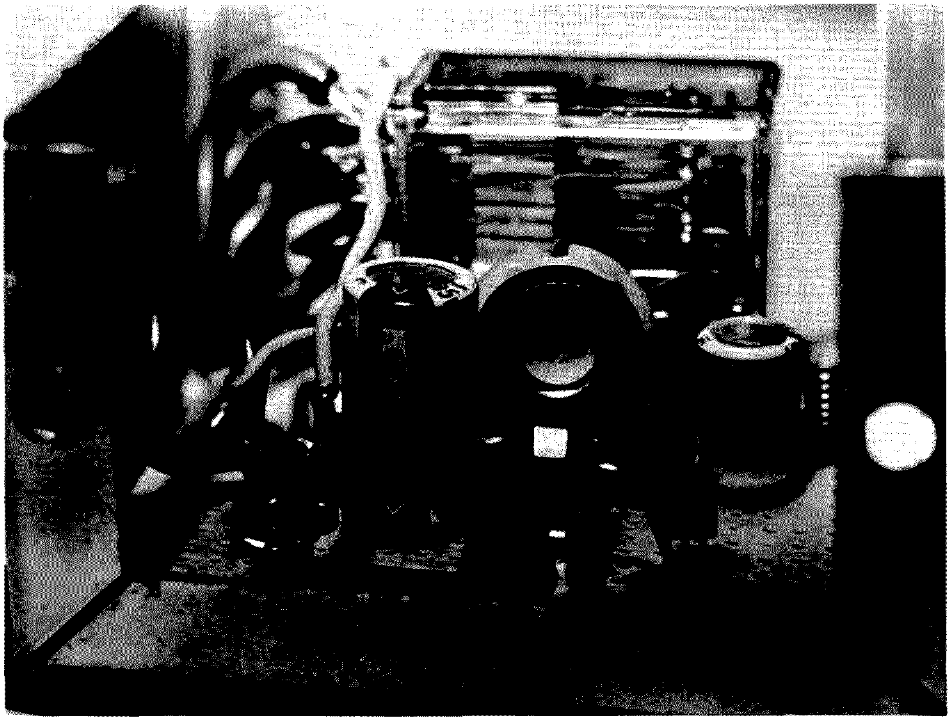


Photo of the turn signal timeout.

C3 is needed to prevent false resetting while flashing. My theory is that C1's delay keeps pins 2 and 4 high enough to prevent resetting during the time when the flasher opens the circuit. Somehow, C1 has to be electrolytic; a tantalum-type does not do the job. Too large a C1 causes a long reset delay.

Due to variations in forward voltage drop among silicon and germanium diodes, and due to variations in flasher rates, I suggest that the Q1 base resistor be a 250k trimpot. I found that it should be set at 80k us-

ing 1N914s, and 180k using 1N34s, in order to keep Q1 on, and thus charge C2. The exact resistance required is quite critical, but provides reliable operation, once determined.

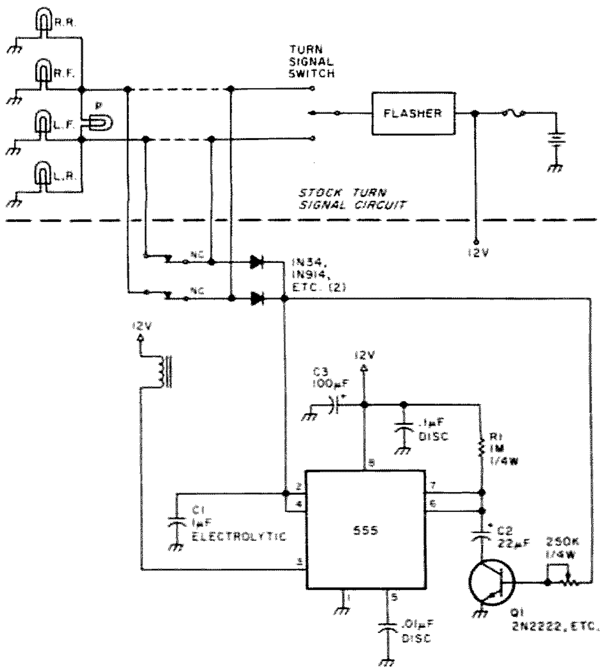
Time-out is determined by the formula: T(sec.) = 1.1 x R1 x C2. R1 is in megohms, C2 is in farads, and tolerances of components require experimentation, which explains my six-second discrepancy from the formula.

Any DPDT relay with 5-Amp, or so, contacts, and 12-volt coil should do, keeping in mind the 200-mA sinking capability of a 555. I used a Potter & Brumfield R10-E1-X2-V185.

I epoxied the relay to vectorboard, on which all components were mounted; this was stuck into a 1-5/8" x 2-1/8" x 2-3/4" minibox from the junk box. The six leads were brought out to a barrier terminal strip on the box. The box was installed under the left side cover of a Kawasaki 900 where, conveniently, there were two unused welded nuts on the battery box. After installation, my hindsight saw that there was space for the entire kludge under the tank. The circuit could be made much smaller for other machines, if called for.

Wiring to this bike required cutting the left and right turn signal wires after the switch; these were found in a harness under the fuel tank. These four points are then connected to the NC relay contacts, keeping in mind which is "in" and "out" for sensing purposes.

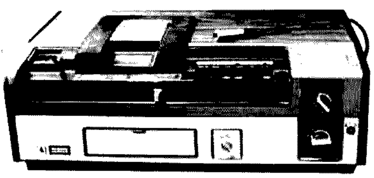
For fully solid state, I don't see why 2N3055-type transistors could not be used instead of a relay, if you want to tolerate their voltage drop. Knowing 555s, possibly the timer should be set longer for cold weather riders.



Schematic for the turn signal timeout.

It works! It's imperfect, and requires resetting in traffic jams. It even seems to make itself unnecessary by making one more conscious of its purpose!

Credit is due to K1ICU for his idea, and for the use of his Kaw as a guinea pig. ■



Looking West

from page 6

along these lines is a far better alternative than brute-force vigilantism, which lowers those involved to the level of the offender himself.

Finally, to those who still feel Scott Lookholder got off easy, let's look at the overall picture. Lawyers I have spoken with tell me that a viable estimate of his legal costs would be between 4 and 6 thousand dollars. Add to this another thousand to satisfy the fine, and financially it may have cost him close to $7,000. Only he and his attorney know for sure. Then, too, he has lost the use of something many of us hold dear: the ability to communicate via his amateur station. Remember, the court made it a provision of his probation that he not utilize his amateur privileges for at least a year. There is also the possibility that the FCC will begin proceedings to revoke his license, thereby making his QRT period permanent. Nobody knows if this will happen, but it is a distinct possibility. No, Scott Lookholder did not get off easy by a long shot. It cost him dearly, and hopefully it will be a lesson to others who have thoughts of engaging in similar illegal activities.

While we are on the subject of malicious interference, I would like to discuss another new type with you for a moment. One might almost call it "legal interference," but it is morally wrong nevertheless. It usually shows up when a group of two or three who want to see just how much they can get away with take over and monopolize a given repeater. They carefully structure their remarks so as to not violate any rules and regulations as set forth by the Commission, but nonetheless their statements are constructed in such a way as to "get the goat" of all others who may be listening. Usually, they will not recognize breakers, and those who do make it in find themselves harassed in one way or another. These bothersome people play it strictly by the rulebook, including proper station identification at the prescribed intervals. They always "stand on their constitutional right of freedom of speech" and in doing so take away yours and mine. If this sounds all too familiar, then you have such a faction in your home town.

What can be done about them? First, all of us have to remember that our amateur licenses are not a guarantee of freedom of speech. Rather, it is a privilege to communicate granted by our government, and it can be revoked any time the government sees fit. There are no rights stated or implied. Herein lies at least part of the solution. Since a repeater is not a public utility, the licensee is under no obligation to provide this service to those he deems are abusing it. The repeater owner-operator has one very effective weapon at hand: the ability to take away the toy from those who do not appreciate it. Many owners hesitate to take such action, fearing that a time will come when some user will want to make an emergency call and the system will be off. True, this can happen, but if the same amateur wants to make this call and the repeater is being abused by those who do not respect it, he will have no better chance then anyway. It is up to the technical minds who produced the myriad of FM relay devices which now stretch the length and breadth of this nation to fulfill their obligation to the amateur community by initiating a cleanup of the bad on-the-air operation. If they do not, and if abuses continue to grow, they will only have themselves to blame when the ax falls—when the FCC and other government agencies start to do it for them. Repeater owner-operators have more than just a technical responsibility to erect and maintain a system. There is also a moral obligation to ensure the proper utilization of a given system. If they fail in this, they should not be permitted the privilege of continued system ownership. The day in which a repeater owner-operator can isolate himself from the rest of the amateur community is long gone. His responsibilities are clear-cut and he must discharge them for the good of the community.

THE SOME-PEOPLE-NEVER-LEARN DEPARTMENT

Maybe it would be better to call this "Once Involved, Always Involved." This might be the motto of Bob Thornburg WB6JPI. After two years of political hiatus, Bob was elected earlier this month to the chairmanship of TASMA, the organization which replaced the old SCRA in the middle of 1978. Bob sees his job as one of uniting the various special interests which abound on two meters. Frankly, it looks as if he has his work cut out for him. While Association membership by those involved in other aspects of two meter operation has been steadily on the rise, repeater owners seem to be staying away as if to protect the organizational structure change.

Late last year, just around the time of the change, a rather vile letter was circulated to many or all area repeater owners calling for the destruction of the SCRA and its new open-door policy and "a return of political power to those competent to administer it." The letter went on to give steps which should be taken by repeater owner-operators to ensure that the above would indeed happen. However—and this is very important—the letter was basically unsigned, a condition which thus destroyed its overall credibility. Whether this letter has had anything to do with the lack of organizational interest on the part of repeater owner-operators cannot be determined. One thing is clear: They are staying away, and Bob will have quite a job during the next twelve months trying to bring them back into the fold. It won't be the first time that Bob has pulled off a miracle. He is very adept in that regard. Can he do it? If he can't, nobody can.

Already, Bob has support from virtually every other segment of southern California's two meter society, including the weak-signal people and repeater-user groups. Indeed, he is a very popular and well-respected individual in this area who honestly cares about his fellow man. He has taken on a very big responsibility, and we wish him well.

It's hard to find a reason for this lack of initiative on the part of this area's two meter repeater owners. No one reason seems to predominate. Some speculate that many of the oldliners who helped start voluntary coordination are just tired of the political arena and want out. As with any organization, attrition along these lines is to be expected. No one group of in-

In attendance at the TASMA meeting were Jim Rieger WA6EZL and ED Tippler WA6KYZ. Jim is probably the nation's best authority on linear translators.

Marlene Thornburg WD6FBI sips soda as Herb Gordon W6KBD explains her new duties as TASMA treasurer.

dividuals can be expected to stand in front of the firing line forever. In other cases, it's obviously apathy. They have their systems operational and nothing else concerns them. Why should they get involved? They need involvement like they need a headache. More predominant, however, is an unspoken sentiment which seems to say that the organization no longer represents those whom it was established to protect—the southern California repeater owner-operator—and that opening voting membership to all interested amateurs has weakened the political position of the repeater owner. Therefore, why should an owner-operator bother to keep membership in an organization in which he is no longer in the majority position. This was the view stated in the letter discussed earlier.

It's interesting to note that the 220-SMA, which was formed at the same meeting, suffers none of these ills. The 220 people of this area, system owner and spectrum user alike, seem very together in their goals and viewpoints. Structurally, the two organizations are almost identical, yet 220 keeps its repeater owners as members while two meters can't. Why the unity on 220 not found on two meters? Is it because all 220 spectrum users see the US WARC proposal as a common enemy? Is it that they have watched the development of two meters and have sworn that the same pitfalls will never occur on 220? No one can rightly say. However, at this time, the 220 people of this area are far more together than any other group. Perhaps it's time for everyone to step back and take a good look at what has put them in such a position. The 220-SMA is going strong, and we can all learn from them.

All the above might lead you to believe that two meters in this area is in a disastrous state. Far from it. TASMA's 2 meter band plan has been accepted without complaint, and while repeater owner support is dwindling, support from all other sectors of the two meter society is strong and growing. However, making overall spectrum management work takes the ongoing cooperation of all users. Those who own and operate repeaters are a key part of two meters, and it's to soliciting their active support that Bob and his staff will be dedicated.

DX-ON-A-REPEATER DEPARTMENT

Southern California is known as an area of "repeaters with a purpose." Over the past few years, we have seen systems developed for just about every reason under the sun, including one for the exclusive use of school children. Now, thanks to the Southern California DX Club, even HF DXers have a meeting ground of their own. According to club president Dave Bell W6AQ, while not the first system of its type in the nation, the AD6P/R system will serve as more than just a local gab channel for DXers. The club has great plans for the newly established system, and the future seems bright with promise. Already, it is used to alert members as to where the rare ones can be found. In the future, one might even hear actual on-the-air seminars on the art of DX-chasing.

While its prime usership is made up of DXers, AD6P (144.88 in/145.48 out) is an open repeater which invites all area amateurs as well as visitors to Los Angeles to utilize its facilities. If you happen through LA and want to meet some of its top DX enthusiasts, then drop in on the system or, if time permits, attend one of their club meetings. You will find either one a rewarding experience.

ON-THE-MOVE DEPARTMENT

Jim Hendershot WA6VQP, network director for Westlink, asks that I pass along the news that the new Westlink studio facilities are fully operational at their new location in Canoga Park, California. The new studio features such amenities as cartridge tape units used to gather and pre-edit items for the newscast and additional post-production duplicating equipment to cut down the reproduction time of finished cassettes. He still hopes to expand the reproduction facilities further when funds permit the acquisition of more cassette recorders.

What started a year and a half ago as a small undertaking to produce a weekly amateur radio news program has grown to an enterprise which serves the news needs of thousands of amateurs nationwide. Now in its seventy-second week of consecutive operation, the Westlink Amateur Radio News Service has become a vital link in keeping us all informed of events which affect our day-to-day operation. It is still free to any group or individual who supplies blank cassette tapes in SASE mailers. For more information about this service, contact Jim at Westlink's new address: 8331 Joan Lane, Canoga Park CA 91304.

HF INTERNATIONAL: AN OUTSIDER LOOKS IN

It was not until after I arranged the interview with Norm and Jeanne Meuller that I first bothered to listen to the spectrum HFI calls its home, CB channels 32 through 40. I expected to hear the same type of "10-4 Good Buddy" operation as is found on what CBers call the "lower 23," but was quite taken aback by what I actually heard. Frankly, it sounded a lot closer to 20 or 40 than to what I expected. Operation seemed very structured and in no way haphazard. Other than the strange-sounding dual callsign bit (HFI members utilize both their assigned FCC callsign and their HFI call or "HF number"), the operation seemed as if it could be taking place on any of the amateur bands. I was shocked, perplexed, and maybe a bit mad. After all, here I proudly sat with an amateur license displayed on the wall. Who were these people to play ham without bothering to be hams!

The following Sunday I met with Norm and Jeanne. Upon entering Norm's office, I noted two things immediately: an absolutely marvelous amateur station in one corner, and a large poster of Jerry Lewis touting HFI in relation to the annual MDA campaign. Inquiring, I learned two things right off the bat. It was indeed an amateur station, and Norm was licensed to use it. "My god," I thought to myself. "An amateur runs HFI?" The MDA poster was also explained. HFI and its close to 50,000 active members would be participating in the 1978 Labor Day Jerry Lewis telethon. I thought again to myself: "These are the bad guys who are out to destroy ham radio? The bad guys everyone had told me about? Something doesn't jive. Bad guys don't do nice things like this!"

The questions I asked ranged from simply what was HFI and its goals to what their official stand was on specific matters. Basically, here is what I learned: HFI is an organization of hobby-type SSB users operating in the upper portion of the 27 MHz personal radio band. It was founded to promote the use of SSB communication in that particular spectrum and to give the SSB CB hobbyist an organizational structure of his own. At its peak, HFI boasted more than 90,000 members, but this was prior to the reorganization. Though it is still quite large—probably still better than 50,000 at the latest estimate—no exact figure was available at the time of the interview.

Norm asked that I make it clear that HFI does not condone the use of excessive and illegal power levels or out-of-band operation. In his remarks, he made it clear that an HF number does not always mean that the holder is a current HFI member. Therefore, those operating illegally between the 11 and 10 meter bands are not necessarily HFI members, though some may still use their HFI numbers issued many years ago. All of the foregoing has been reiterated to the members of HFI in recent membership mailings, in which Norm stressed the need for legality in day-to-day on-the-air operation. Another point I was asked to emphasize was that HFI, under the current direction of Norm and Jeanne Mueller, never backed or condoned in any way the actions of Mr. Richard B. Cooper or his Communications Attorney Service. Norm's basic commentary was that Cooper/CAS was detrimental to both the amateur and CB services and would eventually cause both harm. Contrary to popular belief in amateur circles, HFI was not one of Cooper's ardent supporters.

Norm sees today's HFI as an intermediate ground between AM CB radio and the amateur service. He would like to see HFI take an active role in helping the CBer make the change, with as minimal an environmental impact on the amateur service as possible. He believes that the education of the transitioning CBer is the key. However, such education can only come about if the FCC acts to create "SSB only" channels wherein the AM CBer can get away from the "10-4 Good Buddy" attitudes of AM and learn proper operation from his SSB-minded peers. HFI feels that if such were the case, actual on-the-air amateur-oriented training could be accomplished (especially if CW were permitted).

As an amateur himself, Norm sees one of amateur radio's greatest problems today to be the uninitiated AM CBer who has the technical expertise to obtain an amateur license but has never been educated in the moral and operational values which amateurs associate with their hobby. He specifically cites many of the problems prevalent on FM repeaters as an example of this lack of proper indoctrination. Again, in relation to the amateur service, he sees this as an avenue for active HFI involvement.

While HFI would like more SSB-only spectrum for its members, Norm does not feel that it should come from the amateur bands. Rather, HFI endorses proposals which would place such spectrum directly next to the current 40-channel Class D allocation and above it in an area below 10 meters (with a buffer zone between the two). HFI feels, however, that such can only come to pass if all HF members obey the current regulations as written—especially those regarding proper station identification at prescribed intervals and respect for band-edge and power limitations. The

organization knows that only a mass show of good faith to the FCC will have any meaning. To that end, HFI's literature constantly reminds its members of these precepts.

Above all, HFI wants to become a respected member of the hobby radio community. They want amateurs especially to know that they are not the enemy. They want to be considered as friends and working partners. It has taken me a year to sit down to write this, a year of waiting to see if I was being handed something substantial or just hot air. I have followed HFI's progress these past 12 months, and what I was told a year ago is substantially true today. Norm and Jeanne Mueller are two people who are sincerely devoted to their beliefs and who are very positive-thinking people. Under their leadership, HFI has taken many giant leaps toward its prime goal.

Whether you like or dislike organizations such as HFI is unimportant. What does count is that today's non-amateur hobby radio enthusiasts are responsible for a good percent of all personal radio operation and cannot be ignored. There are many myths these days in amateur circles about how anyone who owns a CB radio is a bad guy. Myths they are, and as such they should be dispelled. There are good guys and bad guys in every walk of life. We have both in amateur radio, and I'm sure that Norm has both in HFI. What is important is learning that we are all human beings with a common interest, even though we may express this interest in different ways. HFI has said to us, "We want to be your friend and work with you." What will our answer be? You can let me know, or you can write directly to Norm c/o HF International, PO Box 7576, Riverside CA 92513.

THE WHATEVER-HAPPENED-TO-??? DEPARTMENT, REVISITED

Without warning recently, the FM and Repeater column seems to have disappeared from *QST!* It's well known that its editor, Lou McCoy W1ICP, has retired from active League duties and now lives in one of my favorite places, New Mexico. I sincerely wish Lou many prosperous years of retirement, as well as many more happy years of hamming.

However, Lou's departure seems to have left a rather big gap in Newington, one that should be filled quickly. In this day and age, when FM is on the lips of virtually every amateur, *QST* cannot afford to be without such a service to the ARRL membership. The column is necessary, and I, speaking as one ARRL member, would like to see it reinstated. Perhaps one of you reading this is willing to offer your services to the ARRL. Lou did a fine job with it, and his act will be hard to follow.

Microcomputer Interfacing

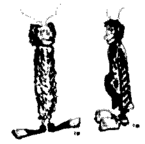
from page 28

This means that one subroutine may call another. In this way, a control subroutine may, in turn, call a timer subroutine. When the timer subroutine has completed its task, it causes a return to the control subroutine. This situation requires two levels on the stack, or four R/W memory locations, since two full 16-bit return addresses must be maintained on the stack while the timer subroutine is in operation: (1) the return address for the timer-to-control link, and (2) the return address for the control-to-main-task link. *The stack operations take place automatically whenever a call or a return is executed.* The call and return instructions may be either conditional or unconditional, but each subroutine must contain at least one return instruction.

Recall that the 8080 chip contains seven 8-bit general purpose registers, the accumulator (A), B, C, D, E, H, and L. In programs where subroutines are used, there may be register conflicts since the subroutine and the main task may both require the use of a specific register. Sometimes this problem may be solved by choosing another register, but this is not always possible, particularly when the A register and the flags are involved. To avoid register conflicts, it is possible to use the stack for temporary data storage. All of the internal 8080 registers may be pushed onto the stack and popped back into the 8080 as needed. Data is stored and retrieved as register pairs, with register A and the flags forming a two-byte word which is treated as a register pair.

The subroutine in Table 1 is a time delay routine in which registers D, E, A, and the flags are stored on the stack. At the completion of the subroutine, the data stored on the stack is retrieved and placed back in the internal registers. The complementary operations of stack storage and retrieval are called *push* and *pop*, respectively. Notice that the stack pointer is initialized at the start of the program, before any other instructions are executed.

The use of subroutines in a program allows many complex tasks to be subdivided into small segments which are easy to link together and which relieve the problem of continuously rewriting frequently used program steps and routines. You will find that a personal library of frequently used subroutines is indispensible when you are programming.



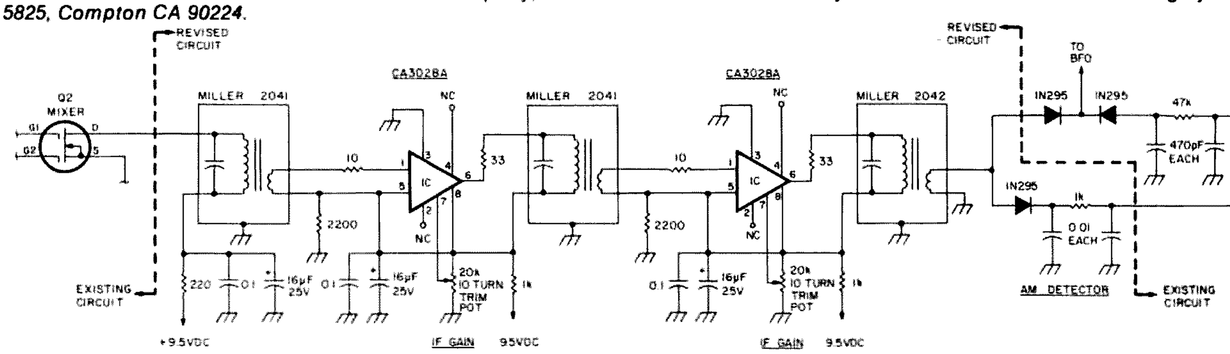
Corrections

I have recently been advised that J. W. Miller Company no longer has the 8901-B and 8902-B i-f units which I used in my circuit on pp. 48-49 of the January, 1979, issue of *73* ("Building an Economy Receiver").

I have enclosed a copy of a revised i-f circuit which does use currently-available components.

Tom McLaughlin WB4NEX
St. Petersburg FL

Fig. 1. Revised i-f circuitry, "Building an Economy Receiver." Resistors are ½-W, 10%. Miller 455-kHz transformer: #2041—input 25k, 600-Ω impedance; #2042—output 25k, 1-kΩ impedance. Transformers are available from J. W. Miller Company, PO Box 5825, Compton CA 90224.



There are two errors in my article, "A Single IC Time Machine," which appears on page 148 of the February issue.

Both errors are in Fig. 15. In Fig. 15(a), the error is caused by a possible "smear." At the top of the figure, near the middle, there is a pad for the −5-V regulator. This pad is shown connected to the adjacent circuitry by a fine line. This fine line is possibly a "smear" from the original silk screen and should be removed.

The second error will raise a lot of eyebrows. Basically, it is an inversion. The grey area of

the PCB of Fig. 15(a) should be rotated 180° on the darker overlay.

H. M. Knickerbocker K6SK
La Mesa CA

In response to a letter from one of our readers, Lee Reed W5VRC (ex-W4RBL), author of "Build An Economy Zener Checker" (February, 1979, page 137), would like to comment on his zener checking circuit.

The problem is the inherent danger of a transformerless line-operated power supply.

Should the "hot" side of the ac line be inadvertently connected to the "common" side of the unit, as it would if the ac plug were inserted backwards into a receptacle or if the ac socket is miswired, it is possible to get line voltage between the common side (which the user may be holding) and an external ground.

As a remedy for this, the use of a small isolation transformer is recommended or, at the very least, a 1k 2-Watt resistor should be added in series with the fuse.

A few dollars spent on a transformer is certainly worth the safety which it affords.

Gene Smarte WB6TOV/1
News Editor

In my article in the September, 1978, issue ("Nuclear Attack!"), I left out a very important "=" at step 193. Here is a procedure to fix the program:
1) Load the bad program into memory;
2) Press:
GTO 193
LRN
2nd Ins
=
LRN

This will insert the "=" between the "B" and the "X". I apologize to all.

I have been receiving requests for a version of the game to run on the TI 58/59. I will be glad to send anyone a program listing for this machine, provided the request is accompanied by an SASE.

Dan Everhart WA7WKA
293 Lander Hall
University of Washington
Seattle WA 98105

In "Impedance and Other Ogres" (February, 1979, page 47, column 1), the fourth and fifth lines from the bottom read, in part: "... $P_{AV} = E_{RMS} \times \cos\theta$." Since we do indeed believe in Ohm's Law, the formula should read: $P_{AV} = E_{RMS} \times I_{RMS} \times \cos\theta$. To our readers and Georg Simon Ohm, we apologize.

Gene Smarte WB6TOV
News Editor

Review

When the *1979 Radio Amateur's Handbook* made its appearance last November, I was probably the first on the block to pay $9.75 and take a paperback copy home. The ARRL has put a lot of effort into promoting the *1979 Handbook* as being new and different. My 1974 edition is worn from heavy use and I moved it aside, making room for the newcomer, with a bit of reluctance.

The most obvious change in the new *Handbook* is the size. Like *QST*, the *License Manual*, and other League publications, the *Handbook* has gone to the bigger 8½" x 11" format. The new size makes older *Handbooks* look small and unimportant, but a quick weighing revealed that it was a scant 3½ ounces heavier than the 2-pound 1974 edition.

Old-timers will be glad to know that Ohm's Law is still V = IR in the elementary theory section. The basic principles haven't changed, but the theory chapters have been either completely or partially rewritten. Both beginning and experienced hams will find the "Radio Design Technique and Language" chapter useful. In addition to a comprehensive discussion on tuned circuits, a glossary of radio terms is included.

A chapter on vacuum-tube principles will not be found in the *1979 Handbook*; in its place there is a greatly expanded chapter on solid-state fundamentals. The *Handbook* editors have limited the coverage of this vast topic to those devices and applications that are most applicable to general amateur use.

The chapter on HF transmitting contains a number of charts and graphs that eliminate some of the drudgery of design calculations. The *Handbook*'s new size seems to lend itself well to this kind of presentation. Throughout the edition, graphs and charts are included. One conspicuous area is missing, however. Gone is the index of tube specifications and base diagrams. The token coverage of solid-state device specs has also been deleted.

One of the most repeatedly mentioned attributes of the *1979 Handbook* is the "Narrow Band Voice Modulation" chapter. The *Handbook*'s coverage of NBVM is largely a rehash of the *QST* articles and, in some cases, is a word-for-word reproduction. Experimenters looking for parts suppliers and discrete filter design information will be very disappointed.

In the enthusiasm for NBVM, such modes as RTTY, slow scan, and facsimile seem to have been forgotten. It is ironical that a book devoted to state of the art neglects even a short reference to these "specialized communications techniques" that many ham/experimenters are involved in. ARRL publications are sorely lacking in this area.

In keeping with the state-of-the-art theme, the FM and repeater chapter includes information on tone-decoding circuitry as well as a "practical synthesizer." However, there is no complete schematic for an FM transmitter or receiver. In this chapter as well as in most of the others, the editors have chosen to include many subcircuits dealing with a specific part of a rig.

The chapters on propagation, transmission lines, and antennas have been partially rewritten. Theory sections tend to be more mathematically oriented than earlier editions, while specific construction details are fewer.

If you are an "appliance operator" who doesn't care how your station works, then you may find the *Handbook* to be a waste of money. Highly knowledgeable hams looking for the latest in microprocessor control will probably be disappointed with the *1979 Handbook*. Beginners searching for a wire-by-wire description on building their first rig may be frustrated with the *Handbook*'s contents. Like its predecessors, the *1979 Radio Amateur's Handbook* is not a rigorous text on electronic theory; instead, it is a reference and idea book for hams willing to think.

Tim Daniel N8RK
Oxford OH

FCC

Reprinted from the Federal Register.

AMATEUR EXTRA CLASS LICENSE

Eliminating Granting of Credit Toward the Telegraphy Portion of Examination to Former Holders of the Amateur Extra First Class License

AGENCY: Federal Communications Commission.

ACTION: Notice of proposed rulemaking.

SUMMARY: The Commission is proposing to delete § 97.25(d) from its Rules. This provides credit toward the telegraphy portion of the Amateur Extra Class license examination to holders of the former Amateur Extra First Class license and its successor licenses.

DATES: Comments shall be filed by April 30, 1979, and Reply comments shall be filed by May 30, 1979.

ADDRESSES: Comments shall be filed with: Secretary, FCC, 1919 M Street, N.W., Washington, D.C. 20554.

FOR FURTHER INFORMATION CONTACT:

Mr. Philip W. Savitz, Personal Radio Division, (202) 632-7175.

SUPPLEMENTARY INFORMATION:

Adopted: February 14, 1979.

Released: February 27, 1979.

By the Commission: Commissioner Quello absent.

1. In accordance with the Administrative Procedure Act, 5 U.S.C. 553, and § 1.412 of the Commission's Rules, the Commission hereby gives Notice of Proposed Rule Making in the above captioned matter.

2. During the period from June 1923 to June 1933 the Federal Radio Commission issued Amateur Extra First Class operator licenses. Subsequently, the equivalent license issued by the Federal Communications Commission was designated "Class A," and then "Advanced."

3. In 1952 the Commission created the Amateur Extra Class license. Obtaining this license requires successful completion of written examinations in nine areas of basic, general, intermediate and advanced amateur practice. These written examination requirements are much more stringent than those associated with the Amateur Extra First Class license. However, the telegraphy proficiency requirement for the Extra First license was 20 words per minute, which is the same as the current requirement for the Amateur Extra Class license.

4. Recognizing this identical telegraphy requirement, the Commission, in its Report and Order in Docket No. 19163, released on September 13, 1972, amended § 97.25(d) of its Rules to provide that credit for the telegraphy portion of the Amateur Extra Class examination be granted to applicants who present proof of having continuously held the Amateur Extra First Class license and its successor licenses.

5. Section 97.25(d) has now been in effect for more than six years. Recently, the number of persons seeking examination credit pursuant to this provision has declined to the point where such an application is now a rarity. As it appears that § 97.25(d) has become obsolete, the Commission is proposing its deletion from the Rules, effective six months from the adoption of such an order. This delay will give any former holder of the Amateur Extra First Class license who may remain a final opportunity to receive telegraphy credit toward the Amateur Extra Class examination.

6. The specific rule amendments we are proposing are set forth below. Authority for these proposals is contained in Sections 4(i), 5(e), and 303 of the Communications Act of 1934, as amended. We invite interested parties to submit comments concerning our proposals on or before April 30, 1979, and reply comments on or before May 30, 1979. An original and five copies of

all comments and reply comments shall be furnished the Commission, pursuant to § 1.419 of the Rules. Respondents wishing each Commissioner to have a personal copy of the comments may submit an additional six copies. Members of the public wishing to express interest in our proposals but unable to provide the required copies may participate informally by submitting one copy of their comments, without regard to form, provided the correct Docket number is specified in the heading of the comments. All comments and reply comments filed in this proceeding should be sent to the Secretary, Federal Communications Commission, Washington, D.C. 20554.

7. Individuals wishing to inspect the comments and reply comments filed in this proceeding may do so during regular business hours, 6:00 A.M. to 5:30 P.M., Monday through Friday, in the Commission's Public Reference Room, 1919 "M" Street, N.W., Washington, D.C. 20554.

8. For further information contact Mr. Philip W. Savitz, Personal Radio Division, FCC, 1919 "M" Street, NW, Washington, D.C. 20554, (202) 632-7175.

FEDERAL COMMUNICATIONS COMMISSION,
WILLIAM J. TRICARICO,
Secretary.

The Federal Communications Commission proposes to amend Part 97 of Chapter 1 of Title 47 of the Code of Federal Regulations as follows:

§ 97.25 [Amended]

1. In § 97.25 paragraph (d) is deleted and paragraph (e) is redesignated as paragraph (d).

PART 2—FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS: GENERAL RULES AND REGULATIONS

PART 97—AMATEUR RADIO SERVICE

Amendments of Rules Concerning the Northern Mariana Islands

AGENCY: Federal Communications Commission.

ACTION: Order (Rulemaking).

SUMMARY: The Northern Mariana Islands has recently been added to the Commission's jurisdiction. Certain charts and tables in the amateur rules are being amended to reflect this change in the Commission's jurisdiction.

EFFECTIVE DATE: March 13, 1979.

ADDRESSES: Federal Communications Commission, 1919 "M" St. NW., Washington, D.C. 20554.

FOR FURTHER INFORMATION CONTACT:

Mr. Robert Cassler, Private Radio Bureau (202-634-6620).

SUPPLEMENTARY INFORMATION:

In the matter of amendments of Parts 2 and 97 of the Commission's rules concerning the Northern Mariana Islands.

Adopted: February 22, 1979.
Released: March 2, 1979.
By the Commission:

1. On January 9, 1976, as a step toward eventual political union with the United States as a Commonwealth, the Northern Mariana Islands came under the jurisdiction of those laws of the United States which have general applicability to the several States. Previously, these islands were administered by the United States for the United Nations as part of the Trust Territory of the Pacific Islands, and those persons seeking authorization to operate a radio station were required to apply to the High Commissioner of the Trust Territory of the Pacific Islands. As of January 9, 1976, the Communications Act of 1934, being a law of general applicability to the several States, became applicable to the Northern Mariana Islands, and jurisdiction over radio stations on the Northern Mariana Islands passed from the High Commissioner to the Federal Communications Commission.

2. Certain amendments to the rules governing the Amateur Radio Service in Parts 2 and 97 of the Commission's Rules are necessary to reflect the change of status of the Northern Mariana Islands. Two minor amendments to Parts 2 and 97 concern the frequency bands available to amateur radio operators on the Northern Mariana Islands. The Northern Mariana Islands lie in Region 3. Most of the rest of the United States lies in Region 2. International allocations for the Amateur Radio Service are different for Region 3 than for Region 2. Footnote NO62 to § 2.106 and § 97.61(b)(4) are being amended to reflect this.

3. The other two amendments concern the use of the 1800-2000 kHz amateur band. Because this band is shared with the radionavigation (LORAN-A) service, input power is limited according to geographic area. The charts in footnote NG15 to § 2.106 and § 97.61(b)(2) are being amended to add the Northern Mariana Islands to the list.

4. Authority for these rule changes is contained in Sections 4(i) and 303 of the Communications Act of 1934. Because these amendments are basically minor changes in the rules to reflect the addition of the Northern Mariana Islands to the Commission's jurisdiction, the Commission finds that, for good cause, the notice and public procedures provisions of the Administrative Procedure Act are unnecessary (5 U.S.C. 553(b)). For more information about these rule changes, contact Mr. Robert Cassler, Personal Radio Division, FCC, 1919 "M" Street, NW., Washington, D.C. 20554 (202-634-6620).

5. Accordingly, it is ordered that, effective March 13, 1979, Part 2 and Part 97 of the Commission's Rules are amended as set out in the Appendix.

(Secs. 4, 303, 48 Stat., as amended, 1066, 1082; 47 U.S.C. 154, 303.)

FEDERAL COMMUNICATIONS COMMISSION,
WILLIAM J. TRICARICO,
Secretary.

APPENDIX

Part 2 of Chapter I of Title 47 of the Code of Federal Regulations is amended as follows:
1. In Section 2.106, footnote NG15, and footnote NG 62 are amended to read as follows:

§ 2.106 Table of frequency allocations.

* * * * * * *

NG15 * * *
(a) * * *
(4) * * *

MAXIMUM DC PLATE INPUT POWER IN WATTS

Area	1800-1825 kHz Day/Night	1825-1850 kHz Day/Night	1850-1875 kHz Day/Night	1875-1900 kHz Day/Night	1900-1925 kHz Day/Night	1925-1950 kHz Day/Night	1950-1975 kHz Day/Night	1975-2000 kHz Day/Night
*	*	*	*	*	*	*		
Baker, Canton, Enderbury, Howland...	100/25	0	0	100/25	100/25	0	0	100/25
Guam, Johnston, Midway, Northern Mariana	0	0	0	0	100/25	0	0	100/25
American Samoa	200/50	0	0	200/50	200/50	0	0	200/50
*	*	*	*	*	*	*		

NG62 Consistent with Resolution 10, Radio Regulations, Geneva, 1959, interregional amateur contacts in this band should be limited to that portion between 7000 and 7100 kHz. In the band 7100 to 7300 kHz, the provisions of No. 117 of the Radio Regulations, Geneva, 1959, are applicable. In addition, 7100 to 7300 kHz is not available in the following U.S. possessions: Baker, Canton, Enderbury, Guam, Howland, Jarvis, Northern Mariana Islands, Palmyra, American Samoa and Wake Islands.

* * * * * * *

Part 97 of Chapter I of Title 47 of the Code of Federal Regulations is amended as follows:
2. In Section 97.61, paragraphs (b)(2) and (b)(4) are amended to read as follows:

§ 97.61 Authorized frequencies and emissions.

* * * * * *

(b) * * *
(2) * * *

MAXIMUM DC PLATE INPUT POWER IN WATTS

Area	1800-1825 kHz Day/Night	1825-1850 kHz Day/Night	1850-1875 kHz Day/Night	1875-1900 kHz Day/Night	1900-1925 kHz Day/Night	1925-1950 kHz Day/Night	1950-1975 kHz Day/Night	1975-2000 kHz Day/Night
*	*	*	*	*	*	*		
Baker, Canton, Enderbury, Howland...	100/25	0	0	100/25	100/25	0	0	100/25
Guam, Johnston, Midway, Northern Mariana	0	0	0	0	100/25	0	0	100/25
American Samoa	200/50	0	0	200/50	200/50	0	0	200/50
*	*	*	*	*	*	*		

(4) 3900-4000 kHz and 7100-7300 kHz are not available in the following U.S. possessions: Baker, Canton, Enderbury, Guam, Howland, Jarvis, the Northern Mariana Islands, Palmyra, American Samoa and Wake Islands.

Ham Help

An obviously demented *73* author is looking for 455-kHz i-f components. These may be anything from standard i-f transformers to moderately-priced crystal and ceramic filters.

They must be easily applied and usable with a wide range of solid-state devices, from junk-box transistors to IC devices—also, with tubes if possible. They must give good results in an i-f strip used for CW and/or SSB receiver use.

Manufacturers, distributors, or surplus dealers foolish enough to provide me with technical info, application notes, and an easy way for *73* readers to get their hands on the goodies may find themselves pestered unmercifully by *73* readers wanting to purchase parts to see if the circuit really works.

Alexander MacLean
WA2SUT/NNN0ZVB
18 Indian Spring Trail
Denville NJ 07834

I need help in converting a Drake TR-3 to semi-break-in CW. I feel that there must be some circuits for this obvious improvement of the TR-3 which possibly appeared in ham magazines in the 60s.

At present, my 15-year-old TR-3 must be manually switched between transmit and receive. The successor to the TR-3, the TR-4, injects a tone into the grid of the VOX amplifier circuit. Possibly, the same may be accomplished with the TR-3.

Ron Yokubaitis WB5TKQ
PO Box 3554
Austin TX 78764

I need the RCA manual sections for the high-band CMC-60 FM 60-Watt "boat anchor" rig (transmitter and dynamotor power supply only). I will duplicate and return within one week.

Jack Myers W3RU
5740 Auberger Dr.
Fairfield OH 45014
(513)-829-0511

I need help with an SR-C802—the schematic diagram or owner's manual, preferably.

Walt Persans WA2ZBE
135 Roe St.
Staten Island NY 10310

Contests

from page 21

AWARDS:

The ITU Trophy will be awarded to the country which earns the highest number of points computed as described above. The country which wins for 3 consecutive years or 5 interlaced years will remain in possession of the trophy. The trophy will be awarded to the representative national association of radio amateurs of the winning country. Gold, silver, and bronze medals will be awarded to the 3 highest-scoring radio amateurs in the world on each mode. Certificates will be awarded to the highest-scoring radio stations in each country on each mode. Depending on the number of contestants in each country, the contest committee will consider more certificates.

ENTRIES:

Logs will be filled out separately for each mode. Logs will follow the standard form and must be mailed before 30 June 1979. Address entries to: LABRE, UIT Contest Coordination, PO Box 07-0004, 70.000—Brasilia, DF, Brazil. Logs received after August 30 will not be computed for awards. Include a QSL, a self-addressed label, and IRCs for personal contest results. Note: Look for special ITU calls worldwide!

ARMED FORCES DAY
May 19, 1979

This year's observance of Armed Forces Day marks three decades of communications tests between the amateur radio fraternity and military communications systems. Since 1950, this event has been scheduled during the month of May and has emphasized a continuing climate of mutual assistance and warm esteem. Saturday, May 19, 1979, has been designated as the 30th Annual Armed Forces Day.

A featured highlight of the nationwide celebration will be the traditional military-to-amateur crossband communications tests. These tests give amateur operators an opportunity to demonstrate their individual technical skills and to receive recognition from the Secretary of Defense or the appropriate military radio station for their proven expertise.

The proceedings will include operations in continuous wave (CW), single sideband voice (SSB), radioteletype (RTTY), and slow-scan television (SSTV).

Special commemorative QSL cards will be awarded to amateurs achieving a verified two-way radio contact with any of the participating military radio stations. Those who receive and accurately copy the Armed Forces Day CW and/or RTTY message from the Secretary of Defense will receive a special commemorative certificate from the Secretary. Interception by shortwave listeners (SWLs) is not acknowledged by QSL cards; however, anyone can qualify for a certificate by copying the Secretary's message.

Crossband Radio Contacts

The military-to-amateur crossband operations will be conducted from 19/1300 UCT (Universal Coordinated Time) to 20/0245 UCT May 1979. Military stations will transmit on selected military frequencies and listen for amateur stations on those portions of the amateur bands indicated in Table 1. The military operator will specify the particular frequency in the amateur band to which he/she is listening. Duration of the contact should be limited to three minutes.

Station	Military Frequency (kHz)	Emission	Appropriate Amateur Band (MHz)
NAV	7385	RTTY	7.00-7.050
Headquarters, Navy-Marine Corps MARS	14455	RTTY	14.25-14.35
Washington, D.C.	13975.5 (13973)	SSTV	14.225-14.250*
NNNØNCG	4005	CW	3.5-3.65
US Coast Guard MARS Radio Station	6970 (6971.5)	LSB	7.050-7.100
Alexandria VA	14385	CW	14.0-14.1
	20988.5 (20987)	USB	21.25-21.45
NNNØNHZ	7380 (7381.5)	LSB	7.2-7.3
CINCLANTFLT MARS Radio Station Norfolk VA	14440 (14398.5)	USB	14.1-14.25
WAR	4001.5	CW	3.5-3.75
Headquarters, US Army MARS	4020 (4021.5)	LSB	3.775-4.0
Washington, D.C.	4030	RTTY	3.65-3.775
	6997.5	CW	7.0-7.15
	14405	CW	14.0-14.2
	20994 (20992.5)	USB	21.25-21.45
AIR	4025 (4026.5)	LSB	3.9-4.0
U.S. Air Force MARS/SITFA Radio Station	7305 (7306.5)	LSB	7.25-7.30
Washington, D.C.	7315	CW	7.025-7.20
	13977.5	CW	14.025-14.20
	14397 (14398.5)	USB	14.275-14.350
NPG	4001.5 (4003)	LSB	3.775-4.0
Navy Communication Station	4005	CW	3.5-3.65
Stockton CA	4010	CW	3.65-3.75
	6989	CW	7.00-7.025
	7301.5 (7303)	LSB	7.025-7.050
	7385	CW	7.050-7.075
	14375	CW	14.00-14.025
	20983	CW	21.0-21.2
	20998.5 (20997)	USB	21.27-21.40
NNNØMET	7347.5	RTTY	7.075-7.1
USMC Air Station MARS Radio Station El Toro CA	13922.5	RTTY	14.075-14.1
NPL Navy Communication Station San Diego CA	14390.5 (14389)	SSTV	14.225-14.250*

*SSTV from NAV will run from 1300-2100 UCT 19 May 1979
**SSTV from NPL will run from 1600-2400 UCT 19 May 1979

Table 1.

Transmitting Station	Frequencies (kHz)
NAM U.S. Navy Communications Area Master Station, Norfolk VA	4005, 7380, 14400
GXH U.S. Navy Communication Station THURSO, Scotland, United Kingdom	7394, 14520
NPG U.S. Navy Communication Station Stockton CA	4010, 7347.5, 13922.5
NDT U.S. Navy Communication Station Yokosuka, JA	7430, 15500
WAR Headquarters, U.S. Army Washington, D.C.	4030, 6997.5, 14405
AIR 2045th Communications Group Andrews Air Force Base Washington, D.C.	4025, 7315, 13997.5

Table 2.

CW Receiving Test

The CW Receiving Test will be conducted at 25 words per minute. The broadcast will be a special Armed Forces Day message from the Secretary of Defense to any amateur operator desiring to participate. A ten-minute CQ call for tuning purposes will begin at 20/0300 UCT. The Secretary of Defense message will be transmitted at 20/0310 UCT from the stations on the listed frequencies in Table 2.

RTTY Receiving Test

The Radioteletype (RTTY) Receiving Test will be transmitted at 60 words per minute. Radio station "AIR" will transmit using 850 Hertz (wide) shift. All other stations will transmit using 170 Hertz (narrow) shift. A ten-minute CQ call for tuning purposes will begin at 20/0335 UCT. The special Armed Forces Day message from the Secretary of Defense will be transmitted at 20/0345 UCT. This test is to exercise the technical skill of the amateur operator in aligning and adjusting equipment. Transmission will be from the same stations and on the same frequencies as listed for the CW Receiving Test.

Submission of Test Entries

Transcriptions should be submitted "as received." No attempt should be made to correct possible transmission errors.

Time, frequency, and callsign of the station copied as well as the name, callsign, and address (including zip code) of the individual submitting the entry must be indicated on the page containing the message text. Each year, a large number of acceptable copies are received with insufficient identification information, or the necessary information was attached to the transcript and became separated, thereby precluding the issuance of a certificate.

Entries should be submitted to the appropriate military command and postmarked no later than 25 May 1979.

Stations copying NAM, GXH, NPG, or NDT submit entries to: Armed Forces Day Test, Chief, Navy-Marine Corps MARS, Bldg 13, NAVCOMMU WASHINGTON, Washington, D.C. 20390.

Stations copying WAR submit entries to: Armed Forces Day Test, Commander, United States Army Communication Command, ATTN: CC-OPS-MARS, Fort Huachuca AZ 85613.

Stations copying AIR submit entries to: Armed Forces Day Test, 2045th COMM GP/DONV, Andrews Air Force Base, Washington, D.C. 20331.

MASSACHUSETTS QSO PARTY
Starts: 1200 GMT May 19
Ends: 2200 GMT May 20

This year's contest is sponsored by the Greater New Bedford Contesters. A station may be worked once per band, with phone and CW being separate bands for the purposes of this contest. No crossband or repeater contacts are permitted. Mobiles and portables may be counted as new contacts each time a county change takes place. DX stations count for QSO points only when worked by MA stations.

EXCHANGE:

RS(T) and MA county or state/VE province.

SCORING:

All stations count 2 points for each completed SSB exchange, 4 points for each CW exchange. MA stations multiply QSO points by total MA counties worked plus states and provinces worked. Out-of-state stations multiply QSO points by total number of MA counties worked. As an added bonus, add 5 points to your total score for each sponsor station worked (W1FJI, N1AS, K1KJT); sponsors can only be worked once for bonus points.

AWARDS:

Certificates will be awarded to 1st, 2nd, and 3rd place winners in each MA county as well as each state. Two special awards will be given—one to the ARC with the highest aggregate score in MA (min. of 3 logs), and a second award to the station in MA who submits the all-time highest number of QSOs (now held by N1YY at 664 QSOs in 1978). In addition, a certificate will be given to stations working all 3 sponsors.

SUGGESTED FREQUENCIES:

CW only—1810, 3560, 3720, 7060, 7120, 14060, 21060, 21120, 28060, 28120.

Phone only—1820, 3960, 7260, 14290, 21390, 28590, 50.110.

Use of FM simplex is encouraged; CW must be in CW bands only!

LOGS & ENTRIES:

Logging must conform to FCC rules—date, time, band, mode, callsign, state and province worked, exchange RST. Submit separate summary sheet along with logs. Summary sheet information: name, call, mailing address, club affiliation for aggregate score, total QSO points, multipliers, and total score. Deadline for mailing is June 30. For awards and results, send an SASE to Arthur Marshall W1FJI, 60 Meadow Rd., Westport MA 02790.

MICHIGAN QSO PARTY
Contest Periods
1800 GMT Saturday, May 19 to 0300 GMT Sunday, May 20
1100 GMT Sunday, May 20 to 0200 GMT Monday, May 21

Sponsored by the Oak Park ARC with phone and CW combined into one contest. Michigan stations can work MI counties for multipliers. A station may be worked once on each band/mode. Portable/mobiles may be counted as new contacts each time county changes.

EXCHANGE:

RS(T), QSO number, QTH = MI county or state/country.

SCORING:

Multipliers are counted only once. MI stations score 1 point per QSO times sum of states, countries, and MI counties on phone. Each CW contact is 2 points per QSO. KL7 and KH6 count as states. VE counts as a country. Max. multiplier is 85. Non-MI stations score QSO points times number of MI counties. QSO points are as follows: 1 pt. for each MI phone QSO, 2 points each CW QSO, 5 points each club station contact W8MB. Max. multiplier is 83. VHF-only entries same as above except multipliers per VHF band are added together for total multipliers. No repeater contacts allowed, but 5 points for each OSCAR QSO.

FREQUENCIES:

CW—1810, 3540, 3725, 7035, 7125, 14035, 21035, 21125, 28035, 28125.

Phone—1815, 3905, 7280, 14280, 21380, 28580.

VHF—50.125, 145.025.

AWARDS:

Only single-operator stations qualify. MI trophies to high MI score, high MI (upper peninsula) score, high aggregate club score. Plaque to high VHF-only entry and high mobile. Certificates to high score in each county with minimum of 30 QSOs. Out of state—high out-of-state trophy and certificates for high score in each state and country.

ENTRIES:

A summary sheet is requested showing the scoring and other pertinent information, name and address in block letters, and a signed declaration that all rules and regulations have been observed. MI stations include club name for combined club score. Party contacts do not count toward the MI Achievement Award unless one fact about MI is communicated. Members of the MI Week QSO Party Committee are not eligible for individual awards. Decisions of the contest committee are final. Results will be final on July 31 and will be mailed to all entries. Mailing deadline is June 30, 1979, to: Mark Shaw K8ED, 3810 Woodman, Troy MI 48084.

ACHIEVEMENT CERTIFICATES

1979 will be the 21st year that hams have had their own program to publicize Michigan and its products. Just as for the past 20 years, the Governor will award Achievement Certificates to hams who take an active part in telling the world of Michigan's unlimited resources, opportunities, and advantages.

Certificates are awarded on the following basis:

1) A MI ham submits log information and names and addresses (if possible) of 15 or more contacts made to out-of-state or DX hams with information regarding MI.

2) An out-of-state ham, including Canada, submits log information and names and addresses (if possible) of at least 5 MI hams who relate facts to him about MI.

3) A foreign ham, excluding any resident of Canada, submits the call letters and name/address plus log information for at least 1 MI ham who has told him about MI.

4) Only QSOs made during MI Week, May 19-26, will be considered valid!

All applications for certificates must be postmarked by July 1 and mailed to Governor William Milliken, Lansing MI 48902.

For your information, the state bird = robin, fish = trout, flower = apple blossom, state tree = white pine, stone = Petoskey Stone.

PERSONAL COMMUNICATIONS ESSAY COMPETITION

The Personal Communications Foundation is pleased to announce its 1979 law student essay competition.

Any person who is a student in good standing at an ABA-accredited law school on February 15, 1979, is eligible to participate. Prizes of $500, $250, and $100 are being offered. In addition, the Foundation will endeavor to have the winning essays published in a national bar journal.

The general subject matter of the essay must deal with one or more of the legal aspects of personal communications by use of amateur radio, Citizens Band radio, monitors, and/or radar detectors. Within this area, suggested topics include, but are not limited to, constitutional issues, federal v. state and local regulation, effects upon property use and values, zoning and land-use considerations, and civil and/or criminal liabilities in connection with equipment operation (exclusive of FCC proceedings).

Essays may be of any length. They must be typed, double-spaced. Footnotes must appear at the end of the essay and conform to the current edition of *A Uniform System of Citation* published by Harvard Law Review Association.

All essays must be received

at the offices of the Personal Communications Foundation on or before October 1, 1979. Contestants must include, in addition to their name, mailing address, and telephone number, the name and address of their law school. Essays will be returned only if they are accompanied by a self-addressed, stamped envelope.

All entries will be judged by a committee of the Board of Trustees of the Foundation. The decision of the judges is final, and all entries will become the property of the Foundation. Winners will be announced no later than November 30, 1979.

The Personal Communications Foundation is a nonprofit California corporation dedicated to the collection and dissemination of legal research and information concerning personal communications. Its Board of Trustees is composed of lawyers, judges, and law-school professors who are licensed amateur radio and/or Citizens Band operators. Inquiries and essays should be addressed to Kenneth S. Wideitz, President, Personal Communications Foundation, 10960 Wilshire Boulevard, Suite 1504, Los Angeles, California 90024. Telephone (213)-478-1749.

THE SASQUATCH AWARD

Sponsored by the Chilliwack Amateur Radio Club, the requirements are as follows: Eyeball contact with one Sasquatch, radio contact with two Sasquatch. Canadian and Continental US work six amateurs in the Chilliwack District, of whom three shall be club members. DX stations work five contacts, of which two shall be club members. Use all bands and all modes with all contacts made after March 1, 1979. The cost is $1.00 for VE/W, 3 IRCs for DX. Send log data only, QSLs not required. Apply to: Chilliwack Amateur Radio Club, c/o 317 Marshall Avenue, Chilliwack, BC, Canada V2P 3J5.

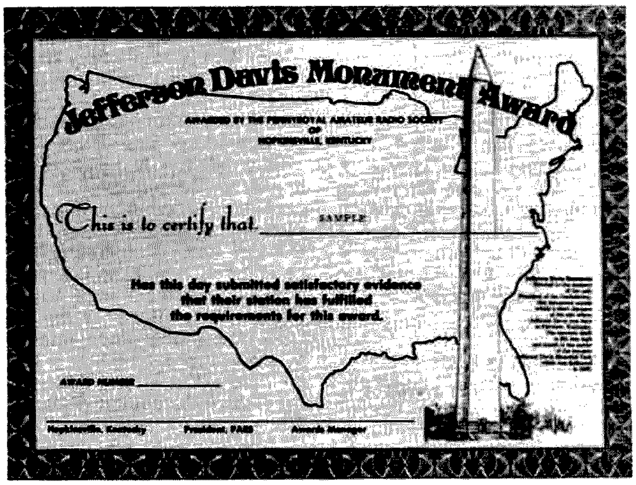
Chilliwack ARC Members: VE7s—AFA, AHN, AIO, AKD, AND, BEN, BHG, BYU, BZY, EWO, EX, FK, NHF, PU, QN, RS, TL, ZI. Local Area Calls (VE7s)—AGZ, AYZ, BBV, BDH, BIF, BLB, BPW, CBQ, CIO, CIW, CIX, CQO, GM.

JEFFERSON DAVIS MONUMENT AWARD

The Pennyroyal Amateur Radio Society of Hopkinsville KY will be operating portable from the Jefferson Davis Memorial Park on June 3, 1979, from 0001 to 2359 GMT. This certified sequential award will be issued to any station presenting written confirmation of contact with a PARS member during the QSO period, or any ten Kentucky amateurs during the year. Awards may be obtained by sending $2.00 and the QSL cards to: PARS, PO Box 1077, Hopkinsville KY 42240. The QSL cards will be returned with the award. Frequencies to be monitored are as follows: Novice—3740, 21140, 28140; General—3970, 7270, 14310, 21370, 28610.

NORTHERN LIGHTS AWARD

The Northern Lights Award is offered by the Northern Lights Chapter of the QCWA and is available only to members who are located outside the state of Alaska. Make contacts with three (3) members of the Northern Lights Chapter on any mode, any band, and any time after November 11, 1975. This is a one-time free award! Send a list of the three confirmed contacts, giving the date and time of the contacts to the secretary: J. W. "Mac" McQueen KL7AVX, 1928 East Dimond Blvd., Anchorage AK 99507.



NOVICE WAS NET FORMING!

For anyone interested, a Novice WAS net is forming at 1400 GMT on Saturday mornings on 21.125 MHz. Net control stations are KA8AKL and WD8RUH. Check in with QTH and state(s) needed. Listen for QST WASN or NWASN to locate the net. For more information, contact Rick Todd KA8AKL, 14470 Basslake Rd., Newbury OH 44065.

FAR SCHOLARSHIPS

The Foundation for Amateur Radio, Inc., a nonprofit organization with its headquarters in Washington DC, announces its intent to award six scholarships for the academic year 1979-80. All amateurs holding a license of at least the FCC General Class or equivalent can compete for one or more of the awards if they plan to pursue a full-time course of studies beyond high school and are enrolled in or have been accepted for enrollment in an accredited university, college, or technical school. The scholarship awards range from $250 to $800, with preference given in some of them to residents of various areas.

Additional information and an application form can be requested by letter or postcard, postmarked prior to June 1, 1979, from: FAR Scholarships, 8101 Hampden Lane, Bethesda MD 20014.

The Foundation is devoted exclusively to promoting the interest of amateur radio and scientific, literary, and educational pursuits which advance the purposes of amateur radio.

LETTERS

from page 18

it 50 others would follow suit . . . for what? People who subscribe to QST *get their money's worth in the magazine. If they are sending in the money to buy representation, then I think they are getting cheated. Sure,* QST *could be better . . . but it's certainly worth the subscription price, even at the new rate of $18 per year . . . which is about time.*

If there are any 73 loyalists reading this, go soak your head. If there are any ARRL loyalists, go soak your head and leave it under.—Wayne.

THE HP3422

John M. Murray W1BNN
4 Kenwood Circle
Bloomfield CT 06002

Dear Mr. Murray,

I enjoyed your article in the January, 1979, edition of *73 Magazine* concerning the ship that sank off Haiti.

I have spent the last 3 years with the United States Coast Guard in San Juan, Puerto Rico, where I worked in communications and the Rescue Coordination Center (RCC). We handle approximately five hundred separate search and rescue cases each year under the direct control of the San Juan RCC. I do, however, remember the case of the HP3422, because of the part amateur radio played in saving these people's lives, and because I was on duty at the time of the incident and recall some of the procedures used.

The initial call for assistance was copied by an amateur radio operator in the States, who in turn notified the Coast Guard. Because time is usually a very important factor in rescue cases, the Coast Guard attempts to talk directly to the unit for locating, assisting, and other instructions, rather than using the longer and not-so-efficient relay method. Although we do have a number of club and personal amateur radio stations, in an emergency situation the FCC has allowed us to use any frequency with the distress unit providing it does not cause a problem with the defense of our country. In this particular case, the Coast Guard Communications Station, Portsmouth VA, was our initial radio unit in contact with the vessel. The Coast Guard has several teletype and telephone networks set up between the Navy, Air Force, other Coast Guard units, and civilian organizations in order to help perform our missions.

During this case, many different military organizations were used in the attempt to get assistance to this vessel. The Navy assisted with the direction-finding work, which they supplied to the rescue aircraft (to get it within 1 mile of vessel), the Air Force helped with aircraft, and the Coast Guard provided the major coordination and communications effort. So you see, even though it seemed that only one or two people were trying to get assistance and rescue these people, several different groups, in-

cluding amateur radio operators, played an important part in the case.

I will not go into any more details concerning this incident, because my memory and the facts might tend to differ with each other. However, for your information, the people were picked up by a passing merchant vessel diverted to the scene to assist.

James C. Norton WD8EAI
Cleveland OH

NOTHING PERSONAL

I like your magazine very much. It is probably the best ham publication on the market today! BUT... it's not worth $15 a year to me. The last time I subscribed, I got a three-year subscription for that amount.

I know what you are going to say. You're going to tell me how inflation has made the price go up and all that jazz. Well, that may be. I can't, however, keep paying what I believe to be an outrageous price. I'm sorry, OM, nothing personal.

Clay Welsh W1PI
Springfield MA

VLF RECEPTION

I very much appreciated your fine editorial on Sam Harris. I had the W8FKC call from about 1948 to 1968 and knew Sam when he was at Brush Development in Cleveland and lived in Burton, Ohio. I used to work him on 144 and 220 from my former homes in Hudson and Chagrin Falls, Ohio, when the bands were dull. I built several paramps based on his designs and used them for moontracking the very first series of Ranger moon probes with a 28' dish. In fact, the paramp designs were the basis for my being interviewed for a position at Arecibo by Dr. Drake and others up at Cornell back in about 1964-65. I didn't get the job, which is just as well, because I did not really have enough expertise at the time. However, I was also on a year's leave of absence from OU here in 1966-67 with a position as station manager of the mm-wave dish supported by NRAO out at Kitt Peak AZ. I also spent a summer at Greenbank WV. All this was due in part to my interest and ability in VHF microwaves as a result of Sam Harris' work on low-noise amplifiers, etc., so I feel Sam had some influence over my career. I have graduated to the dc-to-500-kHz range now, teaching audio methods, supervising EE senior labs, and doing contract research on various NASA-, Signal Corps-, USCG-, and FAA-supported grants and contracts.

I enjoy reading 73 very much, although sometimes the quality of the technical work is not too good. A case in point was a recent article regarding VLF signal reception. In his article about a simple VLF converter (*73 Magazine*, January, 1979), W3QVZ mentioned the use of a 1000-foot (300-meter) longwire for WWVB, and only obtaining an estimated 20 uV at the input terminal. In theory, the 13-kW erp from WWVB at 60 kHz will develop a field intensity of about 100 uV/meter at W3QVZ's QTH in Woodbine, Maryland (see NBS Special Publication #432). Now, does this tell us that a 300-meter longwire strung out over the landscape only has an *effective height* of about 20/100 meters or *only 20 cm*? This, in fact, might be approximately true considering the input attenuation involved and the inherent difficulty of making accurate signal-strength estimates with a longwire antenna at VLF.

A longwire antenna system is just not the way to go at VLF. The antenna looks more like an extended groundwire, with much more capacitance to the variable noisy ground currents flowing in the earth than effective capacitance to the electric field above. Thus, the wire is picking up orders-of-magnitude more ground noise than signal. W3QVZ's comment that the antenna leaves much to be desired, even when used with a tuned circuit, is very true.

There is a much better approach to this problem of VLF signal reception. A 3-meter-or-so vertical whip antenna mounted up as high as possible and reasonably in the clear, with low capacitance to ground (but with a very good ground system at the receiver and underneath the antenna), can provide an effective height of 20 to 60 cm. In Ohio, I can receive WWVB 60 kHz with an estimated 150 uV/meter field intensity as developed on a $2\frac{3}{4}$-meter standard CB-type vertical whip. In order to operate a vertical, it is usually necessary to have a unity-voltage-gain, high-input-impedance circuit at the antenna base.

In my case, a preamplifier related to that presented in 73 *Magazine* (May, 1978, pp. 146-153), has a measured input capacitance of 85 pF with no antenna connected. The $2\frac{3}{4}$-meter vertical has a capacitance of about 100 pF. The effective height is very roughly 100/(85 + 100) meters, or about 60 cm. I actually estimate about 90 uV for WWVB at the antenna terminal. If 90 uV is developed on an antenna with an effective height of 60 cm, then 100 cm (or a 1-meter theoretically perfect antenna) would develop about 150 uV. This approximately checks out with what WWVB says their 60-kHz signal level should be at my location in Ohio. The point to make here is that *3 meters up and vertical in the clear is better than 300 meters long over the bush.*

There are a multitude of other problems connected with operating vertical whip antennas, but they can be solved. In fact, these types of vertical antennas are now being used in military and marine VLF monitor systems for radio navigation throughout the world. The biggest single problem with all VLF E-field antennas is providing a really good ground system and relatively low capacitance to ground at the antenna terminal. In VLF reception, we are trying to measure the potential difference between what we think is our local ground system and an ideal probe sticking out into free space. A long horizontal wire does not solve the problem.

Another way of measuring antenna performance is to compare the actual height (or length) with the effective height. Thus the $2\frac{3}{4}$-meter vertical has an efficiency of [60 cm/(2.75 x 100 cm)](100) = 22%, and the 300-meter longwire has an efficiency of [20 cm/(300 x 100 cm)](100) = 0.07%, assuming all our measurements are correct. Even if we are off by a factor of ten, the short vertical antenna is still better!

Still another way of looking at the problem of a 300-meter longwire is to consider the height above ground. In the W3QVZ case, it was 60 feet, or about 20 meters, off the ground. The lead-in from this longwire may be a more effective antenna than the 300 meters of longwire. The horizontal wire adds so much capacitance directly to a noisy ground plane that it is degrading the performance of the height above ground. A good rule to follow in designing a "flattop" horizontal wire is to make the length about equal to the height and to place a buried counterpoise of radial wires in the ground underneath the whole antenna to provide a good earth ground. This is typically the type of antenna used for transmitting radio navigation beacons in the 150-kHz to 400-kHz range with a height and width of 15 to 20 meters. While the radiation efficiency is low for transmitting at these frequencies because of the very long wavelength, the receiving efficiency can be quite high in terms of effective height when used with a low-noise, high-input-impedance antenna coupler circuit.

An attempt at illustrating the problem of a longwire antenna with a low height-to-length ratio (as compared with a short vertical whip) is shown in Fig. 1. The downward point lines indicate the predominant coupling to the ground plane, and the dotted lines pointing upward show the coupling to the free-space electric field. In real-world antennas at low frequencies, it is often necessary to make a series of two-dimensional electrolytic tank experiments and plot the field contours by applying dc potential between an upper electrode and the bottom ground plane electrode containing the model antenna. The results are difficult to illustrate in two dimensions. Fig. 1 is a rough pictorial representation of the situation, not to any scale, to illustrate the idea of effective height (which is a purely mathematical concept). The main point we are trying to illustrate with all this is that it is important to have the probe (antenna)

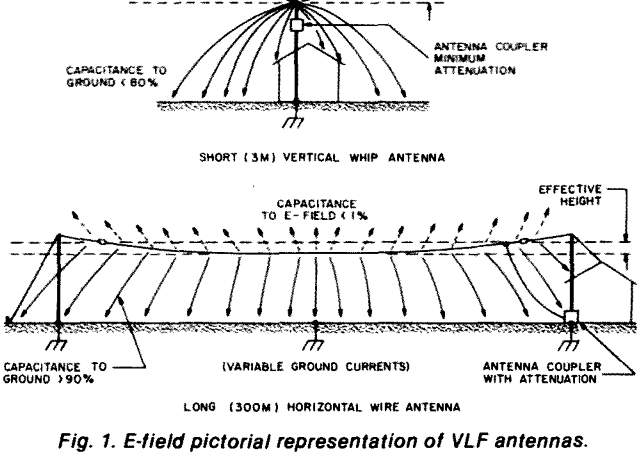


Fig. 1. E-field pictorial representation of VLF antennas.

out in the electric field as high as possible to minimize parallel capacitance and coupling to the local ground plane. In amateur work with VLF antennas, we should stop thinking about the way antennas work at 80 meters and up. Virtually all VLF E-field antennas are much shorter than a quarter wavelength. We should consider the antenna as more like placing a high-impedance probe at the end of a cable connected to an oscilloscope, with the high-Z circuitry at the antenna designed to minimize undesired noise pickup. (H-field loop antennas are a whole different story at VLF, suitable for some other author to present.)

Another aspect of W3QVZ's article on the VLF converter is the trouble experienced with cross-modulation. The use of an LM318 bipolar IC as a wideband input stage amplifier is prone to this problem. The input circuit, low-pass filter, and the input 10k summing resistor used with the LM318 operate as an attenuator for low-level signals. This decreases the signal even before it is amplified. It is not common practice to use operational amplifier methods at the very first input stage of a communications receiver. The signal-to-noise ratio is always decreased whenever an attenuation network is inserted between the source and the amplifier. A better input stage amplifier is a JFET MPF102 or 2N5457, each of which is much less susceptible to cross-modulation problems.

Good DX-hunting on VLF!

R. W. Burhans
Athens OH

227 MOD

As a member of Army MARS, I am grateful to KH6JMU for his work on expanding the frequency range of the Yaesu FT-227R Memorizer to include some MARS coverage (*73*, March, 1979).

Following his instructions, I removed the red wire from pin 3 and the blue wire from pin 7 on Q712 (MC14028B), located on the PLL control board (PB-1773A), and soldered them to a nearby ground. I found that the display became functional from 142.000 MHz to 149.995 MHz, as he indicated it would. The unit would transmit out-of-band below 144.000 MHz, but not above 147.995 MHz—which is required to work our local Army MARS repeater (148.01 in, 143.99 out).

After studying the diagram on page 19 of the owner's manual, I noted that although Q712 controls the low-end cutoff, Q711 (MC14081B) controls the high-end cutoff which must be overridden in order to transmit above 147.995 MHz.

The "fix" is very simple. All that is required is to cut a 1/16-inch gap in the foil leading from pin 10 on Q711 to D701, allowing Q713 to function properly above 148.000 MHz. This quick fix allows full transmit and receive functions from 142.000 to 149.995 MHz, including memory. (Would you believe 1600 channels?!)

Perhaps this 15-minute modification will make the FT-227R attractive to MARS members who were considering other alternatives.

Mike Zoruba N8AIF
North Ridgeville OH

GENERATOR IMPROVEMENT

First off, thanks to Louis Hutton K7YZZ for the translation and Sr. Mario Scarpelli I6THB for his design, "The Italian Freq Generator" (January, 1979). I would like to suggest an improvement to prevent a "race" condition. Separate pin 13 of IC X5 and add an R-S flip-flop as shown in Fig. 2. This modification forces the "load" pulse to be equal to one half of the period of the generated signal, at least 50 ns at 10 MHz. Ten different 74192s were tried in the original circuit, with poor results above 5 MHz. With the modified circuit, the output signal is not "off 1 or 2 Hz at audio" and "several hundred Hz at MHz range," but is exactly "thumbwheel switch settings" plus "one" times the "multiplier switch" plus or minus the "reference oscillator error."

I had to add an additional 5 pF to the 33-pF and 100-pF capacitors to tune down to 3.400 MHz and 1.000 MHz respectively. Again, thanks for a good design, as I now have a signal generator which tunes from 0.993 Hz to 10.000 MHz with ± 1 ppm accuracy.

Clancy Arnold W9AFV
Lawrence IN

P.S. If you change IC X20 from a 7400 to 74S00 and use 2 unused gates of it for this modification, you add nothing to the parts count and gain an increase in drive power from 15 pF at 400 Ohms to 150 pF at 93 Ohms.

MEXICAN OPERATION

First, I thought I'd let you know how much I enjoy your magazine and how much I appreciate the fact that I can buy a subscription to it in Mexico for the same price as paid by stateside subscribers.

I thought some of your readers might be interested in knowing that there is now a *possibility* that licenses may be issued to visitors to Mexico. Until recently, only Mexican citizens were permitted to hold amateur licenses, and Mexico has no

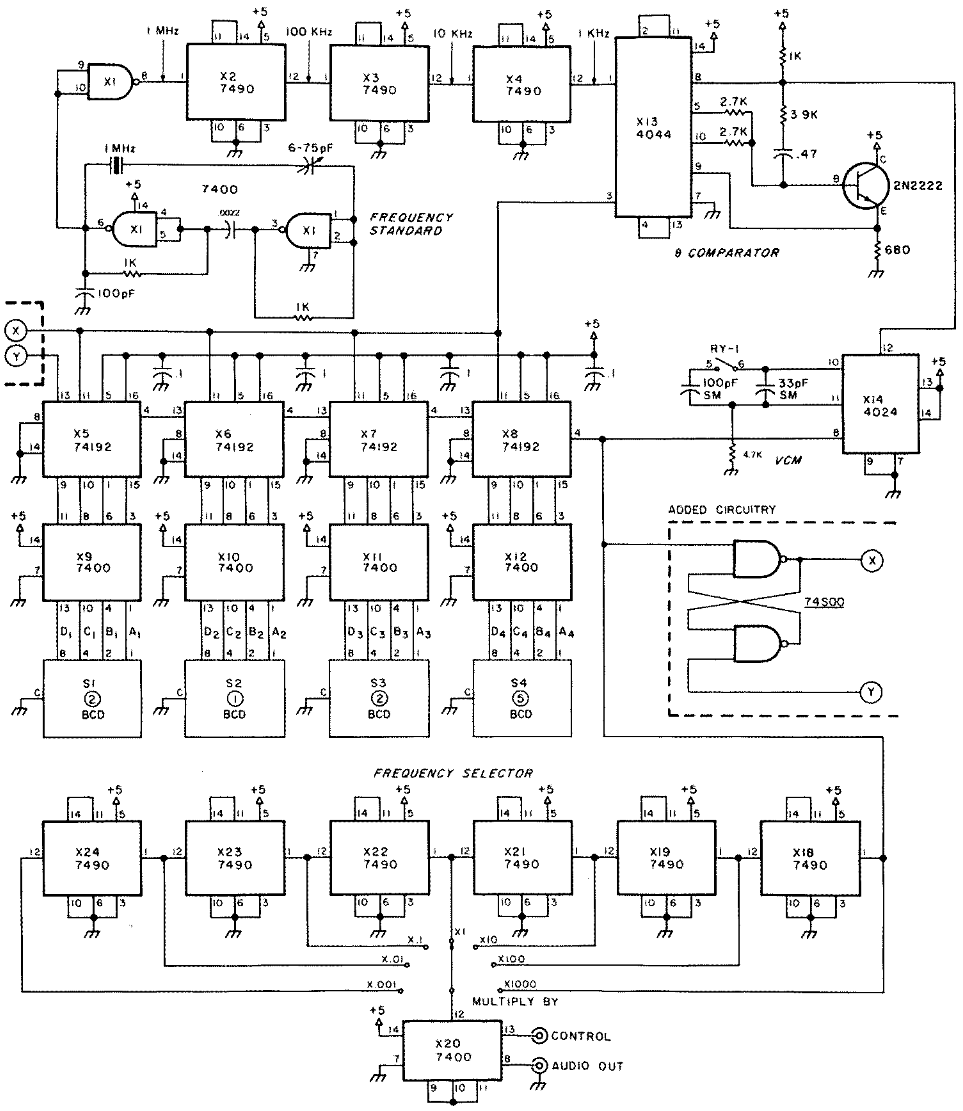


Fig. 2. Added circuitry for "The Italian Freq Generator."

reciprocal agreements in force; however, due to a change in the regulations covering amateur operation in Mexico, permits may be issued up to a term of 6 months to persons visiting Mexico.

I would suggest that anyone interested in obtaining such a permit submit a request to: Secretaria de Comunicaciones Y Transportes, Subdireccion General de Permisos Y Asuntos Internacionales, Depto. de Frequencias Radioelectricas, Oficina de Licencias, Torre Central de Telecomunicaciones, Ave. Nino Perdido Y Cumbres de Aculzingo, Mexico 12, D.F., Mexico.

I suggest that a photocopy of the current license be included, as well as a copy of the Mexican tourist card (obtainable at the airline or travel agency offices) and a statement that "In accordance with Article 19, subsection b, of title 3, Regulations to Install and Operate Amateur Radio Stations as published in the Diario Oficial of July 4, 1977," you are requesting consideration of your request to be granted a temporary permit to operate. I would also suggest that a list of places to be visited, the approximate dates, and the equipment to be brought into the country be sent at the same time.

I cannot guarantee that this will get the applicant a permit, but at least such a possibility exists, for the first time.

Kenneth M. Price XE1TIS
Irapuato, Mexico

PURE BODIES

In your editorial in the November, 1978, issue of *73*, you express concern about the effects of radar radiation absorbed as one drives down the highways of New Hampshire.

I submit that your concern is extremely parochial. You get zapped once every twenty miles or so. Consider the plight of those of us living on the heights just across the Hudson from the Big Apple—as one looks at the Empire State Building, one sees not only the TV antennas with their tremendous erp, but also all manner of dishes, yagis, corner reflectors, and horns aimed in our direction. And that is just a start—many other buildings from the Battery to uptown are also squirting a potpourri of rf our way. Of course, not all of this radiation is in the microwave region, but a good deal of it is—and many of those UHF TV channels are getting mighty close—and running lots of Watts.

I have no idea how much microwave energy I'm being subjected to, but if, as you claim, the highway dosage is 5000 times the amount of leakage allowed from microwave ovens, I'm sure I'm being subjected to a helluva lot more than that!

When you start your Church of the Pure Body, I think I'd be ready to become a convert. I'd then be able to protest the violation of my religious principles by all those rf sources across the river. Do you think we could get them to install a copper-screen rf fence along the top of our Palisades? As you say, if enough people protest, they can raise hell with the system. I don't want to move—I've lived here longer than the system has been imposing its rf on me. And the saddest part of all is that so much of the rf is being used to carry the pure unadulterated garbage that is the rule rather than the exception on the TV channels these days.

Allen L. Barnett WB2QPM
Jersey City NJ

WRIST-COM

Our January, 1979, issue contained a brief mention of a project to develop a "wrist radio" communications system. Since then, we've received an especially informative letter on the recent history of this concept. An excerpt from the letter appears below.

The conclusion one draws from your comments is that NASA was the first to conceptualize and develop a functioning two-way wrist radio. I feel that it would be more to your advantage to provide full coverage regarding the actual facts in the development of a two-way wrist radio communication system beyond the representations provided by Chester Gould.

In late 1972 and into 1973, I developed a concept and then a breadboard working model of a sophisticated two-way wrist-worn communications system for deaf-blind persons which included digital on-board control, outputting of a number of different types of messages, and Morse code capability. It also provided for signaling back to a base station in cases of an emergency. We call it the "Wrist-Com." For one version of the Wrist-Com wireless signaling system, the "Institutional Wrist-Com," we required assistance in microminiaturization, and, because of their reputation and willingness to assist, we entered into an agreement with the Technology Utilization Office of NASA which would result in their producing for us a system which was based upon our design specifications and breadboard, and which would be usable at the Helen Keller National Center for Deaf-Blind Youths and Adults by our staff and clients, and elsewhere. More than four years have gone by since the original commitment was made, and NASA is still working on the project. (Since the original agreement, I have served as a technical consultant to NASA.)

I am quite disappointed that reports such as those occurring in *Microwave Systems News* and *73* should give so much publicity to a device which is merely an artist's conceptualization, when an actual system specifically designed to make use of a sophisticated two-way wrist radio and capable of satisfying many of the survival and signaling needs of severely handicapped people is presently being prototyped. Moreover, the prototype work is based on my designs developed here at the Helen Keller National Center. In light of the above, credit for the initial development of a practical two-way wrist communication system should be given to the Helen Keller National Center for Deaf-Blind Youths and Adults.

Frederick M. Kruger, Ph.D.
K2LDC
Director of Research
Helen Keller National Center
Sands Point NY

Thanks for providing us with the proper background on the Wrist-Com idea. Best of luck with the project, Fred, and be sure to keep us up to date on your progress.—Jeff DeTray WB8BTH/1, Assistant Publisher.

HAD IT

I enlisted in the Navy in 1956, and ended up as a Radioman. In 1962, while on my one and only tour of shore duty, I was stationed with several amateurs, and a friend of mine had quite a collection of back issues of *CQ* and *QST*. I spent a lot of time reading and enjoying these old magazines, especially "Never Say Die" and "Scratchi." So, I went and got a General class license.

I spent many enjoyable hours working 20 CW from the small ham shack where I had the misfortune to be stationed. I ended up with a big bunch of QSL cards (all of which were acknowledged), and then went to a ship home-ported in a country without reciprocal privileges.

About this time, the subscription to *CQ* I had ordered finally caught up to me. Right away I opened it to W2NSD, only to find out it wasn't there; no Scratchi, either. Then I saw an editorial by the new editor, and the part that sticks in my memory after 15 years was something he wrote to the effect that there is no place in a ham magazine for levity. And that was why Wayne Green was no longer the editor. The next ten issues were passed on to my ham shipmates without being opened. Naturally, I never renewed that subscription.

At the same time, I let my membership in the ARRL lapse, mainly because of incentive licensing. I didn't mind working harder for something more, but it really ticked me off to lose what I already had.

In 1966, I became a submarine sailor. No chance for amateur radio there, but each time my license expired, I renewed it, thinking that one day I would be on the air again. In the meantime, I had tours on four submarines, in Viet Nam, and in Taiwan. Finally, in 1976, I retired from the Navy. During my career, I had been the leading Radioman in five different radio shacks, and only a Navy Radioman can tell you what that means to a Radioman. I had also managed to acquire a First Class Radiotelegraph license, and shortly after retiring, I received my Merchant Marine Radio Officer's license and Z-card. I did not, however, attempt to upgrade my amateur license, mostly because of a lack of interest.

Shortly after I retired, I received your offer of a three-year subscription at a special price, and I went for it. The first couple of issues got me thinking again, and over the past couple of years I have been doing quite a bit of soul-searching and discussing amateur communications with some of the amateurs I know.

I have now reached the conclusion that after twenty years as a professional radio communicator, I've had it. Amateurs today are the same as they were when I started. If you manage to get in contact with one of them, either they are looking for as many contacts as possible or, if they are interested in communicating (rag chewing), which is my bag, it seems like all they can talk about is what gear they are using. The fact that I can receive them at all tells me that they have an antenna, a transmitter, and some sort of electricity hooked up to it. If I ask about the weather, they don't know because they haven't been outside of the ham shack for the past week. If I ask about the liberty where they are, such as the night spots, local attractions, etc., the contact either fades, or the other guy comes on like the caretaker at the local monastery.

Well, now I have a job as a locomotive engineer. (That's the guy who runs the train.) I have a radio on my engine but I

couldn't tell you what frequency it's on. I suspect it's around 160 MHz, on FM, but if it isn't, I'm not concerned. As a matter of fact, I'm not really all that concerned about whether it works or not. And that's the limit of my two-way communications.

If, as you fear, WARC takes away the amateur frequencies, I'm not going to mourn them. If I haven't made it clear why not, I'll spell it out here: incentive licensing. Once it went in, I went out and have stayed out.

Well, Wayne, I know this is the type of letter you don't like to receive, but it is how I feel. If you want to cancel my subscription now, that's okay. If not, I'll keep reading the magazines as they come until it runs out, but I won't be renewing it.

Jack McCord KA4EXD
Arlington VA

OUT OF SIGHT

I have just returned from an ARRL convention/hamfest, where I attended an ARMA (Amateur Radio Manufacturer's Association) meeting at which most of the ARRL board of directors also sat in. Since ARMA allows manufacturers, dealers, reps, and publishers to be members, the ARRL was classified as a publisher and allowed to participate in the meeting. The meeting started with just a handful of manufacturers and dealers and the group of ARRL directors. The first words that came from the ARMA meeting moderator were, "It has been said that ARMA is anti-ARRL—this is not so." With that, you could hear a sigh of relief in the form of a wheeze from the elderly ARRL board members. The main topic of the meeting was the 220 band and what to do with it. They also talked about the 10 meter amplifier ban.

As some of you know, the ARRL has asked the FCC to allow the use of 220 for the Novice for phone, hoping to bring more users to the band. ARMA wants to start an all-new entry level exam for 220, with a code recognition test (3 to 5 wpm) and a Novice-type technical exam. The testing for the new class would be much like the Novice test, only the old term "Novice" would not be used. After all, who wants to be a novice at anything? The term "Communicator" will not be used either. They said that "communicator" sounds too much like CB and that the high emotional feeling of hams about that word would spell doom for the ARMA plan. So they have to come up with a name that all will go for.

ARMA then disclosed its plan of attack. It called for $30,000 to go for a lobbyist to push a $1.5 million FCC grant/funding pool for the "new class" license. ARMA said that the FCC had told them that if the money were appropriated, the new class could be on the air by midsummer of '79. With that came the big question—Will the ARRL back ARMA and their plan? Silence fell over the room. ARMA members were on the edge of their chairs, and all you could hear were the tapping of toes, the counting of fingers, and the scratching of heads coming from the ARRL leaders. Then came the big answer: Well, maybe, but off the record—we don't want to make anyone in the "fraternity" mad at us and lose members.

It seemed to me that the ARRL directors were looking after themselves as board members, but as elected representatives they were not doing their job in any way. Even the next day, at the ARRL membership meeting, the ARMA plan was not brought to light to the membership. If a phrase could be used to express the ARRL feelings on any issue that might have an impact on membership, it's "out of sight, out of mind."

James W. Menefee, Jr. WA4KKY
Jacksonville FL

FCC

Reprinted from the Federal Register.

PART 97—AMATEUR RADIO SERVICE

Editorial Amendment Concerning Application for Station License

AGENCY: Federal Communications Commission.

ACTION: Correction of final rule.

SUMMARY: FCC amends rule to correct error in paragraph sequence.

EFFECTIVE DATE: March 13, 1979.

ADDRESSES: Federal Communications Commission, Washington, D.C. 20554.

FOR FURTHER INFORMATION CONTACT:

Upton Guthery, Office of General Counsel, 202-632-6444.

In the matter of editorial amendment of § 97.41 Rules of Practice and Procedure; Order.

Adopted: February 26, 1979.

Released: March 2, 1979.

1. To correct inconsistencies between the amendatory language and the paragraphing of the rule changes in two orders amending § 97.41 of the Rules, we are issuing this order specifying the correct text of that section. The orders in question are FCC 78-76, 43 FR 7323, February 22, 1978, and FCC 78-210, 43 FR 15331, April 12, 1978.

2. Authority for this action is contained in Sections 4(i) and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. 154(i) and 303(r), and § 0.261(d) of the Rules, 47 CFR 0.261(d). Because the correction is editorial in nature, compliance with the prior notice and effective date provisions of 5 U.S.C. 553 is unnecessary.

3. Accordingly, it is ordered, effective March 13, 1979, That § 97.41 is corrected to read as set forth below.

(Secs. 4, 303, 48 Stat., as amended, 1066, 1082; 47 U.S.C. 154, 303.)

R. D. LICHTWARDT,
Executive Director.

In part 97 of Chapter I of Title 47 of the Code of Federal Regulations, § 97.41 is corrected to read as follows:

§ 97.41 Application for station license.

(a) Each application for a club or military recreation station license in the Amateur Radio Service shall be made on the FCC Form 610-B. Each application for any other amateur radio license shall be made on the FCC Form 610.

(b) One application and all papers incorporated therein and made a part thereof shall be submitted for each amateur station license. If the application is only for a station license, it shall be filed directly with the Commission's Gettysburg, Pennsylvania office. If the application also contains an application for any class of amateur operator license, it shall be filed in accordance with the provisions of § 97.11.

(c) Each applicant in the Safety and Special Radio Services (1) for modification of a station license involving a site change or a substantial increase in tower height or (2) for a license for a new station must, before commencing construction, supply the environmental information, where required, and must follow the procedure prescribed by Subpart I of Part I of this chapter (§§ 1.1301 through 1.1319) unless Commission action authorizing such construction would be a minor action with the meaning of Subpart I of Part I.

PART 97—AMATEUR RADIO SERVICE

Extending Grace Period for Renewal of an Expired Amateur Radio Service Operator License

AGENCY: Federal Communications Commission.

ACTION: Order (Rulemaking).

SUMMARY: The Amateur Radio Services rules are being amended to extend the grace period for renewal of an expired amateur radio license from one year to five years. At present, persons who do not renew within one year of the expiration of their license must be retested in telegraphy and radio theory. Extension of the grace period will reduce the number of re-examinations and/or requests for waiver of the re-examination requirement.

EFFECTIVE DATE: March 16, 1979.

ADDRESSES: Federal Communications Commission, Washington, D.C. 20554.

FOR FURTHER INFORMATION CONTACT:

Mr. Stephen J. Francis, Private Radio Bureau, (202-632-7175).

SUPPLEMENTARY INFORMATION:

Adopted: February 28, 1979.

Released: March 5, 1979.

Order. In the Matter of Amendment of Part 97 to extend grace period for renewal of an expired Amateur Radio Service operator license.

1. The purpose of this Order is to amend Part 97 of the Commission's rules to lengthen the "grace" period for renewal of an expired amateur radio operator license. Section 97.13(d) of the Commission's rules now states that, "If a license is allowed to expire, application for renewal may be made during a period of grace of one year after the expiration date. During this one year period of grace, an expired license is not valid."

2. Applicants who allow the one year period of grace to expire must normally be reexamined to demonstrate again their qualifications to be amateur radio operators. The Commission, however, receives many requests for waivers of § 97.13(d) from applicants, who, for various reasons, have unknowingly permitted their licenses to lapse beyond the one year period of grace.

3. In considering whether or not to grant waivers of § 97.13(d), the Commission evaluates the circumstances surrounding the non-renewal of these licenses. The rule is waived in cases when (1) circumstances beyond the licensee's control, such as a physical disability or a death of a close family member prevent the licensee from filing a timely application and (2) the period since expiration of the "grace period" has been of brief duration. When a waiver is granted, the Commission presumes the applicant is still fully qualified to operate an amateur station.

4. It is evident from experience gained in processing several hundred requests for waivers in recent years that the overwhelming majority of requests result in waivers. For this reason, the Commission is amending § 97.13(d) to change the period of grace from one to five years. The Commission concludes that the five-year period is one in which it is reasonable to presume that the licensee will remain fully qualified. While there is no clear demarcation, we believe that an extension of this period beyond the equivalent of one additional license term is unwarranted.

5. The rule amendment will reduce Commission workload in two ways: (1) The Commission will receive fewer requests for waivers, each of which now require individual attention and handling; and (2) the Commission will administer fewer second examinations to ex-licensees who failed to renew their licenses within the "grace period".

6. Authority for these amendments is contained in Sections 4(i) and 303 of the Communications Act of 1934, as amended. The Commission finds, that for good cause the prior notice and public procedure provisions of the Administrative Procedure Act (5 U.S.C. 553) are unnecessary because the Commission believes that there would be no objection to the relief from previously imposed restrictions. Early adoption would simplify application filing requirements, accelerate the speed for processing applications, and reduce delay in eliminating restrictions.

7. *It is ordered,* That effective March 16, 1979, Part 97 of the Commission's rules and regulations is amended as set forth below.

(Secs. 4, 303, 48 Stat., as amended, 1066, 1082; (47 U.S.C. 154, 303))

FEDERAL COMMUNICATIONS COMMISSION,
WILLIAM TRICARICO,
Secretary.

Part 97 of Chapter I of Title 47 of the Code of Federal Regulations is amended as follows:

1. In § 97.13 paragraph (d) is revised to read as follows:

§ 97.13 Renewal or modification of operator license.

* * * * *

(d) If a license is allowed to expire, application for renewal may be made during a period of grace of five years after the expiration date. During this five year period of grace, an expired license is not valid. A license renewed during the grace period will be dated currently and will not be backdated to the date of its expiration. Application for renewal shall be submitted on FCC Form 610 and shall be accompanied by the applicant's expired license.

AMATEUR RADIO SERVICE

Terminating Proceeding Concerning Operator Classes, Privileges, and Requirements

AGENCY: Federal Communications

Commission.

ACTION: Termination of rule making proceeding.

SUMMARY: The Commission decides to defer action on the "Communicator Class" and "dual ladder" amateur licensing. A petition for "lifetime" issuance of the Amateur Extra Class license is denied; and action is deferred on changing the procedure for measuring amateur transmitter power.

EFFECTIVE DATE: Not applicable.

ADDRESSES: Federal Communications Commission, Washington, D.C. 20554.

FOR FURTHER INFORMATION CONTACT:

James E. McNally, Jr., Personal Radio Division, Private Radio Bureau, (202) 632-7175.

THIRD REPORT AND ORDER—(PROCEEDING TERMINATED)

Adopted: March 6, 1979.

Released: March 14, 1979.

In the matter of amendment of Part 97 of the Commission's rules concerning operator classes, privileges, and requirements in the Amateur Radio Service, Docket No. 20282, RM-1016, 1363, 1454, 1456, 1516, 1521, 1526, 1535, 1568, 1572, 1602, 1615, 1629, 1633, 1656, 1724, 1793, 1805, 1841, 1920, 1947, 1976, 1991, 2030, 2043, 2053, 2149, 2150, 2162, 2166, 2216, 2219, 2256, 2284, 2449.

1. On December 16, 1974, the Commission issued a Notice of Proposed Rule Making in the above-entitled matter which was published in the FEDERAL REGISTER on December 20, 1974 (39 FR 44042). The major proposed rule changes contained in the Notice were the following:

(a) Creation of a 'dual ladder' licensing structure;

(b) Creation of a "Communicator Class" license having no telegraphy privileges or examination requirement;

(c) Establishment of new power limits based on transmitter peak envelope power output;

(d) New restrictions on licenses obtained by means of volunteer-administered mail examinations;

(e) Issuance of lifetime Amateur Extra Class operator licenses; and,

(f) Modification of the frequencies and modes available to certain license classes.

2. Because of severe manpower and time restrictions brought about by the huge surge in Citizens Band Radio Service applications since 1974, we were unable to undertake the preparation of a comprehensive Report and Order addressing all of the issues raised in the Notice. We did, however, release a First Report and Order on June 15, 1976 (41 FR 25013) which amended the rules to reflect the following changes:

(a) Except in cases where the applicant was physically disabled (and where the Commission would select the volunteer examiner), volunteer-administered examinations could only be given to applicants for the Novice Class license;

(b) The Conditional Class license and the "conditional" (C) limitation on the Technician Class license were to be eliminated upon renewal. Licensees holding the Conditional Class license were to be issued a regular General Class license, and holders of the Technician (C) Class license were to be issued regular Technician Class licenses;

(c) The 175 mile distance eligibility criteria for the General (formerly Conditional) Class license was eliminated;

(d) Applicants for any class of amateur license must take Element Two;

(e) Holders of the Technician Class license were given all Novice privileges; and,

(f) The maximum permissible input power for Novices was increased to 250 watts.

3. Subsequently, on April 6, 1978, we released a Second Report and Order (43 FR 15324) which gave holders of the Technician Class license full operating privileges above 50 MHz, and which changed the term of the Novice Class license from 2 years, non-renewable to 5 years, renewable.

4. The purpose of this Third Report and Order is to dispose of the remaining unresolved matters.

5. First, we have decided to take no action at this time on the 'dual ladder' licensing structure proposed in the Notice, or on the creation of a "Communicator Class" license having no telegraphy privileges or requirements. We firmly believe in the principle, articulated in the Notice, that in any licensing system there should be a logical relationship between the qualification requirements and the operator privileges authorized at each license class level. We feel that the "Communicator Class", as proposed, was in keeping with this principle; and we do not agree with the majority filing comments who asserted that the privileges to be conveyed by the "Communicator Class" were "out of proportion" to the qualification requirements. Nevertheless, since much time has elapsed since the issuance of the Notice (4 years), and since the Amateur Radio Service has grown about 50% in that time period (with many of the new licensees coming from the Citizens Band Radio Service), it is our belief that the comments, and perhaps even our original proposal, have become somewhat outdated. Then, too, tremendous growth has taken place in the citizens Band Radio Service (1400% in 4 years); and we would like to get the views of these newer licensees on the need or desirability of a "codeless" class of amateur license. Accordingly, we hope to revisit this matter later this year in a new rule making proceeding.

6. At this time, however, we will address the matter of lifetime issuance of the amateur Extra Class license (RM-2030). In the Notice, we proposed to adopt this request since our records indicated that very few amateurs drop out of amateur radio after they have attained the amateur Extra Class. We pointed out, however, that while section 303(L)(1) of the Communications Act of 1934, as amended, allows us to issue operator licenses for life, section 307(d) limits the term of the concomitantly issued station license to not more than 5 years. At best then, we would only be able to eliminate the need to retake the examination should the amateur neglect to renew his (or her) license.

7. In the years since the issuance of the Notice, however, we have become very sensitive to the adverse effects such "special case" consideration can have on our various personal (and amateur) radio service data processing systems. While we generally retain files containing information about expired licenses for periods in excess of 5 years after the expiration date, to maintain these files indefinately would be a new and burdensome requirement, particularly in view of the fact that very few people would be expected to take advantage of the lifetime non-examination renewal privilege. In a separate action, we have amended § 97.13 to extend the "grace period" for all classes of license from one to five years. This extension will accommodate a great variety of personal circumstances which has been the basis of requests for waiver of the "grace period"; and it is, in our opinion, an equitable alternative to a lifetime, non-examination renewal privilege. Accordingly, we have decided to take no additional action on this matter.

8. Lastly, the comments filed in response to our suggestion of establishing new power limits based on transmitter peak envelope power output were, in the main, negative. There were, however, several respondents who did suggest innovative alternatives to our proposal. While we have decided to take no further action on this matter at this time, we are still of the opinion that the state of present-day amateur communications warrants the use of better procedures to determine transmitter power than the "plate voltage times current" method. We intend to revisit this matter at a later time, and we encourage amateurs, in the interim, to develop and disseminate data which could be used as a basis for a workable and state-of-the-art measurement technique.

9. Accordingly, pursuant to the authority contained in Sections 4(i) and 303 of the Communications Act of 1934, as amended: *It is ordered*, That this proceeding is terminated. Further information about this action by the Commission may be obtained by contacting Mr. James E. McNally, Personal Radio Division, FCC, 1919 M St., NW., Washington, D.C. 20554 (202-632-7175).

FEDERAL COMMUNICATIONS COMMISSION,
WILLIAM J. TRICARICO,
Secretary.

OSCAR Orbits

Courtesy of AMSAT

The listed data tells you the time and place that OSCAR 7 and OSCAR 8 cross the equator in an ascending orbit for the first time each day. To calculate successive OSCAR 7 orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the day's *first* ascending (*northbound*) equatorial crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world from you, it will descend over you. To find the equatorial descending longitude, subtract 166° from the ascending longitude. To find the time OSCAR 7 passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR 7 when it is within 45 degrees of you. The easiest way to determine if OSCAR is above the horizon (and thus within range) at your location is to take a globe and draw a circle with a radius of 2450 miles (4000 kilometers) from your QTH. If OSCAR passes above that circle, you should be able to hear it. If it passes right overhead, you should hear it for about 24 minutes total. OSCAR 7 will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15° east or west of you, add another minute; at 30°, three minutes; at 45°, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

OSCAR 8 calculations are similar to those for OSCAR 7, with some important exceptions. Instead of making 13 orbits each day, OSCAR 8 makes 14 orbits during each 24-hour period. The orbital period of OSCAR 8 is therefore somewhat shorter: 103 minutes.

To calculate successive OSCAR 8 orbits, make a list of the first orbit number (from the OSCAR 8 chart) and the next thirteen orbits for that day. List the time of the first orbit. Each successive orbit is then 103 minutes later. The chart gives the longitude of the day's first ascending equatorial crossing. Add 26° for each succeeding orbit. To find the time OSCAR 8 passes the North Pole, add 26 minutes to the time it crosses the equator. OSCAR 8 will cross the imaginary San Francisco-to-Norfolk line about 11 minutes after crossing the equator. Mode A: 145.85-.95 MHz uplink, 29.4-29.50 MHz downlink, beacon at 29.40 MHz. Mode J: 145.90-146.00 MHz uplink, 435.20-435.10 MHz downlink, beacon on 435.090 MHz.

Oscar 7 Orbital Information

Orbit	Data (May)	Time (GMT)	Longituda of Eq. Crossing °W
20387	1	0043:48	73.8
20400X	2	0138:05	87.4
20412	3	0037:25	72.2
20425X	4	0131:42	85.8
20437	5	0031:02	70.6
20450	6	0125:19	84.2
20462qrp	7	0024:40	69.1
20475	8	0118:57	82.7
20487X	9	0018:17	67.5
20500	10	0112:34	81.1
20512	11	0011:54	66.0
20525	12	0106:11	79.6
20537	13	0005:31	64.4
20550qrp	14	0059:48	78.0
20563	15	0154:05	91.6
20575X	16	0053:26	76.4
20588	17	0147:43	90.0
20600	18	0047:03	74.9
20613	19	0141:20	88.5
20625	20	0040:40	73.3
20638qrp	21	0134:57	86.9
20650	22	0034:17	71.8
20663X	23	0128:34	85.4
20675	24	0027:55	70.2
20688	25	0122:12	83.8
20700	26	0021:32	68.6
20713	27	0115:49	82.2
20725qrp	28	0015:09	67.1
20738	29	0109:26	80.7
20750X	30	0008:46	65.5
20763	31	0103:03	79.1

Oscar 8 Orbital Information

Orbit	Data (May)	Time (GMT)	Longitude of Eq. Crossing °W
5877Abn	1	0039:21	53.8
5891X	2	0044:32	55.1
5905Abn	3	0049:43	56.4
5919Abn	4	0054:54	57.7
5933Jbn	5	0100:05	59.0
5947Jbn	6	0105:16	60.3
5961Abn	7	0110:27	61.7
5975Abn	8	0115:38	63.0
5989X	9	0120:49	64.3
6003Abn	10	0126:00	65.6
6017Abn	11	0131:11	66.9
6031Jbn	12	0136:22	68.2
6045Jbn	13	0141:33	69.5
6058Abn	14	0003:31	45.0
6072Abn	15	0008:42	46.3
6086X	16	0013:53	47.6
6100Abn	17	0019:04	49.0
6114Abn	18	0024:14	50.3
6128Jbn	19	0029:25	51.6
6142Jbn	20	0034:36	52.9
6156Abn	21	0039:47	54.2
6170Abn	22	0044:58	55.5
6184X	23	0050:09	56.8
6198Abn	24	0055:20	58.1
6212Abn	25	0100:31	59.4
6226Jbn	26	0105:41	60.8
6240Jbn	27	0110:52	62.1
6254Abn	28	0116:03	63.4
6268Abn	29	0121:14	64.7
6282X	30	0126:25	66.0
6296Abn	31	0131:35	67.3

DX

from page 13

about evenly between CW and SSB. They were active for three weeks and operated during the CQ-WW 160 Meter Contest.

Amateur radio operators in Sweden and the U.S. will attempt direct contact between Bishop Hill, Illinois, and Biskopskulla, Uppland, Sweden, during the weekend of May 26th and 27th. Bishop Hill was a communal settlement established in the 1840s by Swedish immigrants, and is now a historical site maintained by the state of Illinois. Led by W9FKC and SM0FY, the two groups will contact as many stations as possible during the time period. Special QSLs will be issued, and SASEs are requested. QSL to WA9AQN.

The Wiesbaden Amateur Radio Club will be going on a DXpedition to Lichtenstein from 26 May to 3 June. They will be using the callsign HB0XAA. The frequencies they will be using are: 3.780, 7.090, 14.280, 21.350, 28.650 SSB, and 25 Hz up from the bottom for CW. For the Novices, some of them will try to get on at other times, but nothing is scheduled so far. The QSL manager will be Hugo Jakobljevich DJ0LC, Am Weinberg 10, 6201 Auringen.

BEATA ISLAND

The following letter from Tim HI8MFP wraps up the recent HI1RCD operation from Beata Island:

"The Beata DXpedition was a success, with more than three thousand contacts in 52 hours of operation. Fifty-three countries were contacted. The first contact took place at 2045 GMT on the 25th, and the last was made at 1234 GMT on the 28th.

"The trip on the boat to the island was excellent. We left the island six hours before the set time, on the recommendations of Navy authorities who said they were expecting changes in the water currents which would make the trip back dangerous.

"QSL information should be sent to: Beata Operation, PO Box 2191, Santo Domingo, Dominican Republic, West Indies (or via bureau: PO Box 1157, Santo Domingo, Dominican Republic). The cards are already being printed and we hope to start mailing them soon. We would like to remind all those who contacted us on the 27th to send an SAE and 3 IRCs in order to receive the first day cover.

"The prefix HI1 was activated for the first time, and now we are compiling all the information to be sent to the ARRL in order to try to qualify Beata as a new country. If this goal is achieved, the group would be willing to repeat the operation next year for a week.

"Thank you for your cooperation, and we hope you appreciate our effort."

DX NOTEBOOK

Bangladesh S2

S2BTF shows regularly on Saturdays near 14275 MHz after 1700Z.

Qatar A7

A7XAH has been showing around 14225 kHz between 1300Z and 1500Z on Fridays. This is a list operation.

Senegal 6W8

6W8HL has N1ACW as MC on 14260 kHz from 2100Z daily. At 2245Z they shift to 21275 kHz.

South Georgia VP8

VP8SU has G3KTJ and QSL manager G3RCA running the list Sundays from 1900Z to 2100Z on 14280 kHz. He also hangs around this area during the week.

Minami Torishima KA1

KA1NC regularly offers this rare one to 5BDXCC hunters at 1100Z on 3798 kHz.

Christmas Island VK9XI

This is a club station and usually is activated on meeting nights. Look for it Wednesdays around 14225 kHz after 1530Z.

Aves Island YV0AA

If you receive this magazine early, you may still be able to catch this one. The operation opens April 28th and will secure on May 1st at around 0600Z. The frequencies to watch are: 3795, 7085, 14195, 21245, 21295, and 28495 on SSB, and 25 kHz up from the bottom edge on CW. They will announce listening frequencies.

Peter Island

Willy got to Peter Island just about on schedule, but after an on-site survey, any landing attempt had to be scrubbed. Willy decided to head east through the Drake Passage and into the Atlantic. He should have passed through ZD9 in April, and present plans call for stops at PY0/Trinidad in May, possibly PY0/St. Peter-St. Paul in June, and then on to the Azores by the end of July.

48,100 QSOs IN 1978

With a last-minute spurt on December 30th and 31st which netted 540 QSOs, Dick Spenceley KV4AA wound up 1978 with a total of 48,100 contacts. This was an average of 131 per day, or one QSO every 11 minutes of 1978.

Dick KV4AA and his SSB operating position, where many of the more than 48,000 QSOs in 1978 were made.

About 65 percent of the contacts were on CW, with the balance on SSB. A total of 199 countries were worked, with only a couple of them being "chased." Assorted equipment held up nicely, as did Dick's 73-year-old health.

Continuous calling by European stations on CW (even during QSOs) and the cooperation of U.S.A. SSB ops, plus contest operations, made large totals easy. KV4AA took part in just about every contest that turned up. Otherwise, QSOs, though short, were not of the "contest" or "DXpedition" variety. This makes a difference of three QSOs per minute versus one every three minutes.

All this started in 1976, when Dick's AJ3AA bicentennial call resulted in 35,335 QSOs, or an average of 96 per day. A goal of 36,500 contacts was set for 1978—100 per day. When this was passed on October 19th, a new goal of 45,000 was set. This was met on December 14th, and another 3,100 were worked.

It is realized that certain factors are a "must" for such totals, such as a fairly "exotic" call and plenty of time. This will limit most. KV4AA was not on continuously, as he works daily until 1:00 pm. Until the latter part of the year, he was seldom on after 7:00 pm. Stations contacted twice or more often during the same day were only counted one time, unless the mode and band were different.

Invaluable aid was given the project by YASME (WA6AHF) and other West Coast hams who handled the KV4AA QSLing chores.

KV4AA's three-year total now stands at 115,280 contacts. Dick says, "This year, we rest—but 't ain't easy getting used to."

THE RUSSIAN WOODPECKER

The following report is from the *West Coast DX Bulletin* and was compiled by a W3.

"If you have not heard this one, you have not been on the air in the last year or two. Like a lot of other things, you try to live with it and wish it would go away—but it seldom does. Maybe if you know a bit more about it, it might help to tolerate the burden.

"The 'woodpecker' is a long-range radar; the range can be estimated by noticing that the repetition corresponds to 25-wpm CW dots. At this speed, the time from dot to dot is 96 milliseconds. This means that the radar range is roughly 47 million feet, or 8950 miles. This on-the-air estimate was done without instruments, so it is probably a bit in error. If the actual design range was 15,000 km, or 9320 miles, the error would be only 4%.

"Presuming a ten-million-Watt source, and 18 dBi of antenna gain, the effective radiated power, erp, is 88 dBW. However, if you figure twenty meters at 1000 miles, this immense signal is reduced by path loss to a mere .0006 of a Watt.

"This might make some think that a one-Watt jammer would have an advantage over the woodpecker of 1000:1, but this is not correct. Not all of a jamming signal will be effective unless it is able to pass through the i-f and video filters of the radar. A constant carrier is not effective at all, because it is rejected as a dc signal by the ac-coupled video circuitry of the radar.

"However, CW dots will get through. Assuming a rise time of one millisecond for amateur CW, an additional 20-dB advantage is given back to the radar because of the mismatch in rise time, video bandwidth, and corner frequency. Notice that the CW dot jammer, even if only using one Watt, still has a 10:1 ad-

vantage. A 100-Watt or a 1000-Watt signal would be even better.

"There is some reason to believe that much of the above is true. For one thing, the woodpecker is only heard on the phone bands, where voice envelopes can be rejected by the radar video circuitry. Also, if someone is sending CW dots at 25 wpm, the woodpecker usually shifts frequency within five minutes.

"Some have noted that continuous 25-wpm CW dots on the woodpecker's frequency have caused them to stop transmitting—one time, for a period of three weeks. The woodpecker then returned with a new gimmick. When problems developed, the woodpecker would switch to another frequency on the amateur band."

This seems very interesting, and while we sure aren't advocating intentional jamming, it would be interesting to experiment around with. The problem is, we aren't sure which would be worse, the woodpecker or a bunch of endless CW dots at 25 wpm.

DX RIDDLE

Which three DXCC countries all share the same prefix, including numerical designator, yet are located within separate continental boundaries?

QSL INFORMATION

3X1IX to Box 477, Conakry
4X4CW to WBØYHG
5R8EA to OZ6MI
6O1FG to IØDUD
6W8HL to Box 5012, Dakar
8Q7AF/AG to WB4ZNH
9J2BO to W6ORD
9M8HG to Box 2242, Kuching, Sarawak, Borneo
9N1MM to W3KVQ/N7EB
A7XAH to DJ9ZB
FM7WO to JH3XCU
FR7ZL/T to N4NX
IY7EX to I7DPO
JD1YA to JH1RNZ
K1CO/PJ7 to K3RYA
KA1IW to K8DYZ
KA1NC to K4JEX
KH3AA to Box 69, APO SF 96305
KP4AM/D to Box 717, Oakland CA
LU3ZY to LU2CN
S2BTF to IØJN
STØHF to G4GFI
T2T to W5SBO
TF3CW to K1RH
VO6ONT to VO1HP
VP2DXA/B/C/D to W8UVZ
VP2LGK/LGL-J6LGL/LGK to WB4SXX
VP2MBH to WØSH
VP5HX to WA1SQB
VP8SU to G3RCA
VQ9MR to N5GU
VR1BD to W5RBO
VR3AK to Box 30323, Honolulu HI 96820
VR6TC to W6HS
VS5CW to Box 398, BSB, Brunei
WA7JRL/SU to W8LZV
WH4AAA to W5RU
YVØAA to Box 2285, Caracas DF
ZD9GH to ZS1Z

Many thanks to the *West Coast Dx Bulletin*, Long Island DX Association *Bulletin*, and *WorldRadio Magazine*.

New Products

from page 26

but also allows the internal speaker to remain unmuted.

The Communicator II has incorporated a novel mounting bracket which allows forward and backward slide adjustment to accommodate virtually any mobile mounting position. The transceiver mount mates with the mounting bracket slides and the unit is secured in place with two quick-turn knobs. Also included with the Communicator II is a desk-top bracket which snaps in place to elevate the front of the unit for indoor use.

A 24-pin accessory connector is mounted on the rear of the transceiver. Five connections are factory wired: PTT, ground, af input, af output, and 13.8 V. These will allow easy installation of TT, phone patch, or subaudible tones. The nineteen unconnected pins allow individualistic modification without case damage.

The Communicator II, priced at $399.00, carries a dealer-backed, factory warranty of one full year. *Pathcom, Inc., Amateur Radio Products Group, 24105 South Frampton Ave., Harbor City CA 90710.*

A. G. Vaughan K5FQY
Los Alamos NM

A GREAT NEW HAND-HELD FROM HEATH

The amateur market is crowded with two meter rigs, yet I had been having problems finding one that would fit the budget of a high-school student. Then one day a new Heathkit catalog appeared in my mailbox. Glancing through the catalog, I found just what I had been seeking: Heath had come out with a new hand-held called the VF-2031. I was not only impressed with it, but also I could afford it.

Before I was to purchase it, however, there were two problems that had to be resolved. First of all, I had heard complaints from owners of Heath's previous hand-held, the HW-2021, which was recently discontinued. It seems that the 2021 had many design problems. Was the VF-2031 going to have gremlins also? After some reflection, I rationalized that Heath most likely had received much feedback on the previous rig's problems, and planned to eliminate similar problems from the VF-2031. The second thing that had me concerned was a notice in the catalog at the bottom of the rig's description. This little blurb stated that the kit was not recommended for beginning kit-builders. Although I had previously built several Heathkits, I was certainly not in the running for the "Kit-Builder's Hall of Fame." I finally decided that if I was to become experienced in electronics, this would be a good test of my ability. Besides, in the back of mind, I *knew* that I could do it. Subsequently, I decided to buy the kit.

Two weeks after ordering, my kit arrived. After opening the carton, the first thing that had to be done was to make several changes in the assembly manual as directed by a correction sheet. After this was completed, I glanced through the manual to become familiar with the construction of my hand-held. Heathkit manuals are a pleasure to read; every step is laid out in a clear, precise manner. There is even a separate book of diagrams so that one need not constantly flip between pages in the manual. Heath also provides various goodies to aid in kit construction: solder, desoldering braid, nut drivers, and alignment tools. The only tool that I did not have for construction of the kit was a pair of wire strippers. Although they are not necessary, past experience told me that these devices are very useful; I also feared that if I continued to strip wires with my teeth, I would become a Leon Spinks look-alike. A quick trip to the house of a friend (Mike WB7ECW) netted me a pair of wire strippers.

Construction

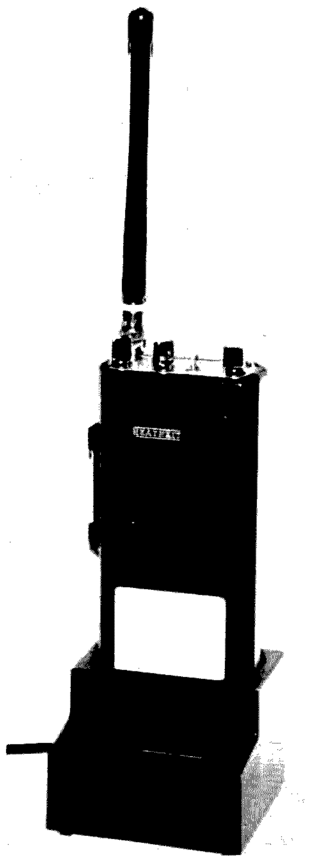
After putting aside the drop-in charger that was built in almost no time at all, I was ready to start the construction of the hand-held. Glancing at the printed circuit board, I realized that I would have to be careful while installing parts; the board is very crowded and things could become a bit rough if I had to remove a component that was tightly surrounded by others.

Since the board was compact, most components were mounted vertically. There was no room for Heath to put component values or numbers on the board, but what they did do, however, was put different symbols on the board for the components. A darkened-in circle, for example, was the symbol for a resistor. In this way, one could tell the relative positions of the components on the board.

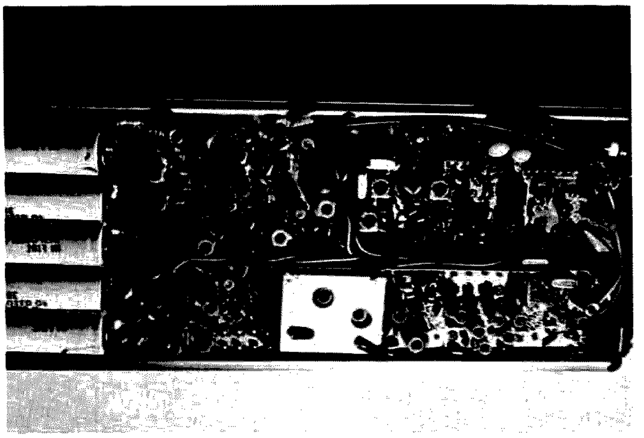
Be careful of component placement with this method, as it can easily lead to confusion. At the time, however, I felt that I couldn't possibly install a component incorrectly. It was because of this attitude that a replacement choke had to be ordered. I was trying to remove a choke that was installed in the wrong spot (it seemed as good a spot as any after several hours of work) and, much to my dismay, I removed a lead from the choke at the same time. This wasn't enough for me, however, as I ended up breaking the glass body of a diode while making room for a capacitor that was to be installed. Moral of the story: Take frequent breaks and do not rush through the construction of any electronic kit.

Another thing that I had to be careful about was component values. Poor lighting can raise havoc with one's eyes, so I made sure that there was enough light so as to not strain

Photos by Scott Rumbaugh



The VF-2031 as it sits in its charger.



Circuit board close-up. Note that the PC board is double-sided.

my eyes. It is very difficult to read the color code of a resistor if the only source of illumination in the room is a desk lamp in the corner of the workbench. Also, a 2.2 pF capacitor looked very much like one of the 22 pF capacitors, as the decimal point was very faint. A similar problem arises with the small glass-bodied diodes; the bands are hard to see. If in doubt, one should use the magnifying glass that Heath encloses.

The printed circuit board is divided into six sections. After one section is completed, it is then time to move on to the next section. Heath provides some hints that might eliminate much misery. They suggest that one should take breaks and inspect each section after completion. These warnings make the kit sound as if it is very difficult to build, however, which it is not. I found the PC board construction to be fairly simple; it wasn't nearly as hard as I had expected. The hardest part of the kit was wiring. I had to be careful that my soldering iron didn't burn any insulation from adjacent wires while I was soldering. This was especially true with the switch wiring, which was fairly tight and constituted the hardest part of construction.

Alignment

After a week of hibernation in my workshop (i.e., bedroom), the construction of the hand-held was complete. At this point, I brought out my trusty ol' VOM to make the resistance measurements. Everything checked out fine; at least my rig wasn't going to go up in smoke when power was applied. I was now ready to proceed and align the rig.

Alignment procedures have always been the worst part of kit construction for me. It is always frustrating to adjust one coil and then have to go back and readjust another coil, repeating this process over and over. I was afraid that the six pages of alignment steps were going to take longer to complete than the actual construction of the rig. As it turned out, these steps were completed in a couple hours and were not very difficult.

The only piece of test equipment needed for alignment is a VOM, an instrument that almost every ham owns or at least has access to. Rf signal generators, deviation meters, frequency counters, and wattmeters are other instruments that are helpful, but they are not required for alignment.

Several test points on the circuit board simplify the alignment procedure. All I had to do was hook my voltmeter to these test points and use the alignment tool to adjust the circuit coils for a peak or dip reading on the meter. The only rough spot in alignment that I encountered was with the receiver front end. The voltmeter readings hardly varied at all as I tried to peak the coils. If I had had an rf generator, things would have been a lot easier. I then remembered that I had a portable VHF receiver. I tuned this receiver 10.7 MHz below the hand-held's receive frequency. The VHF receiver's circuits put out a hefty signal that could be picked up on my hand-held. Voila! I now have an rf signal generator.

I then adjusted the transmitter section, getting a little more than two Watts output power. The deviation potentiometer was set to midrange because I didn't have a deviation meter. Later, I fine-tuned this control while on the air.

The final alignment step was to get the hand-held exactly on frequency. I borrowed a frequency counter from my electronics teacher, since the alignment without a counter involved more work than with one. In other words, I'm lazy! I quickly adjusted the trimmer inductors for each installed crystal. Now that the construction of my hand-held was complete, I was on the air.

Operation

As soon as I put the transceiver on the air, I began to get excellent signal reports. The audio was good and I was getting into the repeater fine. Needless to say, it was good for my ego to have the rig work well. A day or two later, however, I ran into a problem. WB7NML had given me a call on the local repeater; when I answered, he didn't respond. I called him again, but he again did not reply. He then cleared and I noticed that the receiver was "motorboating." I then realized the problem: Nicads don't stay charged forever. The nicads in the VF-2031 last about ten hours on a charge, and on the previous night I had forgotten to place the transceiver in its charger.

Conclusion

The VF-2031 has many features that have made it worth more than the $190 that Heath asks for it, including:

- eight channel capability
- 146.94 MHz crystal
- only one crystal per channel is used; one crystal renders one receive and three (−600 kHz, simplex, +600 kHz) transmit frequencies
- separate microphone and speaker built in
- BNC antenna jack
- battery-saving squelch circuit
- earphone
- many available accessories (external microphone, continuous tone encoder, autopatch encoder, amplifier, and holster-type carrying case)

As demonstrated by the above features and the quality of the rig, it is obvious Heath has come out with a winner—the VF-2031.

Mark Rumbaugh WB7NMM
Corvallis OR

THE MIDLAND 13-510—A USER REVIEW

For quite some time, I have been wanting and trying to get active on two meter FM. It wasn't until just recently that I found myself in a position to make the big jump and purchase that two meter rig. Wanting to get the most rig for the amount of money spent, I did a lot of studying in past issues of *73 Magazine* to see if anyone had ever reviewed the various pieces of two meter mobile rigs and, if so, what they had to say about them. At first, as many articles were published on adding channels to the Icom IC-22S, I thought that this would be an easy rig to work with. Then the many various ham outlet stores started to have their year-end sales. The prices looked better with each issue of *73*. Finally, I made the big jump and called one of the leading stores. They were all out of the IC-22S, as well as most of the crystal-controlled rigs. I also noticed in their advertisement that the Midland synthesized model 13-510 was being listed at $100.00 below suggested retail. Luck of the poor be with me, they had one. So I made the choice, and I believe that I made a very wise choice. I anxiously awaited the UPS truck; after five days, I received the Midland. As I opened the box and pulled out the transceiver, I noticed how everything was carefully packed. I started reading the instruction book and found it to be very straightforward. In no time whatever, I had the rig installed and operating.

A check of the local repeater frequency showed no activity, so I switched down to the Louisville repeater frequency. The Louisville repeater is about forty miles or more from my home, but there was activity on the channel. I waited and listened for a clear period of time to make a try at keying the repeater. I pushed the mike button and gave my call to see if anything would happen. What a thrill to have a Louisville station come back to me and ask for my location. Since then, I have met many new hams on both the local and the Louisville repeaters. Believe me, this is the mode to use, as there is no noise, lots of consideration and assistance to the newcomer on the band, and many good interference-free QSOs.

After getting used to the Midland, I decided to see what all was in the book and learn a little more about the rig. What a treasure-trove of information I found. Let's see what we have.

First off, the Midland is an all-synthesized unit covering the range of 146.00 to 147.995 MHz. It has a one-Watt low-power position and a 25-Watt high-power position. The modulation is direct F-3 and requires a 600-Ohm microphone, which is furnished. The primary power requirement is 13.8 volts positive dc plus or minus 15%. Duplex shift for plus 600 and minus 600 kHz is furnished. Two provisions are provided for other offset frequencies.

In the receiver, the following information is furnished. It is a double superhet, with a first i-f of 16.9 MHz and a second i-f of 455 kHz. The sensitivity is claimed to be .5 microvolts with 20 dB of quieting at a signal-to-noise ratio of .3 microvolts at 12 dB or more. The audio output is 1.5 Watts into an eight-Ohm load. Frequency control is the popular PLL covering the range of 127.1 to 131.1 MHz with no

doubling in the PLL. There are 39 transistors, 10 FETs, 14 integrated circuits, and 28 diodes in the set. The following accessories are included: mobile mount, dynamic microphone, mike hanger, a spare 7-Amp fuse, external speaker plug, and an accessory plug for the accessory socket on the rear panel. The mount is a snap-in unit, which makes it very easy to remove the rig if you don't want to leave it in the car. The power cable has a three-pin socket that makes for easy removal and is so arranged that only the proper polarity can be obtained when plugging the rig in.

The really amazing thing about the entire unit is the amount of information that is furnished in the operator's manual. Midland really had the do-it-yourself amateur in mind when they printed the manual. The manual includes, in addition to basic hookup and operating instructions, the following: block diagram, schematic diagram, wiring diagram, voltage chart, frequency table with a frequency breakdown diagram, top and bottom chassis photos, detailed printed circuit board diagrams, FET, transistor, and IC terminal guide, coax cable plug assembly diagram, and, the most valuable of all, complete alignment instructions. As you can see, it is one of the most complete manuals that I have seen on amateur equipment in some time.

I do not have the facilities to run any real technical signal-to-noise tests or to check the manufacturer's specifications for what is claimed, but I can tell you that all of the on-the-air checks have been very satisfying. The audio is very clear and plenty adequate for normal use. Very little squelch control rotation is needed to have full quieting. All in all, I would rate the Midland 13-510 as one of the best units on the market for under three hundred dollars. I hope you enjoy your rig as much as I do mine, and maybe someday I will hear you on one of the repeaters across the country. See you on two FM.

Midland International, PO Box 1903, Kansas City MO 64141. Reader service number M41.

Billy L. Nielsen WB4APC
Radcliff KY

Social Events

from page 123

32233. Price at the door will be $3.50.

A large indoor swap area will be featured, with advance table reservations available for $5.00 per table per day from Robbie Roberts KH6FMD/W4, 10557 Atlantic Blvd., #31, Jacksonville, Florida 32211. Information on exhibitors' booths and space are available from the same address.

Other features and programs include statewide organization meetings on such topics as traffic nets and MARS, a microprocessor seminar, a solar power demonstration, a DX "pileup" contest, a hidden transmitter hunt, an OSCAR forum, ARRL forums, emergency preparedness programs, DX and contest presentations, antenna and technical seminars, and much more.

More general information may be obtained from JHA, 911 Rio St. Johns Dr., Jacksonville FL 32211.

LITTLE ROCK AR
AUG 4-5

The Central Arkansas Radio Emergency Net (CAREN) Amateur Radio Club will hold its second annual Ham-a-Rama on Saturday and Sunday, August 4-5, 1979, at the Arkansas State Fairgrounds, Little Rock, Arkansas. There will be two main prizes given, as well as door prizes. Featured will be forums, dealers' exhibits, a Saturday night party, and a large flea market. Talk-in on 146.34/.94. For details, send an SASE to Morris Middleton AD5M, 19 Elmherst Drive, Little Rock AR 72209.

ANGOLA IN
AUG 5

The Steuben County Radio Amateurs will hold their annual F.M. Picnic and Hamfest on Sunday, August 5, 1979, at Crooked Lake, Angola, Indiana. There will be prizes, picnic-style barbecued chicken, Inside tables for exhibitors and vendors, and overnight camping (fee charged by county park). Talk-in on 146.52 and 147.81/.21. Admission is $2.00.

CEDARTOWN GA
AUG 12

The Cedar Valley Amateur Radio Club will hold its annual Cedar Valley Hamfest on August 12, 1979, from 8:00 am to 4:00 pm at the Polk County Fairgrounds, on US 278, two miles east of Cedartown, Georgia. There will be food, drinks, and prizes. Talk-in on 147.72/.12 (WR4AZU). For more information, please contact Jim T. Schliestett W4IMQ, Secretary, Cedar Valley ARC, PO Box 93, Cedartown GA 30125, or phone (404)-748-5968.

LEXINGTON KY
AUG 12

The Bluegrass Amateur Radio Club will hold its annual Central Kentucky Hamfest on August 12, 1979, at the Fasig-Tipton Sales Paddock, Newton Pike, Lexington, Kentucky. The program will include grand prizes, hourly door prizes, manufacturers' exhibits, an indoor/outdoor flea market, guest speakers, and forums. For information, contact the Bluegrass Amateur Radio Club, Inc., PO Box 4411, Lexington KY 40504.

PETOSKEY MI
AUG 18-19

The Straits Area Radio Club will hold its Swap 'n Shop and hamfest on August 18-19, 1979, at Petoskey Middle School, State and Howard Streets, across from the Catholic church and post office, Petoskey, Michigan. There will be a donation of $2.00 at the door. Table space is also $2.00. Refreshments will be available. There will be a swap and shop on Saturday from 9:00 am to 4:00 pm and on Sunday from 9:00 am to 12:00 pm. Prizes, a ladies' program, and seminars at 11:00 am and 2:00 pm on Saturday will be featured. A banquet at the Holiday Inn on Saturday at 7:00 pm will have Mellish Reef DXpeditioner Bob Walsh WA8MOA as guest speaker. Banquet tickets are $7.50 and are limited to 200, sold in advance only. For full Information and lodging, send an SASE to Bill Moss WA8AXF, 715 Harvey Street, Petoskey MI 49770, or phone (616)-347-4734.

ROSEMONT IL
SEP 7-9

The Quarter Century Wireless Association will hold its 1979 Chicago Convention on September 7-9, 1979, at the O'Hare/Kennedy Holiday Inn, Rosemont, Illinois. The complete package for the three days is $35.00. Special room rates will also be available. There will be the annual banquet, special ladies' program, various tours, and prizes. For reservations and information, write Phil Haller W9HPG, 6000 S. Tripp, Chicago IL 60629.

PECATONICA IL
SEP 9

The Rockford Amateur Radio Association will hold its second annual Rockford Hamfest and Illinois State ARRL Convention on Sunday, September 9, 1979, at the exhibition hall at the Winnebago County Fairgrounds at Pecatonica, Illinois, just west of Rockford on US Rte. 20. Tickets are $2.00 in advance or $2.50 at the gate. Tickets are available by mail by writing RARA, PO Box 1744, Rockford, Illinois 61110. Please include an SASE for tickets by mail. Prizes include a Kenwood TS-520S transceiver and an Atlas receiver. Campsites are available on site, with electric and sanitary hookup available. There are 300 flea-market tables available at a nominal charge. Plenty of free parking is available. Featured will be speakers, forums, demonstrations, and discussions. A hamfest menu, including hot dogs, BBQ, and soft drinks will be available at reasonable prices. Talk-in on 146.01/.61 or 146.52.

Corrections

I received some comments on my article, "Build a Hybrid Capacity Meter" (March, 1979, page 40), and would like to respond.

Through my error, I did not catch the missing value of the bypass capacitor on pin 5 of the 555 (IC1). This component is optional, but if it is desired, a value of .01 to .1 uF will do.

I also received a letter concerning inaccuracy on ranges other than the one which is calibrated. I double-checked mine and the accuracy is more than adequate. For those requiring the ultimate in accuracy, the following may be performed: Select a 1%, or smaller, tolerance capacitor that will be a midrange value for the selected range (e.g., ≈50 pF for the 1-to-100-pF range) and adjust the calibration control for exactly 50 pF. The scale will then be as accurate as your capacitor, less any nonlinearity of the meter. Naturally, the range switch should be on the desired range.

I also received a call concerning an inability to get a full-scale reading when testing a capacitor that would normally read at, or near, full scale. This can be caused by several things: leaky rectifier diodes, leaky filter capacitor, meter resistance is too high, or the clock frequency is too low. The clock should be operating between 200 and 300 kHz.

Glen A. Deibert WA4HUU
Fayetteville NC

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7A	14	14	14	14
ARGENTINA	21	21	14	14	7	7	14	21	21A	21A	21A	21
AUSTRALIA	21	14A	14	7B	7B	7	7	7	7	7A	14	21
CANAL ZONE	21	21	14	7	7	7	14	14	21	21	21A	21A
ENGLAND	14	14	7	7	7	14	14	21	21A	21	21	14
HAWAII	21	14	14	7B	7B	7	7	14	14	14	21	21
INDIA	14	14	7B	7B	7B	7B	14	14A	14	14	14	14
JAPAN	21	14	14	7B	7B	7B	7B	7A	14	14	14	14A
MEXICO	21	21	14	7	7	7	7A	14	14	21	21	21
PHILIPPINES	14A	14	14	7B	7B	7B	7B	14	14	14	14	14
PUERTO RICO	21	14	7	7	7	7	14	14	14	21	21	21
SOUTH AFRICA	7A	7	7	7B	7B	14	21	21	21A	21A	14A	14
U.S.S.R.	14	14	7	7	7	7A	14	14	21	21	14	14
WEST COAST	21	14A	14	7	7	7	7A	14	14	14A	14A	21

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7A	7	7	7	7A	14	14	14	14
ARGENTINA	21	21	14A	14	7	7	14	21	21	21A	21A	21A
AUSTRALIA	21A	21	14	14	7A	7	7	7	7	7	14	21
CANAL ZONE	21A	21	14	14	7	7	14	14	21	21	21A	21A
ENGLAND	14	14	7	7	7	7	14	14	21	21	14	14
HAWAII	21	21	14	14	7	7	7	14	14	14	21	21
INDIA	14	14A	14	7B	7B	7B	7B	14	14	14	14	14
JAPAN	14A	21	14	7B	7B	7B	7	7A	14	14	14	14
MEXICO	21	14	7	7	7	7	7	14	14	14	14	21
PHILIPPINES	14A	21	14	7B	7B	7B	7B	7A	14	14	14	14
PUERTO RICO	21A	14	14	7	7	7	14	14	14A	21	21	21A
SOUTH AFRICA	7A	7	7	7B	7B	7B	14	21	21	21A	14A	14
U.S.S.R.	14	14	7	7	7	7	7	14	14A	14	14	14

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7A	7	7	7	7A	14	14	14	14
ARGENTINA	21	21	14	14	7	7	14	14	21	21	21A	21A
AUSTRALIA	21A	21A	21A	21	14	14	14	14	7	7	14	21
CANAL ZONE	21A	21	14	7A	7	7	14	14	14	21	21	21A
ENGLAND	14	14	7	7	7	7	7	14	14A	14A	14	14
HAWAII	21A	21A	21	21	14	14	7	7	14	21	21	21A
INDIA	14	14A	14A	14	7B	7B	7B	7A	14	14	14	14
JAPAN	14A	21	21	14	14	7	7	7	14	14	14	14
MEXICO	21	14	14	7	7	7	7	14	14	14	21	21
PHILIPPINES	14	21	21	14	14	7B	7B	7A	14	14	14	14
PUERTO RICO	21A	21	14	14	7	7	7	14	14	21	21	21A
SOUTH AFRICA	14B	7B	7	7	7B	7B	7B	14	14	14A	21	14
U.S.S.R.	14	14	7	7	7	7	7	7A	14	14	14	14
EAST COAST	21	14A	14	7	7	7	7A	14	14	14A	14A	21

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor
SF = Chance of solar flares

may

sun	mon	tue	wed	thu	fri	sat
		1 G	2 G	3 G	4 G	5 G
6 F	7 F/SF	8 G	9 G	10 G	11 G	12 G
13 G	14 F	15 F/SF	16 G	17 G	18 G	19 G
20 G	21 P/SF	22 F	23 G	24 G	25 G	26 P/SF
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W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

GETTING THE CROWDS

Dayton knows how to get 'em out by the thousands, but many other hamfests are floundering. Prizes are nice, but how many hams will drive 200 miles to take a slight chance at winning a rig? Not many. If Dayton depended on the prizes to bring in the customers, the mobs would stay home.

The more established hamfests have to keep growing to survive. We've watched the bungling of SAROC into obscurity. It grew smaller and smaller every year, despite lavish prizes. Other hamfests have been withering for the lack of any hot spark to make them grow.

There was a time in history when the ARRL had but to make a hamfest official and this would bring in the hams. Now few hams will drive across town to get to an ARRL forum, much less drive 200 miles. Those who have attended these dreary forums know what I'm talking about. They have been so orchestrated that it is impossible for anything significant to happen. Pompous officials get up and tell everyone how great the League is and how everything is really okay, no matter what anyone else says. End of meeting.

ST. LOUIS

The recent hamfest in St. Louis set an example of what can be done by a live-wire group. Bob Heil K9EID called me up along in December and asked what he would have to do to get me to come out to St. Louis and give a talk to his club in Marissa, Illinois. I said it was simple—just put on a major hamfest and invite me. The next thing I knew he was doing just that.

Bob got all except one club in the area together to sponsor the hamfest, threw in a computerfest to boot, complete with some computer clubs, and ran a bang-up show. Bob contacted the League, but they said he couldn't put on a hamfest without their support, and they had a long list of demands he had to meet to get their support. He decided to go it without them. The result was a superlative success. Over 3,000 hams thronged to the St. Louis Cervantes Exhibition Center, despite lousy weather.

Signing a proclamation for Amateur Radio Day in St. Louis is Mayor Conway. From left to right are Larry Roberts W9MXC, Bob Heil K9EID, Mayor Conway, and beaming me.

What pulled in such a big crowd? It wasn't any ads in *QST*, for there wasn't a hint about the show there. It was mentioned a lot in *73*... about the only place for many hams to get the word. But just reading about a hamfest and actually going are two different things. Something happened to break all those people loose and get them to drive to St. Louis. Despite a competing hamfest in Kansas, a large number of Kansas hams went right by there on their way to the St. Louis show.

I think the difference between the shows is simple to explain. People will go to a show where they think they are going to have a good time. In this case, there was a controversial speaker—me—on tap to talk about things which really can't be published in the magazine. If hamfest committees would spend more time and effort getting speakers who will make hams want to come to the hamfests, they will have plenty of attendance.

The ARRL convention in St. Paul had both me and Harry Dannals on the program. The committee running the convention told me that they doubled the attendance by having me on the program. Sure, I like to hear that... but what this means is that the speaker is of great importance... greater than many

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Looking West

Bill Pasternak WA6ITF
24854-C Newhall Ave.
Newhall CA 91321

Attention, nostalgia buffs—have we got something for you! As many of you are aware, K6MYK (now WR6ABN) was one of the nation's first successful amateur repeaters. It has been in almost constant day-to-day operation since the spring of 1956. Anyway, in doing research for a new FM and repeater book, I spent a bit of time with MYK's designer/builder/licensee Art Gentry W6MEP. During the course of one afternoon visit, Art hauled out a true piece of amateur relay history.

In the accompanying photo, Art is busy dusting the cobwebs off the original K6MYK receiver. The receiver was designed and built by Art in the early 1950s and was the first such device specifically designed for mountaintop relay service. It is a single conversion affair with a cavity front end with an overall bandwidth on the order of 40 to 50 kHz. Not exactly narrowband, but in those days it was years ahead of its time. This was an AM receiver, since K6MYK was originally an AM repeater.

This receiver remained in service until about 1969, when it became obvious that FM was going to replace AM as the "in" on two meters. During its lifetime, it performed admirably. Only an occasional tube had to be replaced. This receiver was part of an overall repeater package whose survival and growth pattern helped pave the way for much of what we have today.

AS-RADIO-SHACK-GOES-SO-GOES-THE-???? DEPARTMENT

Of the many magazines, pamphlets, and flyers that come across my desk each month, perhaps my favorite is the monthly flyer published by Radio Shack. No, it's not because of the monthly specials RS runs. No . . . the first thing I do is look for something called the "Flyer Side Chat," written by Radio Shack President Louis Kornfeld.

I've never met the man, but after reading about 35 or so of his columns, I kind of feel that I know him. Through him, I may have gained a bit of insight into the RS operation itself. Tandy/RS is really a company on the grow, and Louis Kornfeld is obviously quite proud of that fact. It's not what he writes, but rather the obvious positive approach with which he writes that makes his pride obvious even to the occasional reader. He is also a very straightforward man who likes to speak his mind; his "Flyer" editorials never beat around the bush.

I mention all this because I have found Radio Shack to be a good indicator of the state of the entire hobby electronics industry. They are trend-setters, unafraid to take a giant step forward if a viable market seems available. Witness the success of their TRS-80 computer and many other RS products too numerous to mention. The nice thing about Louis Kornfeld's "Flyer Side Chat" is that it gives you ongoing insight. To see what I mean, I suggest that you visit your local RS and pick up their current "Flyer." If you are like me, you will probably get hooked on Kornfeld's editorial comment . . . or on a TRS-80 of the kind I am saving my pennies for these days.

THE 220-UP-NORTH DEPARTMENT

Ward Hill WA6FUH is an old friend of mine. I first met Ward in 1972, about a month after moving to the southland. In fact, one of the very first Looking West columns announced his engagement. Since then, Ward and his wife Barbara have relocated in Camino, California, where Ward operates his own dental laboratory. I had not heard from Ward for a long time, until the other day when our "postal lady" delivered a rather interesting note from him that I wish to share with you. It concerns a 220 repeater project that Ward and some other local amateurs are involved in.

It all started about a year ago on 146.52. Ward's house sits at about the 3000' level, and, needless to say, he does not need very much power for good simplex coverage. One day on .52, Ward talked with a group of amateurs in Sacramento who were looking for a location for a 220 repeater. One thing led to another, and when WB6UBF/RPT commenced operation, it did so from Ward's house (where it still resides today). As you may have surmised, UBF has rather good coverage. It is an open machine operating on 223.10 MHz in and 224.70 MHz out, with a 90-degree antenna pattern which gives excellent coverage throughout the Sacramento, Stockton, and Auburn, California areas. It also gives some extended coverage to places as far away as San Jose. Not bad for a home-built system that started life as a Clegg FM-76 transceiver.

By the way, an interesting method was utilized by this group to obtain the desired coverage and pattern direction. Rather than use a J-pole antenna phased for a cardioid pattern, the UBF antenna system consists of four 7-element KLM yagis fed from a four-port KLM power divider (which in turn is connected to a Phelps-Dodge 220-MHz duplexer). They are fanned out at equal intervals to produce the desired pattern. Ward reports that results with this novel approach have been far better than expected.

Currently, UBF has about 15 regular user/supporters, but it also has the welcome mat out for anyone else who wishes to drop by the channel pair. There are plans in the mill for a two-meter remote downlink to selected simplex and repeater channels, along with a second downlink to six meters for operating DX openings and six-meter path experimentation. Other projects on the fire include a complete touchtone decoder system to activate most of the foregoing, along with a secondary power source which might be solar. Of course, all of those plans are dependent upon usership growth and financial support.

Each week, we hear of new 220 relay activity starting up here or there. This is extremely important news, in that it helps ensure the future of that spectrum. It's no secret that our own government is about to try to sell out 220 MHz at WARC '79. We have covered this in depth in recent Looking West columns. What is nice to see is that others agree with my policy of taking the initiative to build 220 activity to a level which would make a 220 maritime takeover a very hard task. Remember, today the old *73* slogan, "220—Use It Or Lose It!", is more important than ever before.

This brings us to a recent special issue of *220 Notes*. Entitled "A Special Action Bulletin," its contents outline what action you and I as individual amateurs can take to try to persuade our government to do an about-face in regard to 220 MHz at WARC. Also included is a suggested form letter to be used as a guide in requesting that action be taken by the FCC to keep 220 to 225 MHz exclusively amateur. The form letter was prepared by Barry D. Bayer K9CFV of the legal firm of D'Ancona, Pflaum, Wyatt, and Riskind. It takes the stand of supporting the Petition for Reconsideration on Docket 20271 filed by the 220 Spectrum Management Association of Southern California. The letter reads as follows:

Secretary,
Federal Communications Commission,
Washington DC 20554

Re: In Support of the Petition of the 220-MHz Spectrum Management Association of Southern California, for Reconsideration of Portion of Report and Order Docket 20271

I am a licensed amateur radio

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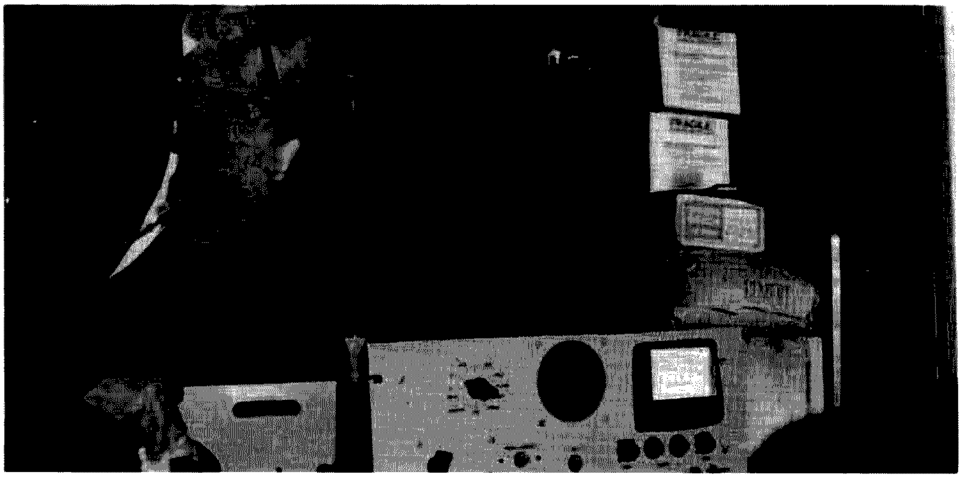

Art Gentry W6MEP dusts off the original K6MYK receiver.

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LETTERS

FREE SPEECH

Recently, the world has witnessed the worst nuclear accident in the history of the United States. On the east coast, and especially in central New Jersey, this incident has made residents aware of how vulnerable we are to next-door nuclear technology.

Amateur radio is now, as it has always been, a prime vehicle for the exchange of ideas and for open discussions between and among concerned licensed operators. For example: Senator Goldwater K7UGA converses with social studies students throughout the country, Columbia University W2AEE initiated the National Student Information Net (40m) during the 60s, and so on.

Since then, however, something has been added to amateur radio. State-of-the-art technology (but not state-of-the-art thinking) has produced the repeater—that wonderfully-efficient contraption capable of fostering human interaction and "communications."

Amateurs throughout the country in the style of "New Directions Radio" are discussing the issues, learning from each other, and forming views which may, in the future, preserve not only amateur radio, but a large proportion of the population as well.

Repeaters with their associated control operators, in many cases, *prevent* communication from taking place. Witness: a discussion of events on the 147.645/147.045 Asbury Park repeater between Bob WA2DEX and myself, WB2MIC. The topic of discussion was the events which took place the previous day in Lacey Township during a scheduled debate between the Jersey Central Power and Light Company and the Safe Energy Alternative Alliance. One individual of the SEA Alliance was arrested while questioning a plainclothes police officer who was recording license plate numbers. The legality and purpose of this officer's actions were described and discussed. Bob is familiar with such matters.

At this point, some true American (protector of free speech and Mom's apple pie) touchtoned the repeater off the air without identifying the transmission—breaking the law, in fact! Whether in self-preservation or as an expression of neo-fascism, this individual deliberately violated an FCC ruling, and did not possess the courage, decency, or intellectual fortitude to explain or admit his actions. The only alternative was to complete the QSO on the repeater's reverse-frequency pair.

There is no argument or debate over the right of a control operator to shut down a repeater. The concern is that such an important issue as nuclear power now has individuals who consider it a controversial topic—one that is taboo.

Let free speech prevail! Let the basic tenets of this nation stand, not only throughout the country but throughout amateur radio as well. After all, ham radio is part and parcel of our entire framework of freedom. Let the open forums happen.

Finally, it is easy to identify the ham neo-Nazis and all they represent by simply engaging in a friendly open dialogue with smatterings of relevance. They'll run and hide, only to plot behind the curtain of the executive committee meetings. There they feel important, in a world and modified hobby that is so far intellectually removed and unaware that the only consolation is peer friendship and closeness. Watch them; observe them; identify them; but most of all, feel sorry for them. But make certain that your views and your right to search for a meaningful QSO are not repressed!

Jozef Boniakowski WB2MIC
Neptune NJ

THE IARL AND TAPES

Regarding your conception of the IARL, please go for it, as you have my support. I am so tired of hearing the League "line" at the hamfests and in their magazine. It seems ludicrous to think that people who can sink as much money as they do into their hobby can't afford another $10, or more, a year to protect their interests, and regardless of League claims, lobbying is the *only* way to do that. Perhaps you're correct about the contests being the way to establish visibility. But, as an avid contester, I feel there are enough contests now, and setting up more may cause us to lose support from those who really dislike contests. It may also tend to cloud the main purpose of the organization. In any event, I hope you'll be ready to go when the time becomes right.

Perhaps you're tired of hearing success stories about your code tapes, but I'm going to relate one, anyway. Two friends of mine, one a Technician and one with an Advanced ticket, were preparing for FCC tests at a local hamfest. I gave the 20-wpm tape to my friend with the Advanced, and subsequent QSO-type tests that I sent him on the air confirmed that he would have no trouble with the test. My Tech friend has been away from code for so long that it looked like a real challenge.

I started him off with your beginner's tape and then gave him the 13-wpm tape. His progress seemed somewhat slow, and he further seemed to have difficulty when I sent him QSO-type tests because he would tend to read the copy and get lost. So I set my sending/spacing to match your 13-wpm tape and made up several QSO-type tests with questions for him, so he would have a better idea of what to expect at the actual test. At the hamfest, I learned early that my Advanced friend had passed his code test; I waited like an expectant father to see if my Tech friend had passed his 13-wpm test. He finally emerged all smiles, as he had passed the test—at 20 wpm!

While I don't recommend using the 13-wpm tapes to prepare for the Extra, this should give you an idea of the margin of safety in the tapes.

R. Michael Reed K0UP
Wolbach NE

SLAMMING

I got to the point when I had to write. I got my Novice ticket in December of 1976, my General in October of 1977, and my Advanced in June of 1978. I have had a subscription to *73* and *QST* since that time and think they are both very good magazines. I just got tired of you putting down the ARRL. Anybody who does something will make mistakes; maybe that's why you don't.

I have yet to see any other magazine cut the others down like you do *QST*. You just can't seem to resist a chance to put the slam on them. I don't know what your personal grudge is against them, but I do think it's about time you started using your editorial for other things besides devoting 75% of it to knocking the ARRL.

I have never been able to find W2NSD/1 giving code practice on the air. As far as the 50-year-old code tapes by the ARRL are concerned, I learned the code in one week from it. You say you dislike putting in the commercial for *73* tapes, but you still put it in, didn't you? I am going to get the *73* 20-wpm tape and, if it's as good as you say, I should be able to pass the Extra code test after the first time through, since it took a week with that no-good ARRL 50-year-old tape.

In your January issue, you say *Radio* magazine had better projects by far than *QST*. Why? Because you don't like *QST*?

I made a few projects out of *QST* and they worked right the first time. So far, I haven't found anything in *73* I wanted to make. So does that make *QST* by far the better magazine?

Wayne, I think it's time you started working with/for amateur radio instead of against *QST* all the time. You can start by stating in your editorial what you and *73* are doing for amateur radio, just to refresh our memories.

I don't really expect to see this printed in *73*, but I just thought I would let you know my feelings. If I were knocking *QST*, I'm sure it would get in print.

Best regards to you and yours, Wayne; 73s for now.

Gordon Traskos WD8DWO
Milford MI

TRAM DIAMOND 60

I have been keeping fairly close tabs on your articles on CB-to-10 conversions, but I must have missed one, because I haven't seen anything on the 23-channel Tram Diamond 60 SSB rig. You have a great mag. Keep it up.

Larry Seymour WB9UFT
Mahomet IL

Hang in there, Larry. Your rig will be coming up.—Jeff DeTray WB8BTH, Assistant Publisher.

OVERVOLTAGE

Although few hams build their own transmitters and receivers as in the days of AM, there is much home brewing in the area of station accessories—keyers, computers, test equipment, etc. Power supplies are popular to build so that the 2-meter rig can be used at home as well as in the car. Power supply circuits are so common and many hams have a false sense of security, particularly with the "new" 3-terminal regulators with thermal shutdown, current limiting, etc.

Unfortunately, overvoltage protection is almost universally avoided. For an adjustable regulator, it is *complex*, but for a fixed voltage or limited range supply, it is quite simple.

Check the reference books. An SCR, resistor, and zener are about all you need, and prepackaged circuits are available commercially and surplus. A dollar or two is pretty cheap insurance when you consider how a blown regulator could do many dollars of damage to that 2-meter rig, computer, or whatever.

Personally, deleting overvoltage protection for solid-state circuits is a crime which I hope never to commit. But check the articles; there are a lot of power supply circuits waiting to prove the point.

E. P. Rolek K9SQG/8
Dayton OH

COME ON UP

Come on up—the air is nice and clean. Don't let all the articles published about 220 MHz scare you. My friends and I here on Long Island have enjoyed this band for quite awhile; we need support now. So, if you have a 220 rig, please use it.

Ed Beinlich WB2IBQ
Whitestone NY

INFLATION

Don't let this inflate your ego, but it must be said that your magazine gets better with each issue.

I got quite a kick out of the recent letter you printed from (my friend) Merrill Eidson of Temple TX. (He's one of my crystal suppliers for those ¼-inch thick AT-cut blanks and crystals for radiobeacon equipment at Alaskan airports. He's the *last one* on the continent who makes up these very important crystal units in the old FT-164 3-inch round white ceramic holders with two nickeled studs protruding.) But I agree with you as being right on in criticizing the ARRL.

F. W. Anderson W7AR
Seattle WA

MORE ON TAPES

Around the middle of January, I received your 20- and 25-wpm code tapes. At the time I received them, you expressed an interest in the amount of time I spent going from the General class speed to the Extra class speed.

The total time I spent was seventy-one hours. I am able to copy the 25-wpm tape now with an error rate of about 3%. The difficulty of the groupings and the added 5-wpm speed was just what I needed to push me into the 20-wpm plain text required by the FCC.

Without the skill I acquired from the tapes, I'm sure I could not have passed the code test. I think they are excellent, and I would certainly recommend them to anyone wishing to upgrade.

Larry L. Sias N0ASV
Kansas City MO

BACKSTABBING

Recently, a friend loaned me an October, 1978, copy of *73* (the first that I have read in years) to review info contained in the article, "Mighty Mods for the 820S." I was very interested in your editorial on "a woman ARRL director." I have been following *the action on* Mary Lewis vs. the ARRL, Thurston, et al, and, while not having all the details, I always felt there was backstabbing, etc. As you probably know, HQ has received two petitions from Northwestern Division members. One requests that ballots be released for election of Director, and the other asks that Vice Director Mayer K7BT be appointed interim Director until the election takes place. You will note from minutes of the January 24-25, 1979, Board of Directors meeting (March, 1979, *QST*), Vice Director Mayer apparently was not allowed by Thurston to attend (out of Division funds), although 10 other Division Vice Directors did! With regard to the last paragraph of that portion of your editorial, I absolutely agree.

Walter R. Joos W6EKM
Vacaville CA

BIG PROJECT

With your reputation for advancing the amateur radio field, I would like to suggest a booklet that would be of great use to the beginner in this field. Namely, an evaluation of amateur equipment for the past fifteen or twenty years, which would include the good and bad points of each, the original cost, possible current value, and some judgment of the equipment.

If you and your associates could work this out, it could be of value for the beginner in buying his first or successive sets.

Don Hurley VE3HAN
Brighton, Ontario

That's an awfully big project, Don. Does anyone want to take on this project?—Jeff DeTray WB8BTH, Assistant Publisher.

GALLED

I am a new Novice. I have bought $50 worth of books which I study at least 8 hours a week. I subscribe to both *73* and *QST*. I *am* going to get that General. I am building a 40-meter QRP rig designed by a local ham, but I do have a problem which you seem to be unaware of.

73, *QST*, and all the manufacturers do not realize that the typical new Novice has limitations as to what he can do. I would like very much to build the Mini-Miser receiver in the *Handbook*. The assembly of parts on boards offers no problem, but I cannot manufacture PC boards, the shielding, and the cabinet. Therefore, it won't be built and we both lose.

Another thing that galls me is the way your publication lacks simple and thorough articles for the Novice. Maybe when I get my General, I will be equally arrogant. I hope not.

Nate Bushnell KA0DGN
Littleton CO

SMALL PROBLEM

I read your March, 1979, article on the universal alarm circuit. It came out just at the right time. With high water levels during the spring thaw, water seepage into the basement started to become a problem. If I had this early warning system built, I could rectify the situation before it caused any damage.

I went down to the local parts emporium and picked up a HEP C4001P McMOS chip. It states on the package: "Pin-for-pin replacement for CD4001A," which is what the project called for. There was only one thing overlooked and that is the type of gate HEP thinks a CD4001A is. Their chip is a quad 2-input NAND gate which, of course, is not correct for the alarm. If you have to use the HEP line, get their C4000P which is a quad 2-input NOR gate, even though HEP thinks that it is a "pin-for-pin replacement for a CD4000A."

Now that this small problem is out of the way, the alarm is complete and works great.

Dave Faucher WA1UQC
Collinsville CT

THANKS

Recently, I was successful in obtaining my Extra class license. Many thanks are due to the editors of *73 Magazine* who put together that TAB book, *Amateur Radio Extra-Class License Study Guide*, which I used as the basis for my self-conducted study program in amateur radio theory and practice over the past several years.

I found the topics introduced there to be an excellent starting point for study of the extensive literature surrounding amateur radio. I undertook this as a surprisingly-enjoyable pastime whenever I found the time to continue with it. As a result, I have been able to reach the point where I am confident that I can be of considerable assistance to the ham fraternity and the public which we serve.

Thanks are also in order for the *73 Magazine* code tapes which I found helpful in brushing up on the 20-wpm code speed needed for the Extra class license exam.

Thomas C. Kipps KA6Z
Fresno CA

QRP ZONE

We're in the process of taking the advice of K5UKH (CB to 10—part XV, November, 1978) and converting a currently-discounted ($34.88 each) Realistic walkie-talkie, Model TRC-201, to ten meters. This unit is identical to the TRC-180 which Tom Murphy K5UKH modified. The receiver in this unit is unusually hot.

International Crystal has the correlation for providing us the pair for 29.000 MHz. Another unit, the 5-Watt TRC-208 with 6 channels, is tempting as it would provide a tight band of 6 channels from 29.000 through 29.050 MHz for QRP operation. A 12-volt power cord plugged into the car lighter liberates you from dying carbon batteries or flagging nicads.

This is the time, Wayne, to stimulate hams into honoring and using a QRP zone, because there are already such large areas on ten for other modes of transmission other than AM.

I would welcome correspondence from interested hams. Service bulletins ($2 each) are available through Radio Shack stores.

F. W. Anderson W7AR
8041 31st Ave. N.W.
Seattle WA 98107

ICOM EAST

When a company that advertises in your magazine performs a service which is far beyond the expected, with courtesy and a sense of dedication, I felt that you would like to know about it.

First, let me assure you that I have been so delighted with the products and service of Icom East, Inc., that I have added

Continued on page 158

Microcomputer Interfacing

Jonathan A. Titus
Christopher A. Titus
David G. Larsen
Peter R. Rony

PREPARING YOUR PROGRAMS

One of the problems facing many microcomputer users is the preparation of software for their particular applications. The software examples which we have provided in past columns are short enough to have been put together or *assembled* by hand, i.e., we translated each mnemonic into its octal, hexadecimal, or binary equivalent. Addresses for jumps, calls, and input/output devices are easily added or changed since the computer programs are short and the addresses are probably listed in sequential order on the rough draft. Unfortunately, not all software preparation is this easy. Many application programs can be many thousands of steps long. This column will initiate a discussion of the aids available for microcomputer program development.

One of the biggest problems in software development is the clear, concise statement of the problem and how it is to be solved. All of the desired results, inputs, outputs, and the complete program flow, including all decision-making steps, must be considered before the programming is started. This can be in outline or block diagram form, but a flowchart will prove to be much easier to follow. A typical flowchart is shown in Fig. 1.

After the problem has been well thought out and a solution put in flowchart form, a decision must be made. Is the program short enough to be easily translated by hand? In many cases, particularly where the programs are simple, hand assembly makes sense. In other cases, software development aids called *editors* and *assemblers* are faster and more efficient. To understand how editors and assemblers work, let's consider the process used to put together this column.

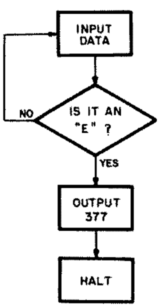

Fig. 1. Typical flowchart.

The first step is an outline of the subject so that we can cover it well in the short column format. A handwritten copy is then typed, corrected, retyped, and perhaps corrected and typed a final time. The illustrations and examples are formulated and drawn separately. This is the *editing* process. When writing a column, it is best to avoid references such as, "the example below" or "the table on the following page." When the column is composed or *assembled*, references to Table 1 or Fig. 4 are much easier to follow.

Computer software is developed in much the same way. An editor program is used, either on a microcomputer or a time-sharing system, to edit the individual program steps. The editor program can correct program steps, change steps, and insert and delete steps just as an actual editor can do with a manuscript. The editor program is generally unaware that you are writing a computer program, since you can use most editors to write a letter, prepare mailing lists, etc. When using an editor to prepare a program in mnemonic form, *symbolic addresses* are often assigned to software tasks within the program. In this way, the actual value of the addresses for subprograms or subroutines is not needed. Just as we can refer you to Fig. 4, the program may similarly refer to the letters, LOOP, as the starting address of a time-delay loop. Allowing us to use symbolic addresses for program steps means that the program may be changed without regard to the actual numeric values of addresses.

The assembler program must be such that it accepts information from the editor and generates an output in a form compatible with your computer. Just as you assemble short programs a step at a time, so does the assembler. The assembler contains a table of mnemonics and their equivalent values. For example, an 8080 assembler would translate an MVIA instruction into 076 octal. The assembler also assigns real 16-bit addresses to your symbolic addresses, such as LOOP. When using symbolic addresses, you must be sure to have a program step for each symbolic address, and you must assign an address if you use a symbol. You cannot assign the same "name" to more than one address. Most assemblers will recognize a *redefined symbol* or an *undefined symbol* and will produce an error message to let you know what needs to be corrected.

The final assembler output will be in punched paper tape, cassette, or disk form ready to run on your system. Most assemblers will also produce a listing of the program showing the address of each step, the data in each successive location, a symbolic address name, and the mnemonic, plus any comments. A typical assembler output is shown in Table 1.

After a program has been assembled, it will probably have to be debugged to get it to operate properly. The program checkout and debugging can be painful without additional software "tools." Computer control panels often prove useful, but reading binary codes can become tedious, and there are many computers without external controls and readouts. As an alternative, there are *debugging programs* available for most microcomputers which allow you to charge instructions, list blocks of data or instructions, and single-step through a program one instruction at a time.

One feature of many debug programs is the ability to establish a *breakpoint* in the software being tested. When the computer reaches a breakpoint, the instruction at that address is executed and an output device, such as a teletypewriter, lists the contents of important, internal CPU registers. Breakpoints are very useful since they indicate not only that the computer reached a certain point in the software, but also what the computer was doing when it got there. If a breakpoint is set in the normal program flow and is not reached, there is something wrong with the program. In this case, the breakpoint would be moved closer and closer to the start of the program until the error is found. When the error is found, it may be corrected by using the debug program to change an instruction, data, etc.

Once the program is operating correctly, the debug program should have the means of saving it on paper tape, a cassette, or another medium. It should also be able to read such

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GLOSSARY

Editor:	A program that allows edit functions such as addition of a line or character to a program, insertion, deletion, etc. It permits you to alter your program. The input data could be anything from programs or reports to raw instrument data.
Assembler:	The program that converts the assembly language code into machine code, accepting mnemonics and symbolic addresses instead of actual binary values for addresses, instructions, and data.
Monitor:	A program which controls the operation of the various programs available. The monitor will be able to access the editor, assembler, or other programs.
Debugger:	A program which allows the user to observe the program flow and the results of the program's operation in a step-by-step mode. A debugger may be used to change data or instructions, alter registers, etc.
Breakpoint:	A special instruction which may be inserted in a program to break off the normal program control and return control to a debug-type program. When a breakpoint is executed, the debug program will indicate what the computer was doing at that point.
Cross-Assembler:	An assembler program which will generate the binary code of a program for a computer other than the type it is being used with. For example, an 8080 cross-assembler might operate on a PDP-8 minicomputer.

```
                          *003 000
003 000 061   START,  LXISP    /SYMBOLIC ADDRESS OF START
003 001 377•          377
003 002 000           000
003 003 333   LOOP,   IN       /INPUT DATA FROM PORT 5
003 004 005           005
003 005 376           CPI      /COMPARE IT TO 026
003 006 026           026
003 007 312           JZ       /IF IT MATCHES GO TO "DETECT"
003 010 015           DETECT
003 011 003           0
003 012 303           JMP      /IF IT DOESN'T MATCH, GO TO
003 013 003           LOOP     /LOOP AND CHECK AGAIN
003 014 003           0
003 015 171   DETECT, MOVAC
003 016 323           OUT
003 017 007•          007
003 020 166           HLT
```

Table 1. Software example showing a typical assembler output.

Contests

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

MINNESOTA QSO PARTY
Starts: 1800 GMT June 2
Ends: 2359 GMT June 3

This year's contest is sponsored by the Heartland Amateur Radio Club. There are no mode or time restrictions, but only one transmitter is allowed in operation at any one time; no crossband contacts are allowed. Novices compete with other Novices, Technicians with other Technicians. Novices and Technicians must identify their license class when sending their call as "/N" or "/T". Phone and CW are considered to be the same contest; please score as such. Net QSOs are not valid.

EXCHANGE:
RS(T) and MN county or ARRL section/country.

SCORING:
MN stations multiply total of points by the number of sections plus DX countries (W/VE excluded). Others multiply QSO points by the number of MN counties worked (87 maximum). Score one point per phone QSO and 2 points per CW QSO. Novices/Technicians count 5 points per QSO. Contacts with HARC station WBØTTZ count 10 points per QSO on each band.

SUGGESTED FREQUENCIES:
CW—28150, 28050, 21050, 21150, 14075, 7075, 7125, 3725, 3600.
Phone—28700, 21400, 14300, 7275, 3950. WBØTTZ will also be operating RTTY on each band.

ENTRIES & AWARDS:
Include a check sheet for each band/mode used if you make 50 or more contacts. Logs must include date/time (GMT), bands, modes, and exchanges. Usual disqualification criteria and classes of awards, plus county awards to MN stations with 10 or more QSOs. Logs must be postmarked no later than July 1st; include an SASE for return of awards and contest summary. Send to HARC, c/o Scott Nelson WDØEFZ, 421 W. Wisconsin Ave., Staples MN 56479.

SOWP 4th ANNUAL CW QSO PARTY

The SOWP 4th Annual CW QSO Party is sponsored by the Society of Wireless Pioneers (SOWP) and will be held from 0000Z on June 6 through 2359Z on June 7. There are no formal requirements except an exchange of name, membership number, and QTH. Suggested frequencies are 55 kHz (±5 kHz) up from the low end of each amateur band. Novices will operate in the center of each Novice band. Members who can only participate part-time are requested to make their calls on the even hours during the period. To optimize long-distance contacts, it is suggested that ten and fifteen meters be used from 1400 to 2100 hours Z. The call will be CQ SOWP. A special certificate will be available to all members who contact a minimum of ten other members during the period. Requests for the certificate must include a list of stations contacted, dates, times, and membership numbers. In addition, an SASE must be included. Certificates will be issued by the V.P. for Awards, Manuel "Pete" Fernandez W4SM, 129 Hialeah Road, Greenville, South Carolina 29607. Requests must be submitted not later than 30 June 1979.

DAFG SHORT CONTESTS FOR 1979
SW (80 and 40 meters):
Saturday, June 9, 1300 to 1800 GMT
Sunday, September 9, 0800 to 1100 GMT
Saturday, November 24, 1300 to 1800 GMT
VHF (2m and 70cm):
Sunday, June 10, 0700 to 1100 GMT
Saturday, September 8, 1200 to 1600 GMT
Sunday, November 25, 0700 to 1100 GMT

The DAFG sponsors this year's short contests and welcomes participation of all RTTY amateurs both inside and outside of Germany. There will be an SW and a VHF contest, both contests being scored separately. The contest is split into 5 single contests within the year. After closing the 5th single contest, the winner of the year in each classification will be announced. Note: The official rules were received too late to list the dates for the first two weekends in January and March.

General call is "CQ DAFG CONTEST." On SW (80 and 40 meters) after each QSO, the station having called last keeps the frequency. The previous holder should QSY. This rule is not valid for the VHF part! Each station may be worked once per band. Contacts via repeaters are not valid. Classifications include: SW—Class A: SW stations above 200 Watts input; Class B: SW stations up to 200 Watts input; Class C: SWL stations. VHF—Class D: VHF stations.

EXCHANGE:
RST, QSO number starting with 001, name, and QTH.

SCORING:
SW—Each completed QSO counts 1 point on 80 and 40 meters.

VHF—Each completed QSO counts 1 point per each 10 km distance on 2 meters and 3 points per 10 km on 70 cm. Each different prefix per each band will be counted as a multiplier. Final score is QSO points multiplied by the total of multipliers.

ENTRIES:
Logs must contain call, name, and complete address of participant in block letters, classification, time (GMT), call, QTH of partner station, RST and QSO number sent/received, band used, and number of prefixes worked. Show final score; logs without final score will count as checklogs. For SWLs, scoring is the same as above; the same station may be reported a maximum of 5 times. Instead of message received info, the SWL should report call of partner station (worked). The results will be published in the news bulletins of the DAFG, in *RTTY Magazine*, in the DARC magazine, and in foreign courtesy publications. Your log should be in the hands of the contest manager not later than 20 days after closing each single contest. Each later incoming log will count as a checklog only. All decisions are final. Send entries to: Klaus K. Zielski DF7FB, PO Box 1147, D-6455 Erlensee 1, West Germany.

All non-DL participants will receive the results of each part of the contest by regular mail. An award will be given every participant at the end of the year. Special plaque for the top scorers in each classification stated in the annual results.

ALL ASIAN DX CONTEST
Phone: 1000 GMT June 16 to 1800 GMT June 17
CW: 1000 GMT August 25 to 1800 GMT August 26

The purpose of this contest sponsored by the JARL is to increase the activity of radio amateurs in Asia and to establish as many contacts as possible during the contest periods between Asian and non-Asian stations. All amateur bands below 30 MHz may be used. Entry classifications include: single operator, 1.9 MHz band, CW only; single operator, 3.5 MHz band; single operator, 7 MHz band; single operator, 14 MHz band; single operator, 21 MHz band; single operator, 28 MHz band; single operator, multiband; multi-operator, multiband.

Power, types of emission, and frequencies used must be within the limits of your own station license. General call for Asian stations is "CQ TEST," non-Asians use "CQ ASIA." No crossband contacts are allowed. For participants in single-operator classes, never transmit two signals or more at the same time. For multi-operator participants, never transmit two or more signals on each

Continued on page 154

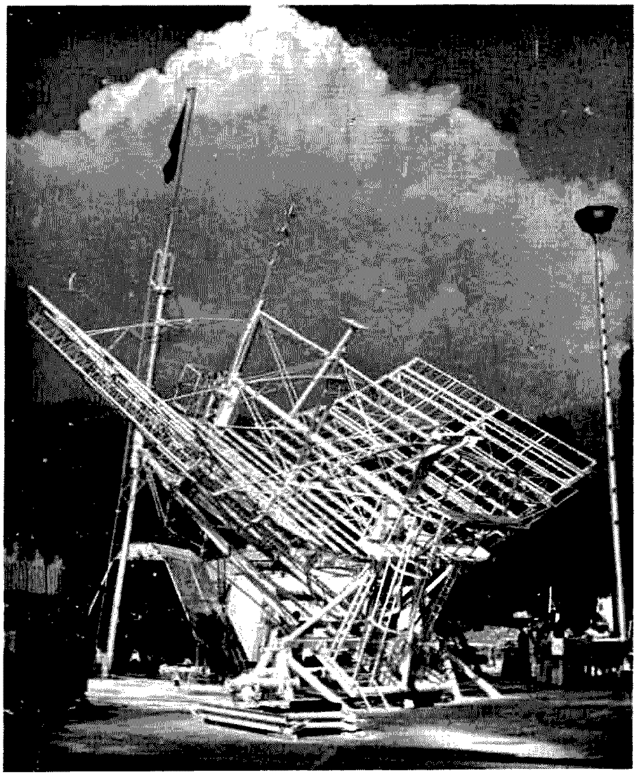
Calendar

June 2-3	Minnesota QSO Party
June 6-7	SOWP CW QSO Party
June 9	DAFG Short Contest—SW
June 9-10	ARRL VHF QSO Party
June 10	DAFG Short Contest—VHF
June 16-17	All Asian DX Contest—Phone
	West Virginia QSO Party
June 23-24	ARRL Field Day
June 30-July 1	Seven-Land QSO Party
July 4	ARRL Straight Key Night
July 14-15	ARRL IARU Radiosport Competition
	Colombian Independence Day Contest
July 28-30	CW County Hunters Contest
Aug 4	DAFG 10 Meter Contest
Aug 4-5	ARRL UHF Contest
Aug 25-26	All Asian DX Contest—CW
Sept 8	DAFG Short Contest—VHF
Sept 8-9	ARRL VHF QSO Party
Sept 9	DAFG Short Contest—SW
Sept 15-16	Scandinavian Activity—CW
Sept 22-23	Scandinavian Activity—Phone
Oct 13-14	ARRL CD Party—CW
Oct 20-21	ARRL CD Party—Phone
Nov 3-4	ARRL Sweepstakes—CW
Nov 10-11	CQ-WE Contest
Nov 17-18	ARRL Sweepstakes—Phone
Nov 24	DAFG Short Contest—SW
Nov 25	DAFG Short Contest—VHF
Dec 1-2	ARRL 160 Meter Contest
Dec 8-9	ARRL 10 Meter Contest

Faces, Places

The Heart of America Radio Club WØRR (Kansas City MO) provided communications at the 1979 Leukemia Telethon. Among the 35 ham participants were Camille Norton WBØYBA, John Bauerly WBØNKR, and Stephen Lufcy WBØLFY.

Last November, LIMARC (Long Island Mobile Amateur Radio Club) members erected three new ATV repeater antennas at their new Syosset, New York, site. The installation crew included (left to right) WB2KCD, WN2VVR, W2MVS, W2KPQ, KA2CLQ, W2TRP, WA2SHC, WB2WAK, N2FP, K2LIO, and WB2SDG. (Photo by K2JKX)



George Romanisky WA6WXD, Los Angeles County Sheriff, was on duty at the Pasadena Rose Parade on New Year's Day. At the time the picture shown was being televised on national TV, he was in QSO through the WR6ABW repeater landline linkup with repeaters WR7AKI, WR8ACC, and WR4ABR.

A few of the hams who pulled emergency duty at the Grumman Corporation's amateur radio station during the Iranian crisis were (front row, left to right) Dick Townes, Skip Courtney; (back row) Zac Zilavy, Ray Schubnel, Jim Kearney, and Jack Cottrell. (Photo by Rich Breunig)

(Left) This solar thermal steam electric generator array is under construction at the Jet Propulsion Laboratory's Pasadena, California, parking lot. A dedicated group of young people has been donating its efforts over the past eight years to build this device for the people of Pitcairn Island. When completed, the array will deliver 5-8 kW in good sun, hopefully allowing the islanders to stretch their increasingly costly supply of diesel fuel a little further. (Above) At the JPL club station W6VIO, Dick Piety K6SVP (left) made contact with Tom Christian VR2TC on Pitcairn. Present in the shack at the time was a group concerned with how to get a very large and heavy structure from the sea in Bounty Bay up a sheer cliff on Pitcairn onto the surface of the island. The group included the New Zealand Consul General for Los Angeles, Frank Muller (right). The consensus was that only a Chinook-type military helicopter would be able to accomplish the task. Any offers? (Photos by Dr. Norman L. Chaflin K6PGX)

RTTY Loop

Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

This month we begin the third year of RTTY Loop. What better way to celebrate a birthday than to investigate once more the hottest topic around today: microprocessors in RTTY. A year ago we looked at reception techniques; this month and next will cover transmitting.

While RTTY transmission can quickly get complicated with various buffers and special function generators, our first efforts shall be directed at merely producing a program that takes keyboard input and converts it to standard RTTY output. We will hold other considerations for later and deal here with the code conversion, speed conversion, and interfacing.

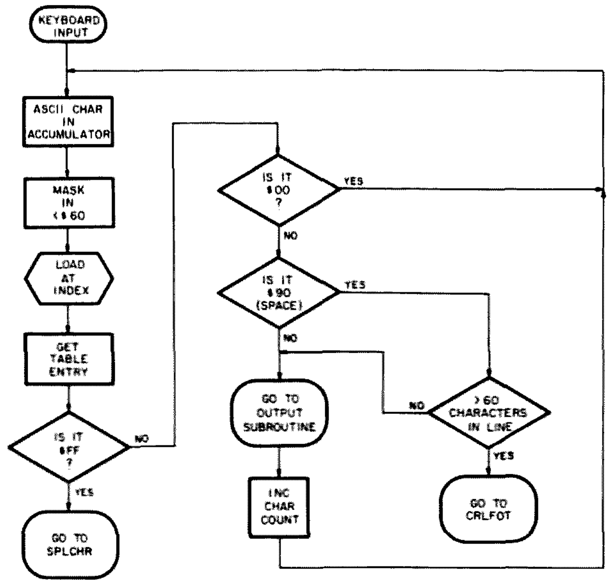


Fig. 1. Main program loop.

Much as we did for RTTY reception, let's enumerate our goals in RTTY transmission: (1) input a character in ASCII from the keyboard; (2) convert that character to the Baudot equivalent; (3) maintain LTRS-FIGS shift appropriately; (4) put the character out at 45.45 baud (60 wpm).

There are also a few niceties we may like, such as downshift-on-space or automatic carriage return/line feed. We will try to incorporate these as the need appears.

The first step, inputting the character as ASCII from the keyboard, is straightforward. Essentially, all computers have an inputting routine, such as the MIKBUG™ INEEE routine, to accomplish this. The only requirement is that the routine mask off the MSB of the input. The ASCII that we use is a seven-bit code, and the eighth bit will confuse things.

Before we get too deeply into this in words, let's walk through the first flowchart, shown in Fig. 1. The keyboard input places an ASCII character into the accumulator. Values greater than $5F are tested for. These represent lowercase and, if present, would cause the table read to search out of the table. If the ASCII code is greater than $5F, it is converted to its uppercase equivalent by subtracting $20. This value is then used as an offset for an indexed search which loads the corresponding table value back into the accumulator. This Baudot-keyed value is either $00, $FF, $FE, or a representation of the Baudot character. If the latter, the format is as shown in Fig. 2.

While the conversion from ASCII to Baudot may at first glance seem to be rather formidable, it really involves the same kind of look-up table as the Baudot-to-ASCII transformation in the receiving program did. By encoding several loca-

MSB : 1 = LTRS 0 = FIGS
1/0)
1/0)
1/0) BAUDOT CODE
1/0)
1/0)
0
LSB: 0

Fig. 2. BAUDOT encoding.

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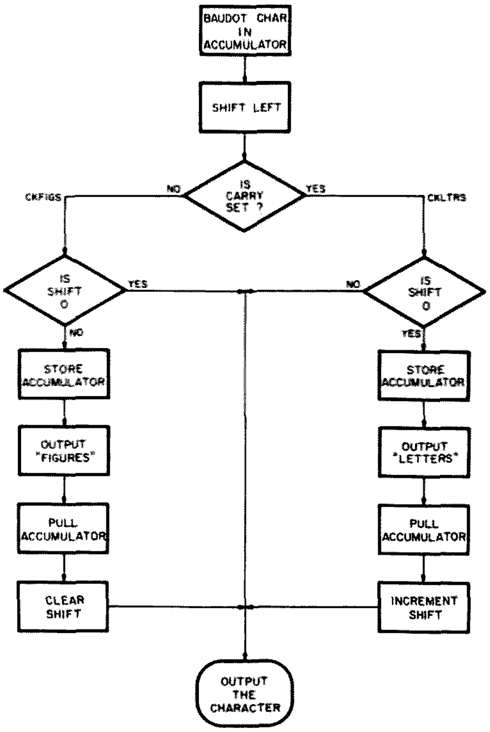


Fig. 3. Shift storage.

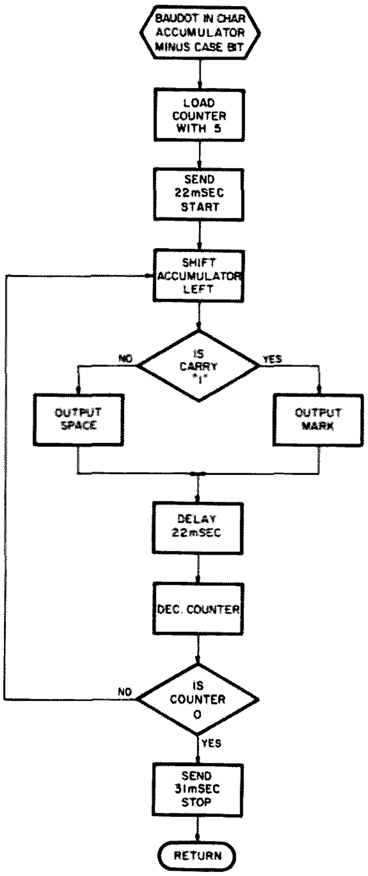


Fig. 4. BAUDOT output.

DX

Chuck Stuart N5KC
5115 Menefee Drive
Dallas TX 75227

Summer is here—the summer of the greatest DX conditions since 1957. Those of you who have been around long enough to have seen a complete sunspot cycle know that it has not always been like this nor will it be like this forever. Perpetual sunspots exist only in DX Heaven. To you newcomers, we can only advise that you take advantage of your good timing and work everything possible while you can. In years hence at future club meetings, the newer generations will hasten to gather at your feet and listen to unbelievable stories of cycle 21.

DX PROFILE

This month we profile not a who but a what, the Northern California DX Foundation. If you are not a member, you are missing out. Drop a note to Box 717, Oakland CA 94604, for complete information on how you can become one of the deserving ones.

The NCDXF was started in 1972 by K6KQN. Its purpose . . . to assist radio and scientific events with funds or equipment. It would be supported by donations from those who benefit. It would provide a central point where funds could be collected and dispersed . . . after applications for assistance were carefully screened by the Board of Trustees.

The Board of Trustees would be a panel of responsible persons, prominent in the electronics industry or business world, having amateur radio (especially DX) for a hobby. They would give their services and counsel to the NCDXF at no salary or compensation in any form. That was the goal.

If you have worked everything, then all the Foundation can offer is the satisfaction of helping others. If the hobby has given you pleasure, put something back to help someone else. The list below has received aid from the NCDXF and must have given some of you a new country. Were any of them new for you?

1974: ARRL Foundation, VR3AG = Fanning, KP6KR = Kingman, OH2BH/OJØ = Market, XU1AA = Khmer, KP6PA = Palmyra, W6WX/KJ6 = Johnston, and OSCAR/AMSAT Project.

1975: CR9AK = Macao, 3B8DA = Mauritius, JY8BH = Jordan, CT9AT = Madeira, C5AZ = Gambia, KC4NI = Navassa, OHØAM and OHØDX = Aland, SV1GA = Mt. Athos, HBØBZD = Liechtenstein.

1976: A35NN = Tonga, 9N1MM/7 = Nepal, ST2SA = Sudan, ST2SA/STØ = So. Sudan, ZK2AQ = Niue, HKØAA = Serrana Bank, TA7ABK = Turkey, YMØAA = Geyser, VK9XX = Christmas Island, HKØAA = Bajo Nuevo, Moonbounce Expeditions—HK1TL = Colombia, So. America, K6YNB/KL7 = Alaska, N6NB = VHF states VT, RI, DE, WV, UT, NV. And we provided an SWL receiver to a boy with a terminal illness.

1977: KP6BD = Kingman, The Personal Foundation, 3B8DT = Mauritius, SU1IM = Egypt, KP6AL = Palmyra, VP8ON = Falklands, 4U1UN = United Nations Amateur Radio Station.

1978: PYØRO = St. Peter/Paul, ZL1BKL/K = Kermadec, K5YY/FH8 = Mayotte, D68AF = Comoros, FH8CY = Mayotte, YI1BGD = Iraq, ZS3 = Walvis Bay, VK9YS = Cocos-Keeling, STØYY = So. Sudan, WØRJU/KP1 = Navassa, K5YY/ST2 = Sudan, FOØXA = Clipperton, CEØAE = Easter Island, LA1VC = Bouvet, ARRL IARU "Project Goodwill."

Application for assistance must come from the person or group directly involved. It takes too much time to deal with 2nd and 3rd party requests. And they must be processed through PO Box 717, Oakland CA 94604, not via a trustee.

Application processing time: The NCDXF has nine trustees that must vote on the requests. They seldom have meetings, so voting is done by telephone. Don K6RV, the president, calls each trustee long-distance (at his own personal expense) to poll the votes on various items. Allow plenty of time for processing.

Equipment donations are encouraged, but must be trouble-free. It is asking too much to expect the Foundation to find a repairman. You are the one that gets the tax receipt.

Membership: Anyone is invited to become a member. A minimum donation of $5 is required to cover membership certificate, etc. There are no yearly dues or demands, but the Foundation must have an influx of capital if it is to continue, so they encourage a yearly contribution. For USA tax purposes, they are classed as a private operating foundation, defined in Code Sect. 4942(1)(3), which allows up to 50% of your adjusted gross income to become a deductible contribution. If you are in a position to make a substantial donation, write for details.

Last month we showed you the SSB operating position at KV4AA. Above is the CW position from where most of the almost unbelievable 48,100 QSOs were made during 1978.

HEARD ON THE BAND

The Desecheo operation, KP4AM/D, was a roaring success with over 21,000 contacts made on all bands 2 through 160. The QSLs were expected to hit the mails in early May, so you should have yours in hand by this time. Although the operation received financial support from the Northern California DX Foundation, it is still several thousand dollars in the red. Those wishing to help out can direct their mail to the DX Club of Puerto Rico, PO Box 50073, Levittown PR 00950. Those taking part in the operation were KP4AM, KP4Q, N4EA, KP4DSD, KV4KV, and N4ZC.

EA6CE was a multi-operator effort in the recent ARRL DX Contest. They managed some 3,000 contacts in a forty-eight hour period and ended with better than 1.5 million points. QSLs should be directed to PO Box 31, Palma de Mallorca, Balearic Islands, Spain.

While we are reporting from Spain, we might mention that Fernando EA8CR sends word that permission has been granted for 160 activity from Spain. This includes the EA6/8/9 types as well, and, while there may be some restrictions in some areas, you should soon be hearing all the EAs on 160.

George Collins VE3FXT was mobiling around the US last summer and dropped in on the Fresno International DX meeting. George is planning quite a bit of DX activity in the coming years, including a massive effort preceding the 1984 Olympics. Plans call for a complete mobile station possibly set up in a light aircraft to move quickly from place to place. His itinerary of well over 100 countries will warm the hearts of many DXers. George has some 11,000 contacts from H5 and S8 and he reports that the gear for Vendaland is already in place.

Speaking of those new African homeland countries, you should be hearing Vendaland and Qwa-Qwa before the year is out. These two, along with H5, Bophuthatswana, and S8, Transkei, should be added to the ARRL DXCC countries list as soon as WARC 79 is history. They most certainly will be made retroactive to their independence dates, so go ahead and work them even though they won't count for a while. There is also the possibility that South Bophuthatswana will count separately from North Bophuthatswana, so work all the H5s you hear until you are sure you have them both. ZS6BOK/H5 was in South Bophuthatswana; H5AA was North.

IP5CJA, on during the WPX contest last March, was on Montecristo Island in the Tyrrhenian Sea, part of the Tuscan Archipelago. This is a wildlife conservancy like Desecheo Island and is administered by the Italian Department of the Interior. Only two operators are allowed on the island at once and for only four days. Although Montecristo Island would appear to qualify as a new country under the same "distinctively separate administration" that qualified Desecheo, the ARRL has so far rejected the Italians' claims.

W4BAA is looking to close out the logs for the 9L1JM operation from November, 1974, to September, 1978. The station has returned to Holland, so if you still need a QSL, it's now or forever hold your peace.

VQ9JJ and VQ9KK are on Diego Garcia for a long stay and plan to be active on 28545 kHz and 21352 kHz. QSL to W5RU.

That AX6 prefix marked the visit of Prince Charles to Western Australia on the 150th anniversary of settlement there in the old west.

Continued on page 158

New Products

DAIWA CN-720 SWR AND POWER METER

Take one look at the new Daiwa CN-720 swr and power meter and you'll realize that it's something unique among ham shack accessories. Unlike other meters, which display only one or two transmitter parameters, the CN-720 simultaneously displays three important quantities—forward power, reflected power, and swr—on a single dial face. Very convenient.

Actually, the concept of the Daiwa metering system is so simple that you'll wonder why someone didn't think of it before. Conventional units require the user to observe two different dial faces or else switch between functions in order to monitor two or more values. The Daiwa system puts two meter movements and three scales on the same dial face. The meter movements indicate forward and reflected power at the same time, which might seem like convenience enough, but Daiwa has gone a step further. In the area where the forward and reflected power pointers cross one another, there is a third scale designed to indicate swr. Simply note the point where the two pointers cross and swr can be read directly from the scale. Thus, you can monitor all three important quantities at the same time on one dial face. Believe me, this makes transmitter and antenna tuner adjustments a snap.

The front panel of the CN-720 contains a single control switch which is used to set the power range of the meter at 20, 200, or 1000 Watts. When rf is applied to the meter, one of three LED indicators is illuminated as a reminder of the power level you have selected.

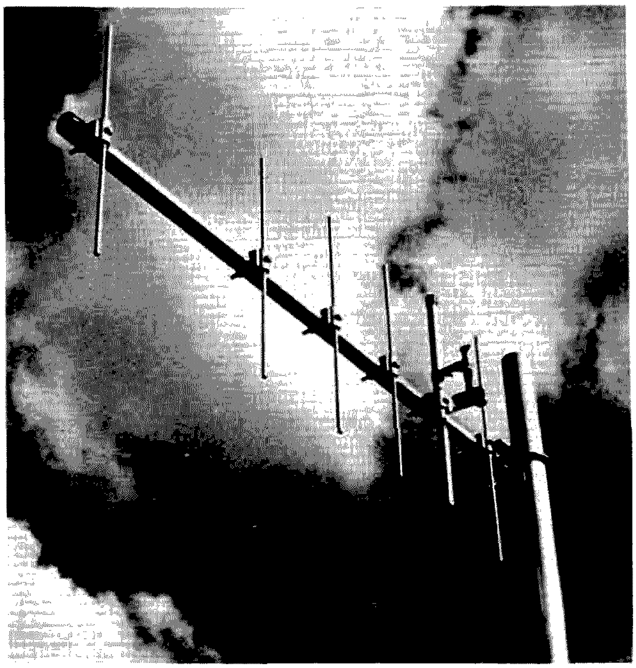
The rear panel features three SO-239s for connection of the station transceiver along with two antennas (or one antenna and a dummy load). A built-in slide switch allows selection of either antenna without resorting to an external coax switch—a definite plus.

The CN-720 is housed in a rugged all-metal enclosure measuring 7" W x 4¾" H x 5" D. An electrically identical unit, Model CN-620, is available in a more compact case measuring 6½" W x 3" H x 3¾" D. Both units are rated for legal limit power from 1.8-150 MHz. All features of the CN-720 are retained in the 620—the only difference is the size. Those wanting a large, easy-to-read meter would probably choose the 720. Where small size and weight are important, the 620 is a better choice. Styling is a subjective factor, of course, but I find these meters very attractive; they should look good in most any ham shack. *J. W. Miller Division, Bell Industries, PO Box 5825, Compton CA 90224.* Reader Service number B47.

Jeff DeTray WB8BTH/1
Assistant Publisher

BROADBAND UHF YAGIS

Cushcraft Corporation has announced 2 new broadband Proline 6-element yagis for UHF service. Both models offer 10-dBd forward gain, 20-dB front-to-back ratio, 10-MHz bandwidth, and 50-Ohm UHF connector termination. They come complete with hardware for versatile end-mount installations. Designated models P456-6 (450-460 MHz) and P467-6 (460-470 MHz), they require no tuning and are ideal for situations where relatively inexpensive yet durable antennas are required. For further information, contact *Cushcraft Corporation, PO Box 4680, Manchester NH 03108.* Reader Service number C67.

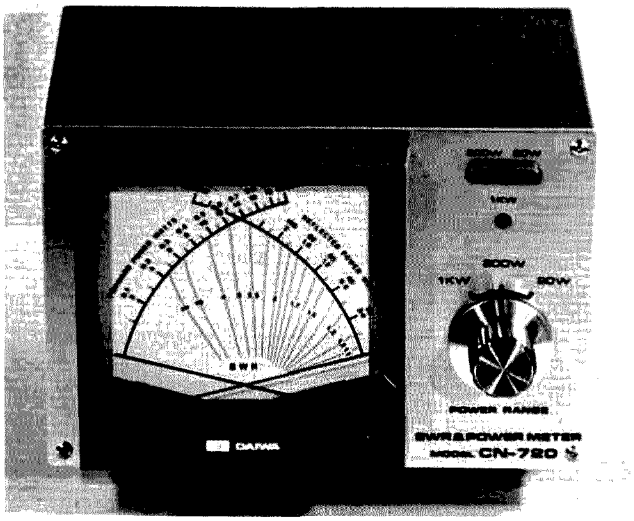


One of Cushcraft's new UHF yagis.

1.4-GHZ, 10-DIGIT FREQUENCY COUNTER

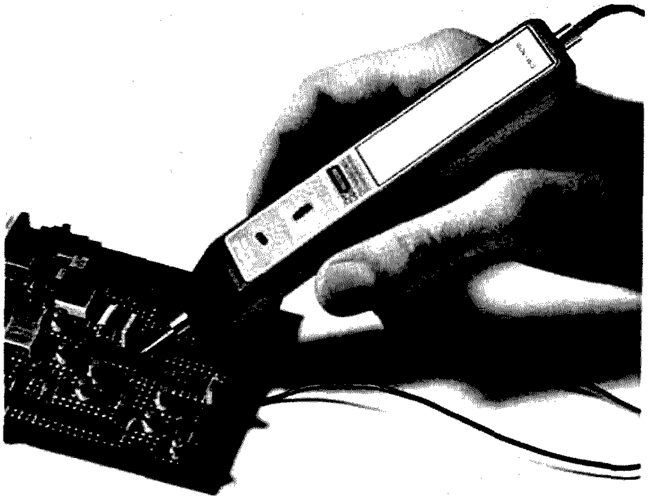
Optoelectronics, Inc., has just announced an all-new, top-of-the-line, ac-dc portable multifunction counter/timer. Dubbed the MCT 9010, this state-of-the-art unit has a most impressive list of features, all of which are standard, including a precision temperature-compensated 10-MHz crystal timebase (0.1 ppm, tcxo 17-40° C) with an aging rate of less than 1 ppm/year guaranteed, four functions (frequency, period, ratio, and totalize), 8 gate times from .01 second to 20 seconds, a low-frequency multiplier for resolution of .001 Hz below 5 kHz, resolution to 1 Hz through 1.4 GHz, and a variable sensitivity attenuator with a typical sensitivity of 1-20 mV rms from 10 Hz to 1 GHz.

Provided with each MCT 9010 will be a "Certificate of Compliance" certifying the timebase stability, aging, and NBS calibration traceability. For further information, contact *Optoelectronics, Inc., 5821 N.E. 14th Avenue, Ft. Lauderdale FL*

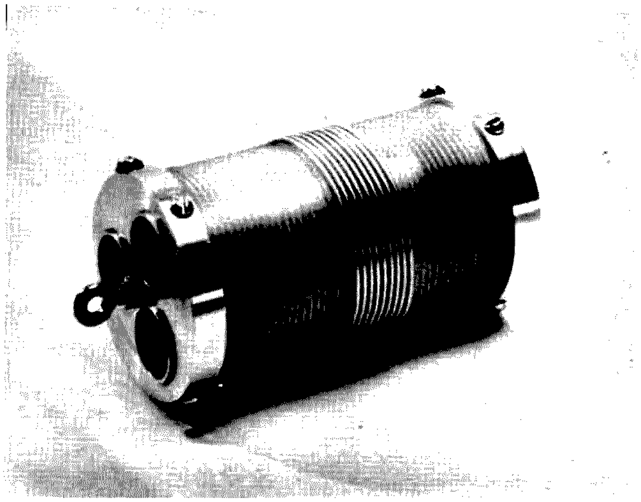


Daiwa's CN-720 swr and power meter.

Optoelectronics' MCT 9010 counter.



B&K-Precision's new digital pulser probe.



Unadilla's new KW-80 80-meter antenna trap.

33334; (305)-771-2050/1. Reader Service number O3.

MODEL HG-52SS CRANK-UP TOWER

Hy-Gain Electronics, a division of Telex Communications, Inc., has announced the Model HG-52 self-supporting tower. The HG-52SS is designed to support 9.0 sq. ft. of antenna area with winds up to 50 mph. This all-steel tower has the advantage of an improved guide system which allows the tubing to be open at each end, ensuring complete galvanizing and total moisture drainage.

The HG-52SS will accommodate standard rotators. A thrust bearing can be bolted to the top section to allow a 2-inch mast. For further information, contact *Hy-Gain Electronics, 8601 Northeast Hwy. 6, Lincoln NE 68505; (402)-467-5321.* Reader Service number H4.

NEW DIGITAL PULSER PROBE ANNOUNCED BY DYNASCAN

The B&K-Precision product group of Dynascan Corporation has just introduced a new digital pulser probe. The new unit, designated as Model DP-100, is designed as an aid to fast analysis and debugging of integrated circuit logic systems.

The DP-100 generates a single pulse in the "one-shot" mode or a 5-Hz pulse train in the continuous output mode. Simple to operate, the DP-100 can be used alone or in conjunction with a logic probe or oscilloscope. When the probe output is applied to a circuit, it will automatically pull an existing logic low to a high state or an existing high state to a low. By observing the change in circuit output, the user can isolate faulty circuits and components. Applied test energy is limited to only 0.33% of the normal power dissipation of a good device. This ensures that circuit damage cannot result from the DP-100 test procedure.

For full versatility, the DP-100 is compatible with DTL, TTL, RTL, and CMOS logic circuits. Operating power is derived from the circuit under test, so batteries are not required. Like other B&K-Precision products, the DP-100 is well protected against overvoltage or polarity reversal. The output (probe tip) is protected to ±35 volts and the input power leads are protected to ±160 V dc and 117 V ac.

For additional information, contact *B&K-Precision, Dynascan Corporation, 6460 West Cortland Street, Chicago IL 60635; (312)-889-9087.* Reader Service number B45.

80-METER ANTENNA TRAPS

Unadilla has added a pair of 80-meter antenna traps (the KW-80) to its line of 10-15-20-40-meter series. The KW-80 takes 1 kW, is weatherized, and is available for the CW band (KW-80C) or the phone band (KW-80F). For further information, contact *Microwave Filter Company, Inc., 6743 Kinne St., East Syracuse NY 13057; (315)-437-3953.* Reader Service number U9.

MODEL TH5DX FOR 10-15-20 METERS

Hy-Gain Electronics has introduced the newest member of its famous Thunderbird line of triband antennas. The TH5DX offers outstanding performance on 20, 15, and 10 meters. It features 5 elements on an 18-foot boom, with 3 active elements on 15 and 20 meters and 4 active elements on 10 meters. The TH5DX also features separate air-dielectric Hy-Q traps for each band. This allows the TH5DX to be set for the maximum F/B ratio and the minimum beamwidth possible for a triband antenna of this size. Also standard on this antenna are Hy-Gain's unique beta-match, rugged boom-to-mast bracket, taper-swaged elements, and Improved element compression clamps. For further information, contact *Hy-Gain Electronics, 8601 Northeast Hwy. 6, Lincoln NE 68505; (402)-467-5321.* Reader Service number H4.

Ham Help

As a radio amateur, I like very much to experiment and try different approaches to various problems. I am sure that there are more persons, in many fields, who are doing the same thing: experimenting with various facets of scientific problems in the hope of finding a better/cheaper/more-efficient way of doing things, or doing things that supposedly cannot be done.

At this time, there is an organization being started to bring together, in one group, various clubs and individuals who might be called amateur scientists. The organization is called, aptly enough, the Amateur Scientist Research Organization. Anyone interested can find out more by writing to ASRO, PO Box 4, McMechen WV 26040. We will be glad to send him the latest newsletter and bulletin. There is no charge or obligation.

Also, there is a net planned for the ham members. We feel that this organization fills a definite need in the world of the amateur scientist. We are open for suggestions from all persons.

Richard S. Meyer WD8BJW
134 Jims Run
McMechen WV 26040

I have a military surplus unit labeled TYPE CFN-46ADT RF TO IF CONVERTER, SERIAL 737, A unit of model BP Radio Eqpt., Navy Dept.—Bureau of Ships, Farnsworth TV & Radio Corp. I would appreciate any information on frequency coverage, i-f output frequency, voltages, etc. Many thanks.

J. O. Dickinson W4LLF
1408 Monmouth Court West
Richmond VA 23233

I will be visiting the United States and Canada for 3 weeks In August of this year, and I would like to meet local amateurs as I pass through. Having the equivalent of a Technician's callsign, I do not know many hams stateside.

Being originally from VU2, I shall be bringing along some slides on VU2 and ZL and will be happy to talk about them. I shall be spending a week each in Concord CA, Point Pleasant NJ, and Toronto, Canada, with no fixed plans, so I would appreciate advice on local attractions, 2-meter repeaters, ham shops, etc. (All letters will be answered.) I have also been a broadcast-band SWL for some years and would like to hear from SWLs, too.

Ashok Nallawalla
PO Box 144
Dunedin, New Zealand

I need a February, 1950, copy of *CQ* to copy an article. I will return it to the owner in good shape. Thank you.

Richard E. Flarida K8BJA
2267 Star Route 183
Atwater OH 44201

Ham Help

I am interested in obtaining information on the World Radio Laboratories Model SB 175 transmitter. I am particularly interested in converting the DSB to SSB, and would also like to know about any other successful modifications that have been made to this unit.

I am also interested in obtaining a schematic on a digital frequency display for the FRG-7 receiver, using either an external frequency counter or a separate readout.

Rex D. Faulkner
3413 Covington Drive
Augusta GA 30909

I would like to get in touch with any hams who are interested in or own antique and classic cars, for the purpose of starting a classic car net on 15 meters. When writing, please list the car(s) (if any) you own.

Gary Carter WA4IAM
329 Oakdale Rd.
Rocky Mount NC 27801

I would like to get in contact with a ham in the Peoria, Illinois, area who could help me with code practice for my General ticket.

Patrick Butler
3208 W. Greenwood Pl.
Peoria IL 61615

Does anyone have a schematic for the Hallicrafters T.T.O. Electronic Keyer, Model HA-4? I will gladly pay copying cost and postage.

Bill Hurt WD4RMA
Rt. 1, Box 212A
Zirconia NC 28790

Anyone interested in starting an informal net for hunters, shooters, and fishermen on about 21,400-410 MHz daily at 1500Z? Drop me a card or meet on frequency.

Art Santella K1VKO
43 Seaview Ave.
East Norwalk CT 06855

I am interested in becoming a QSL manager for any DX station.

Dennis Younker WA6OYV
45255 Raysack, Apt. 2
Lancaster CA 93534

I am trying to make a Gonset GSB-2 Model 900B with a Model 901A work again.

I need a manual, a schematic, and alignment info.

I will be glad to pay any reasonable cost for copies and mailing. Thank You.

R. Maag K6IUP
40103 87th St. W.
Leona Valley CA 93550

I am very curious to know if there exists an unconverted, untampered with, working or not, Motorola HT-220 for sale which costs less than the national debt.

David Pilipauskas WB9HPJ
6649 S. Fairfield
Chicago IL 60629

I would like to purchase a manual or schematic for a Kaar UHF transceiver (model 12TR510A), which I plan to convert to 440 MHz. The manufacturer is no longer in business.

Norris Saari W7LAP
13535 53rd Ave. So.
Seattle WA 98168

I would like to hear from anyone using the new Atlas RX-110 and TX-110L combination. I'm interested in the comments and experiences of others who are using this setup.

Keith Arnold N8AQR
1273 Erickson Ave.
Columbus OH 43227

Social Events

Listings in this column are provided free of charge on a space-available basis. The following information should be included in every announcement: sponsor, event, date, time, place, city, state, admission charge (if any), features, talk-in frequencies, and the name of whom to contact for further information. Announcements must be received two months prior to the month in which the event takes place.

UPPER HUTT NZ
JUN 1-4

The 1979 Annual Conference of the New Zealand Association of Radio Transmitters will be held on June 1-4, 1979, at Upper Hutt, New Zealand. Visitors are welcome to attend this conference. For registration forms, contact the Secretary, 1979 Conference Committee, PO Box 40-212, Upper Hutt NZ.

ST. PAUL MN
JUN 2

The North Area Repeater Association, Inc., will hold its Amateur Fair '79 on Saturday, June 2, 1979, at the Minnesota State Fairgrounds, St. Paul, Minnesota. This is a swapfest and exposition for amateur radio operators and computer hobbyists. There will be free overnight parking for self-contained campers on June 1st only. You may sell from your car in the giant flea market or from the available inside space. There will be AMSAT and microprocessor exhibits, FCC, ARRL, Minnesota Repeater Council booths, and many prizes. Admission is $2.00. For information or reservations for commercial space, write Amateur Fair, PO Box 30054, St. Paul MN 55175.

WENATCHEE WA
JUN 2-3

The Apple City Amateur Radio club will hold its Ham Fest on June 2-3, 1979, at Rocky Reach Dam, 7 miles north of the city on Highway 97, Wenatchee, Washington. Registration fee for amateurs is $3.00 (which includes one ticket for the prize drawing), $1.00 for non-amateurs, and children under 12 are free. A banquet dinner will be held on Saturday night at $5.00 per person. Free camp/trailer space will be provided at the park. Featured will be equipment displays, a VHF tune-up clinic, an arts and crafts show/sale, a swap shop, a photography display, exhibits, a tour of the Power House, a film on the Life of Thomas Edison, and a potluck dinner on Sunday at 1:00 pm. For information and reservations, contact the Apple City Amateur Radio Club, 713 Grandview Avenue, Wenatchee WA 98801.

ISLIP LI NY
JUN 3

The Long Island Mobile Amateur Radio Club, Inc., will hold its Long Island Hamfair '79 on June 3, 1979, from 9:00 am to 4:00 pm at the Islip Speedway, on Islip Avenue (Rte. 111), just one block south of the Southern State Parkway, Exit 43, or south on 111 from Exit 56 of the Long Island Expressway, Islip, Long Island, New York. There will be over 250 exhibitors. General admission is $1.50 and exhibitors' admission is $3.00 per space. Wives, sweethearts, and children under 12 are admitted free. There will be many door prizes available for all ticket holders. Talk-in on 146.25/.85 and .52. The rain date

Continued on page 164

Reader Service—see page 195

Add Digital Display for $50

—100-Hz accuracy

A useful addition to your shack.

Richard C. Jaeger K4IQJ
1599 Gonzalo Road
Boca Raton FL 33432

Several years ago, I decided that a digital readout for my R4B receiver would be a worthwhile addition to my shack. After reviewing existing articles describing counters and vfo readouts, the counter in Fig. 1 was designed, which was similar to one described in *Ham Radio.*[1]

Only the vfo signal is measured, which avoids the complexity of sequentially measuring the frequency of several oscillators. The signal from the vfo in the R4B, which tunes from 5445 kHz down to 4995 kHz, was mixed in a digital mixer (7474) with the output of a crystal oscillator at 5445 kHz, to produce a difference signal in the range of 0-500 kHz.

Since I wanted the ability to accurately calibrate the display, a variable capacitor was used to adjust the frequency of the crystal oscillator which fed the digital mixer, so that the counter could be adjusted to zero on each band. The output of the mixer was fed to the counting circuitry, which displayed a three-digit count (10 kHz, 1 kHz, 100 Hz) fifty times per second. A 50-Hz flicker rate in the LED display is not detectable by the eye, and eliminates the need for latches between the output of the decade counters and the seven-segment decoder-drivers.

After using this readout for over six months, I decided that the overall performance was not satisfactory. First, the three digits did not display sufficient information. I found that I was constantly referring to the receiver dial to determine in which 100-kHz band segment I was operating. Second, since the basic count interval was 10 ms, and the counter was not synchronized to the input signal, the low-order digit flickered annoyingly between two values. Finally, the frequency adjustment obtained with the simple variable crystal oscillator was not sufficient to cover the variation in hfo mixer crystals in the receiver. So, a second design was undertaken with the aim of correcting the faults which had become apparent in the existing display.

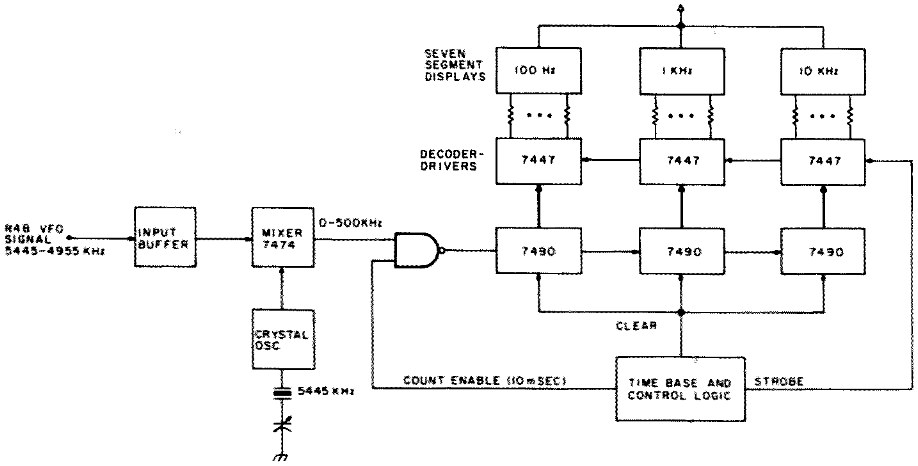


Fig. 1. Block diagram of the first digital readout.

The new version of the display corrects the problems discussed above, and can be built for less than $50 if all of the parts are purchased new. The display was designed with four digits and 100-Hz resolution, as shown in the block diagram of Fig. 2. The incoming signal is first divided by ten, and the basic count interval increased to 100 ms, to eliminate the flicker in the last digit.

After some thought, I realized that mixing the vfo signal to produce the 0-500-kHz signal represented unneeded complexity. Measurement of the vfo

signal could be done directly by simply down-counting or subtracting, rather than counting upward in the counters. To accomplish this, presettable down-counters (74192s) are used and preset to 455.0. When the signal from the vfo at 5455.0 is subtracted from this count, the correct reading of 000.0 is displayed in the lower four digits. The most significant digit is dropped. When the vfo is tuned to 4955.0, the display will show 500.0 kHz. To display readings corresponding to 500.0 to 999.9, the preset count is changed to 955.0. Circuitry for the counter and display is shown in Fig. 3.

Using the presettable down-counters also solves the problem of how to calibrate the readout. Instead of presetting the two low-order digits to fixed values, the preset values are determined by the contents of two additional decade counters (7490s). The contents of these two counters may be altered by simply pulsing their inputs until the preset is correct to calibrate the counter. The preset value in these two digits ranges from 0.0 to 9.9, corresponding to an adjustment range of −5 kHz and +4.9 kHz about the nominal frequency. This range represents a sufficient adjustment range for the crystals used in the receiver and corresponds to approximately a 0.01% or greater tolerance on the mixer crystals used in the R4B receiver. In the digital readout for the R4B, the third digit is always preset to the value 5. The fourth digit is preset to either 4 or 9, depending upon which 500-kHz segment is being used, and is selected by a front panel switch.

The vfo range and preset number are also shown in Table 1 for other rigs which were available to me. The

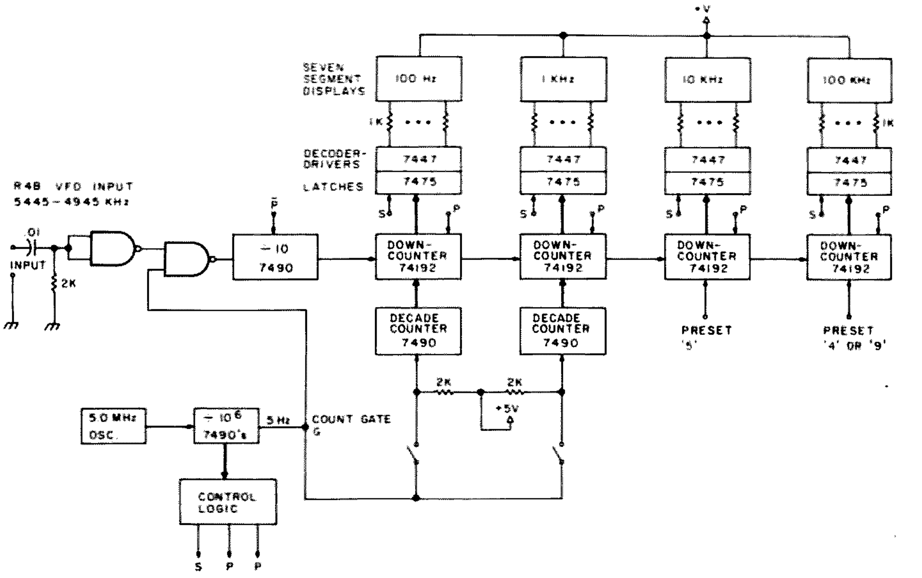


Fig. 2. Block diagram of an improved digital readout. G = count gate; S = strobe for 7475; P = preset for counters.

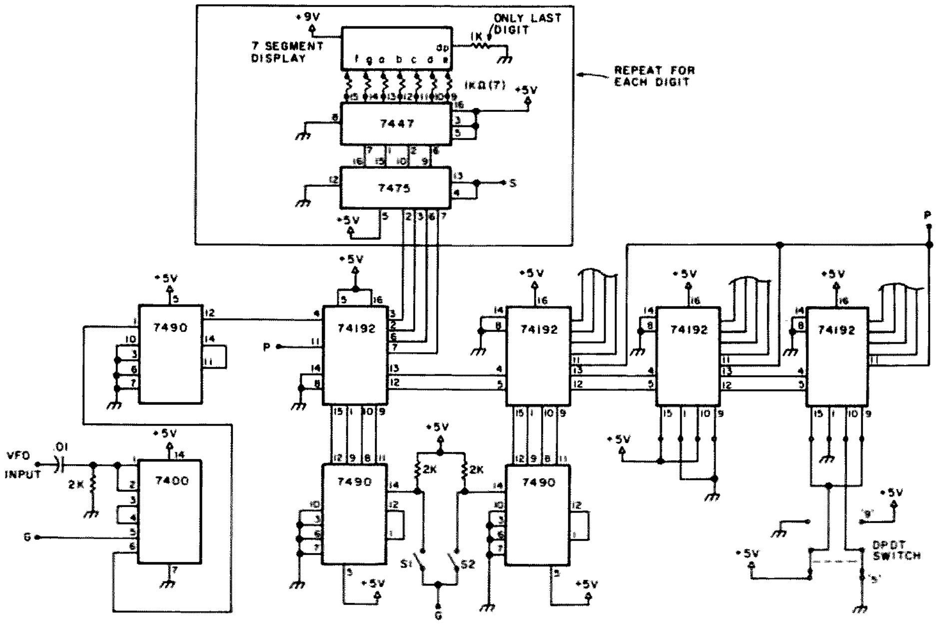


Fig. 3. Counter, display, and display drivers.

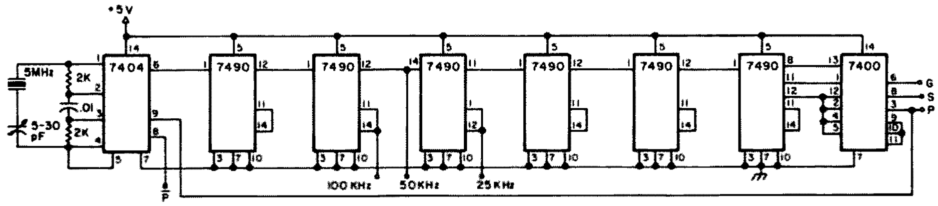


Fig. 4. Timebase and control signal generator.

Heath line of vfos do not have the convenient 5-kHz offset. However, switch-selectable preset can easily be added to the third digit of the counter. It should also be possible to shift the heterodyne oscillator crystals with a capacitor, in order to ensure that an offset always exists. A third alternative is to replace the oscillator crystals with new ones offset by 5 kHz.

The timebase circuitry (Fig. 4) is of straightforward design. A counter chain

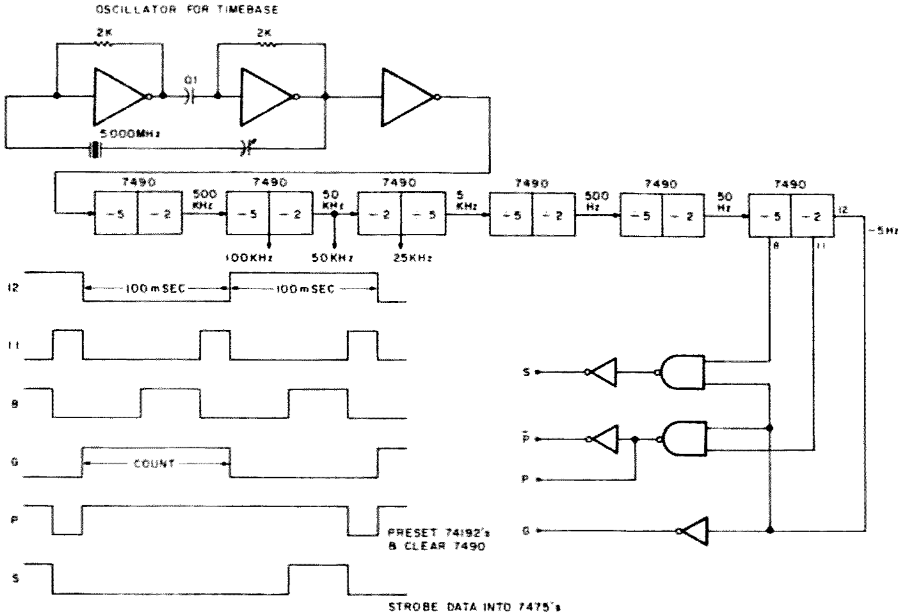


Fig. 5. Timebase and control logic for the digital readout.

divides the output of a 5-MHz oscillator down to 5 Hz. One intermediate divider stage is wired in divide-by-two, divide-by-five fashion, so that 100-kHz, 50-kHz, and 25-kHz outputs are available and may be switch-selected for calibrator purposes, if desired.

The control signals were designed to be of minimum complexity. As shown in Fig. 5, the timebase output is a signal with a 200-ms period. During one 100-ms period, the contents of the counter are gated to the display latches, and continuously displayed on the seven-segment displays. The preset values are then gated into the counters, and the counter is ready to measure the input signal. During the next 100-ms period, the counters are decremented by the input signal, and the cycle then repeats itself.

The vfo signal from the R4B is obtained at the output of the low-pass filter (C132, L6, C149) which is connected to the output of the vfo unit as shown in Fig. 6. The signal is tapped off at the junction of C149 and L6 through a .01-uF capacitor. An attachment is made to the circuit board mounted directly behind the af gain control, and the wire is routed along the side of the chassis to a phono socket installed in the spare position on the back of the R4B.

The digital readout was packaged with its power supply in a small cabinet. The power supply (Fig. 7) uses a full-wave bridge rectifier with a capacitive filter, followed by an LM309 5-volt regulator. The seven-segment displays do not require regulated voltage, and the display drivers (7447) can use a segment supply of up to 15 volts. Power for the seven-segment displays is therefore tapped off ahead of the regulator, in order to minimize dissipation in the regulator. The filter capacitors were chosen to maximize the ripple at the regulator input, while ensuring that the regulator does not drop out of regulation. This can be done easily using an oscilloscope, and also minimizes regulator dissipation. The displays are mounted in a socket assembly and bezel unit which adds immeasurably to the overall appearance of the display.

A toggle switch selects either a 0-500.0 or 500.0-999.9 display. Two pushbuttons are used to calibrate the two low-order digits of the display. Calibration is accomplished by first adjusting the receiver to zero-beat with the calibrator signal. This can be done quite accurately by watching the S-meter as the receiver is adjusted to zero-beat. At zero-beat, the S-meter needle will waver back and forth at a low frequency. After the receiver is adjusted to zero-beat, the two buttons on the readout are depressed until the readout displays the correct frequency. One will get the hang of this adjustment after a little practice. The calibration obtained is well within the 100-Hz resolution of the readout, and the display accurately reads out the frequency to which the receiver is tuned to within 100 Hz. The stability of the timebase in the counter has been found to be more than adequate for this resolution. Drift of the timebase has been measured to be less than 100 Hz from a cold start.

This version of the readout has been in use now for approximately two years, and has proved to be a useful addition to the shack. The display permits an accurate QSY, allowing one to return to the exact frequency of a desired station during contests or when chasing DX. The calibration feature also allows the offset associated with CW reception (100-1000-Hz) to be removed, so that the display indicates the frequency of the received signal directly.■

Transceiver	Vfo range	Preset	Mode
HW-101, SB-101	5500-5000	500	Down count
HW-32	1770-1620	970	Down count

Table 1.

Reference

1. Gerd H. Schrick, "Digital Readout Variable Frequency Oscillator," *Ham Radio*, January, 1973, pp. 14-19.

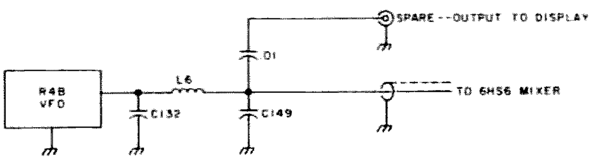


Fig. 6.

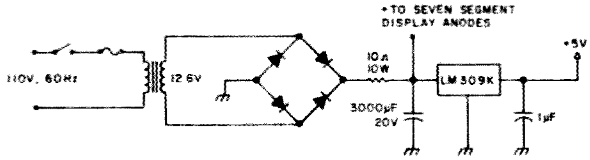


Fig. 7. Display power supply.

High-Performance Receiver Add-Ons

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New circuits and ICs improve performance.

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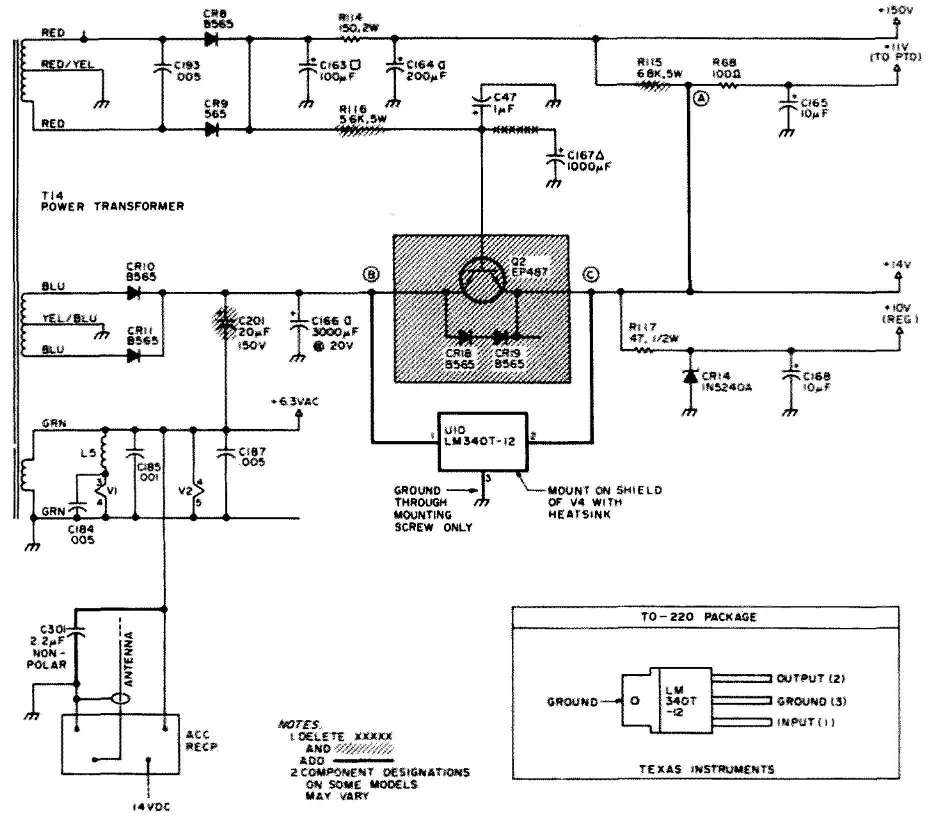

Fig. 1. A simple three-terminal integrated circuit regulator can easily be added to almost any receiver low-voltage supply to improve hum, ripple, and circuit decoupling. The example circuit is taken from the Drake R-4C.

Modern receiver equipment designs often become obsolete before they can be manufactured, tested, and sold. Unfortunately, highly-reliable printed circuit boards almost freeze the performance design of many solid-state receivers. Some of the more exotic, sophisticated technologies are difficult to add to miniaturized solid-state receivers or transceivers. Marketing policies don't make a printed circuit board substitution upgrade possible. But, within the decade, the increasing costs of receivers will make this a very profitable market either for original manufacturers or for small specialty-electronics firms. One of the really big advantages of vacuum-tube equipment is that usually the normally spacious layout permits easy maintenance as well as "graceful" upgrading in the ham shack.

Several field changes that utilize new high-performance components and circuit concepts are described in this article.

Some of them are not even standard equipment in the latest off-the-shelf solid-state receivers. For example, a high-performance, wide dynamic range, doubly-balanced modulator with all of the adjustments factory-set within the device can be added very easily to almost any receiver. The popular Drake R-4B and R-4C radio receivers are used as typical examples of how older receiver performance can be upgraded by simple field changes. Greater local oscillator suppression, better crystal filter floors, and a wide dynamic range product detector are among the easy-to-make changes that produce a big difference in performance. None of the field-change improvements takes over 45 minutes to incorporate.

Low-voltage Power Supply

A miniature, 3-terminal, integrated circuit, 12-volt regulator can replace the high-voltage (150 V dc) drop-down sources while greatly improving the hum and rectifier hash noise. The lower source impedance of an electronic regulator can improve distortion problems. A big improvement for Drake equipment is the removal of the drop-down resistors and transformer which produce 15 Watts of heat. This improvement will increase the component reliability of the receiver, and will also reduce vfo drift.

Presently, the 11 volts is obtained through a power-dropping resistor from the 150-volt line. A reference source for the 14-volt line is obtained through another power-dropping resistor from the 150 volts. A capacitance-multiplying transistor circuit smooths the 14 volts, but the ripple output is still greater than 50 millivolts on many power supplies.

The three-terminal voltage regulator reduces the ripple and hash to less than 2 millivolts.

At a cost of less than $3, the change takes only 45 minutes to make. Refer to Fig. 1. Here are the procedures:

1. Install the 3-terminal LM340T-12 voltage regulator (manufactured by either TI or National) on the third mixer, V4 (6EJ7), shield just above and on the same side as pin 9 of the tube socket. Use a small general-purpose finned heat sink mounted under the integrated circuit tab. Drill a 9/32" hole and use 6-32 hardware.

2. Remove these parts:
Q2—EP-487, regulator transistor;
CR18/19—B565, rectifiers;
C201—20 uF, electrolytic capacitor;
R115—6,800 Ohm, 5-Watt resistor;
R116—5,600 Ohm, 5-Watt resistor. Note the location of the bottom hole (chassis end) where the resistor is removed, labeled point "A" in Fig. 1; you'll need it later.
The wire to C167Δ, 1000-uF electrolytic capacitor (marked C166 on some schematics).

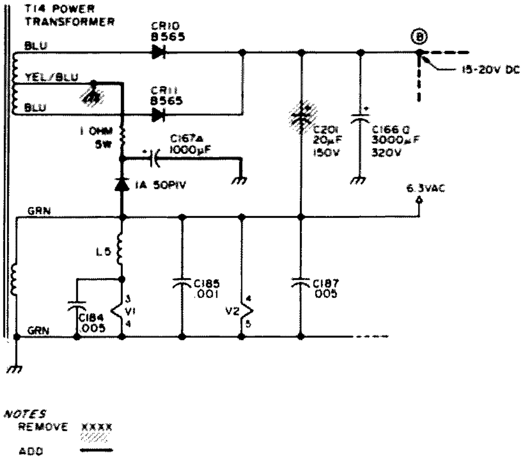

Fig. 2. If the low-voltage winding doesn't provide enough voltage to the integrated circuit voltage regulator, the 6.3 V ac filament winding can be used with a simple half-wave rectifier to boost the voltage.

Caution: Stay away from the upper holes where the power resistors were removed. Accidental connection to this 150-volt line can cause damage!

3. Wire point "B" at the dc input of the old Q2 regulator to the new regulator input, pin 1.

4. Wire point "C" at the dc output of the old Q2 regulator to the new regulator output, pin 2. (Ground is made through the integrated circuit tab.)

5. Jumper wire from the marked bottom hole of the old power resistor, R115 (6,800 Ohm), point "A" to the "+14 V" (now +12 V) bus point where all of the red wires are terminated. This step connects the 11 V line to the new +12 V line. The circuit impedance is now low enough to prevent any interaction.

6. Add a 2.2 uF non-polarized capacitor (25-volt minimum) across the filament socket as shown in Fig. 1.

7. Check the voltages listed in Table 1 after visually confirming the wiring.

If the existing low-

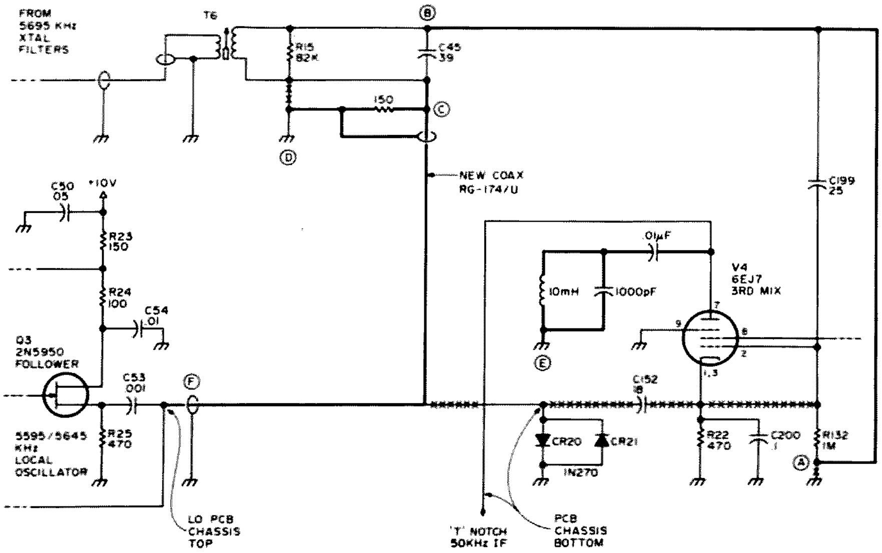

Fig. 3. Proper signal and LO feed and termination techniques are applied to the Drake R-4C receiver third mixer.

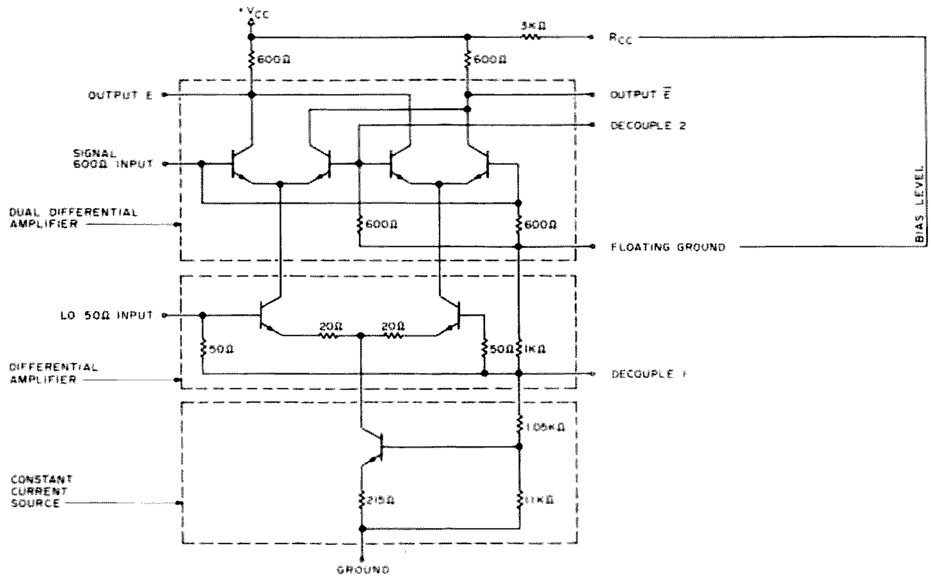

Fig. 4. Diagram of the ready-to-use TL442 doubly-balanced mixer/modulator shows the internal functions which require no external controls or additional circuitry.

voltage transformer winding doesn't provide at least 15 volts, then the 6.3 V ac section of the filament winding can be used to boost the voltage to the regulator. Fig. 2 shows how to bootstrap the 6.3 V ac filament line to the center tap of the low-voltage winding through the use of a simple half-wave rectifier. The unused C167Δ, 1000-uF filter capacitor provides sufficient filtering. The integrated circuit does the rest. If the voltage input to the regulator is too high, additional heat sinking may be required.

Mixer LO and Signal Feeding

Mixers are the first place where receiver performance falls short of our expectations. If the mixer is ahead of the filters, then third-order interference is created within the amateur bands. Specified as "dynamic range," this is probably the most stringent receiver specification. If the mixer is after the filters, then problems can still arise due to the same causes, except for one: The LO is not radiated back through the rf amplifier to the antenna to interfere with other radio services. And, if an audio filter is used for CW, then the dynamic range of the last mixer is not too important. However, when the LO is radiated back into the i-f or amplified without attenuation at the mixer output, then the probability that spurious responses in the receiver will be generated greatly increases. The same principles apply to the i-f signal driving the mixer, as far as reducing the output of this signal at the mixer output.

A modern solution available is to use doubly-balanced modulators to attenuate each signal at any input or output, with only the conversion signal appearing at the output. However, in practice, the bipolar balanced mixers I measured offer about 10-dB poorer dynamic range performance than MOSFETs and vacuum tubes under optimum circuit conditions. Then the only really strong case for a balanced mixer is where the signal or LO are so close in frequency to each other in the mixer output that a tuned circuit cannot discriminate against the amplified LO and signal input.

Balanced mixers do solve the spurious signal problem. However, many tests that I conducted with single versus dual-input circuits (such as a dual-gate MOSFET) have shown that the noise figure and dynamic range performance are about the same either way.

The primary factor in good mixer performance is a strong LO signal on the order of 250 mV for either a vacuum tube or a dual-gate MOSFET, fed either singly or with dual inputs. The dynamic range tends to be proportional to the gain of the particular device. Beyond these good design practices, an order-

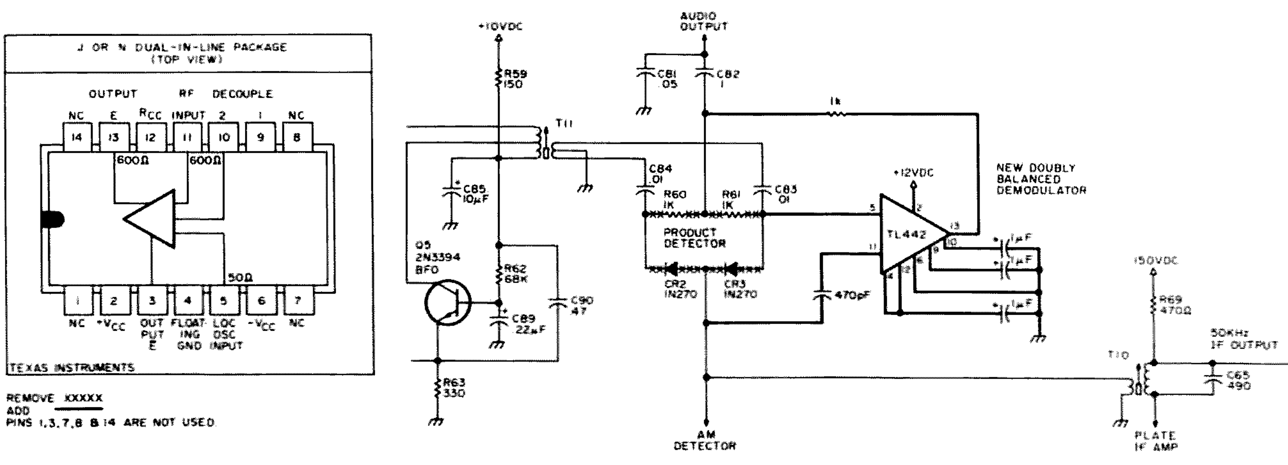

Fig. 5. A communications doubly-balanced modulator/demodulator is applied to the Drake R-4C receiver with a minimum of additional parts. No printed circuit board is needed.

of-magnitude increase in sophistication of circuitry is required.

The third mixer in the Drake R-4C was chosen to demonstrate how to apply proper feed and termination principles to a mixer. As a result, the LO and signal radiation was reduced. And, the crystal-filter rejection floor was lowered by reducing ground loop radiation. Fig. 3 shows the circuit before and after the improvements. Note that the original circuit provided a capacitive divider voltage step-up from the LO output at point "F" to the crystal-filter transformer at point "B" to enhance undesired radiation. Both the signal and the LO signals are terminated in several ground returns at the transformer, T6, grid-leak resistor R132, and limiting diodes CR20/21.

Good principles of mixer feeding were applied. First, the signal was fed with the grid-leak resistor in parallel with the coupling capacitor, thus eliminating this ground loop. Then the LO was fed in series with the signal transformer, T6. Therefore, the LO signal could not be increased, and, furthermore, the LO signal is not impressed across the secondary of the signal transformer, T6.

A 150-Ohm resistor is used to terminate and limit the LO voltage output while not enhancing harmonic generation. Finally, a tuned circuit is connected to the output of the mixer to reduce the LO and input signal by about 20 dB. As a result, the signal rejection floor of the crystal filter is reduced by more than 15 dB, and the broadband white noise is greatly reduced in the SSB mode while only slightly degrading the narrow-band CW mode of operation. Here is the procedure for incorporating this field change:

1. Disconnect the 1-megohm grid-leak resistor, R132, from ground at point "A". Bend it over and reconnect to the output terminal of the i-f transformer, T6, at point "B". It will be in parallel with the 25-pF coupling capacitor, C199.
2. Remove the 18-pF LO coupling capacitor, C52, from the printed circuit board on the bottom near the chassis to the grid at pin 2 of V4, the 6EJ7 mixer.
3. Remove the LO coax from point "F" on the LO printed circuit board on the top side of the chassis to the printed circuit board on the bottom of the chassis.
4. Separate the ground lug at point "D" from the bottom end of the i-f transformer, T6, pin by about 3/8 of an inch.
5. Connect the LO from point "F" (where the coax was just removed) with miniature coax through the same chassis hole, routing along the output (power transformer side) of the tube socket to the i-f transformer, T6. Connect the center conductor to the bottom terminal at point "C" of the transformer, T6. Connect the shield to the ground lug at point "D".
6. Install a new 150-Ohm resistor from the bottom end of the i-f transformer, T6, at point "C", to the ground lug at point "D".
7. Install the 50-kHz parallel-tuned circuit (10-mH miniature molded choke in parallel with a 1000-pF mica capacitor) in series with a 0.01-uF 500-volt disc coupling capacitor from the mixer, V4, plate, pin 7, to the ground lug (next to pin 9) below the power transformer at point "E".
8. Turn on the set after visually confirming the circuit wiring. Tune in a signal to zero beat and retune the i-f transformer, T6, for maximum signal.

Doubly-balanced Demodulator

Finally, a very high-performance communications doubly-balanced modulator is easily substituted for the dual-diode detector. The TL442 was specifically designed for communications applications by providing factory-preset null adjustments internal to the integrated circuit. Signal and LO balanced nulls are greater than 30 dB. In some of the R-4C receivers, the LO input to the first audio amplifier at the top of the volume potentiometer was about 100 millivolts compared with an audio component of just several millivolts. Fig. 4 shows a diagram of the Texas Instruments TL442 (old designation SN76514) integrated circuit. Design features:

1. factory-tuned null adjustments for both signal and local oscillator;
2. noise figure of approximately 6 dB;
3. typical conversion gain of 14 dB;
4. low standard-communication circuit input/output impedances with virtually no reactive components at HF frequencies; and
5. flat frequency response to 100 MHz, with tuning usable to 300 MHz; C_{in} = 3-5 pF and C_{out} = 10 pF.

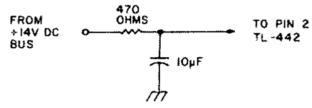

Fig. 6. Decoupling circuit required when 3-terminal regulator is not used.

UHF transistor chips are matched and the resistors are etch-trimmed in the manufacturing process to achieve balanced circuits. The IC actually consists of two cross-coupled differential amplifiers whose emitters are driven by a third differential amplifier. A constant-current source is connected to the bottom

Voltage	Location	Value before	Value after
Dc input	Regulator input, pin 1	17 V dc, 300 mV ac	16 V dc, 200 mV ac
Dc output	Regulator output, pin 2 and output bus	15 V dc, 42 mV ac	12 V dc, <1 mV ac

Table 1.

(third) differential amplifier. This device works best with 200-300 mV local oscillator injection, and performs without significant overloading up to about 500 mV of i-f signal input. Hence, the signal handling characteristics of the TL442 are as good as or better than most vacuum-tube converters in current receiver designs.

For example, a two-tone test with 20-kHz separation showed that the third-order intermodulation products 20 kHz above the upper frequency signal (or 20 kHz below the lower frequency signal) were more than 75 dB below the two-tone signal level. Since the tests were conducted at 6 MHz, the performance would be expected to be somewhat better at the 50-kHz i-f frequency. Normally, the dynamic range of the audio detector is not too important as long as distortion is reasonably low, but, when audio CW filters are used, dynamic range becomes important again.

An excellent description of the TL442 is also available from Texas Instruments.[1] Cost of the doubly-balanced mixer is about $3.00, an excellent trade-off when you consider that no external tuning or bias components are required for this application.

The application of the doubly-balanced demodulator to a receiver is shown in Fig. 5. When a 3-terminal voltage regulator is not used, the decoupling circuit shown in Fig. 6 may be required. Therefore, the load on the last i-f transformer is still maintained at about 4000 Ohms and the avc action is not affected. Normal i-f input to the IC with the avc "on" is about 10 to 30 mV. The LO is connected to the 50-Ohm IC input to reduce loading on the 50-kHz local oscillator. About 125 mV are available at the IC input. The procedures for installation of the doubly-balanced demodulator are:

12 V dc regulator
LM340T-12
Heat sink, Calectro CAT No. J4-866
Hookup wire
6/32 x 1/2 screw
6/32 lock washer
6/32 nut
2.2-uF, non-polarized capacitor
Note: for early R-4C receivers, 1 Amp 50 piv diode (not supplied)

Third mixer
10-mH choke
0.01-uF disc capacitor
1000-pF silver mica capacitor
150-Ohm resistor
12" RG-174/U coax

Doubly-balanced demodulator (product detector)
TL442
3 1.0-uF, 25 V dc tantalum capacitors
1000-Ohm resistor
470-pF disc capacitor
Hookup wire

Audio distortion correction
(thanks to R. J. Sherwood, *Ham Radio*, Dec., 1977)
0.0015-uF disc capacitor
4700-Ohm resistor

Cost: $15.00. Add 5% tax in Texas: 0.75. Shipping/handling: 0.60. Total ____. Mail check or money order to: Sartori Associates, W5DA, PO Box 2085, Richardson TX 75080.

Table 2. As many parts are hard to obtain, the author will supply parts as listed here.

1. Mount the IC "dead-bug"-style (leads up with double-stick tape) on the chassis between the bfo transformer, T11, and the bfo tuning capacitor. An alternative mounting location is the back side of the bfo capacitor. Then simply wire in the leads to the printed circuit board.

2. Connect bias pins 4 and 12 together.

3. Connect pin 6 to a ground point. Then wire all three of the bypass capacitors from pins 4 and 12, 9, and 10 to the same ground point. The values of the 1.0 uF capacitors are not critical, but must bypass both audio and i-f signal components. Miniature ceramic or tantalum electrolytics with at least 10 V dc breakdown are adequate. Connect pin 2, the 12-volt input, to the 14 V dc bus line.

4. To connect the LO input, first lift the 1000-Ohm product detector resistors (R60, R61) off the printed circuit board. Then, connect a wire from one of the C84/R60 or C83/R61 junctions to the LO input of the IC at pin 5.

5. To connect the i-f input, lift the product detector diodes (CR2, CR3) off the printed circuit board at the i-f input junction point. Connect a 470-pF decoupling capacitor from this junction point to the IC i-f input, pin 11.

6. Connect output, pin 13, to the junction of old R60/R61 resistors. The result of the doubly-balanced demodulator addition is cleaner audio over a much larger signal range, particularly in the avc "off" position. Further, the frequency tuning tolerance for SSB signals is wider. Audio output is increased about 5 dB as a by-product. The low output impedance of the integrated circuit makes the audio amplifier less susceptible to hum and other spurious pickup.

Acknowledgements

Assistance and suggestions in applying and evaluating the performance of these receiver improvements are gratefully accorded to Jack Whitaker W5HEZ, Rob Sherwood WBØJGP, and the several members of the Richardson Wireless Klub. I can supply a parts kit for these changes at a cost of $15.60 postage paid.■

References

1. Balanced Mixer Application Notes, Section 6.6 of *Linear and Interface Circuits Applications Book*, Linear Circuits Applications Dept., Mail Station 964, Texas Instruments, Inc., Dallas TX 75222.
2. *Ham Radio*, March, 1977, "Drake R-4C Modification for Improved Audio," G. R. Bailey WA3HLT.
3. *Ham Radio*, December, 1977, "Receiver Problems and Cures," R. J. Sherwood WBØJGP and G. B. Heidelman K8RRH.
4. *Ham Radio*, December, 1977, "Crystal Filter Converter," H. J. Sartori W5DA.

The audio improvement offered by reference 3 is most important. However, in many receivers, parasitic oscillations occur in the several-hundred-Hertz range, and the addition of a 0.0015 uF capacitor across *resistor* R83 *in* the audio amplifier did not entirely eliminate them. To completely correct the phase error in the feedback circuit, eliminate an undesirable peak in the audio frequency response, and eliminate the spurious oscillations, a 4700-Ohm resistor needs to be added in series with the 0.0015 uF capacitor across resistor R83.

A Solution to the Home-Brew Housing Shortage

—building a box for your next project

Custom configurations are no problem.

Weldon I. Hogie W0IHI
615 E. 7th Street
Northfield MN 55057

One of the problems encountered by the home-brew addict is how to package his latest project. With a well-stocked junk box, he may find that the cabinet he prefers costs more than all the parts put into it. Also, even if cost is not a concern, the closest-size commercial cabinet may not have exactly the most desirable configuration.

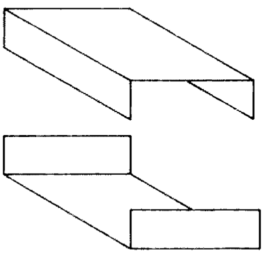

Fig. 1.

It is not too difficult to bend up your own simple cabinet with two U-shaped pieces (double clamshell rotated 90°) as shown in Fig. 1, but there is a limit to accessibility once everything is installed. If a printed circuit board is mounted above the inside of the bottom clamshell, for instance, the board must be removed or tilted away to get at the trace side. Also, unless heavy-duty bending equipment is available so that you can use quite thick material, rigidity leaves much to be desired. This article proposes a method of custom-building your own enclosure in any dimension or configuration desired. The main features are complete accessibility to the interior, excellent rigidity when the covers are removed, and reasonable cost.

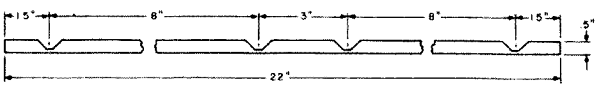

Fig. 2.

Let's Build One

To use an example: Let's build an enclosure 3″ high by 6″ wide and 8″ deep, suitable for an electronic counter, for instance. Obtain a 5- or 6-foot length of aluminum angle material which is 1/2″ on a side and 1/16″ thick. This aluminum angle is generally available in hardware or building supply stores in a display containing various types of aluminum rods, straps, tubes, angles, and decorative sheets.

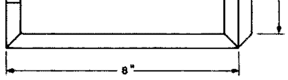

Fig. 3.

Cut two pieces, each 22″ long. Scribe and cut four 90° notches in one side of each of the 22″ lengths, as shown in Fig. 2. Use a hacksaw to cut and a file to smooth up the notches. Now, carefully bend 90° at each notch so you end up with two identical rectangular pieces like the one shown in Fig. 3. These are the side rails. You can bend this material only once, so do it right the first time. You may want to practice on some short lengths of angle before starting on the 22″ lengths.

Cut two pieces of .06″ aluminum sheet 3″ by 6″ for the front and back panels. (Or cut 3-1/16″ by 6″—see *Note* in the section "Cover It Up" below). You could use .05″ sheet, but .06″ is surprisingly more sturdy and not that much more difficult to work with. Fasten the 3″ by 6″ plates to the side rails as shown in Fig. 4 and you

have a very sturdy enclosure ready for stuffing.

The leftover lengths of aluminum angle can now be used to make mounting surfaces inside the enclosure by attaching to the side rails and front and back panels. By cutting off short 1/2" lengths of the angle material, handy little mounting angles can be made to help in fastening the mounting surfaces. When fastening to the rails, use 4/40 or 4/36 flathead screws, countersunk, in order to retain the flat outer surfaces of the rails to help in fitting covers. (Handy hint! Obtain a 1/4" machinist's center drill used by metal lathe operators. It will drill a no. 4 clearance hole and countersink it in one operation. I always keep one handy on the bench, mounted in a handle, for quick deburring and countersinking.)

Larger Enclosures

Look for 3/4" by 1/16" or 1" by 1/16" angle material. Larger enclosures can be fabricated using this wider stock, and good rigidity will still be maintained. The 3/4" by 1/8" angle should also be considered if an exceptionally strong enclosure is desired. While the 1/8" angle is too thick to notch and bend as with the 1/16", suitable lengths can be cut to 45° on each end and fastened together with 90° angle plates or brackets placed inside the rails as shown in Fig. 5. I suppose, for very large enclosures, the rails could be welded up using steel angle material of suitable width and thickness.

Sloping Front Panel

By reducing the angle of one front notch and increasing the angle of the other, rails for a sloping front panel can be made. Caution! The rails will no longer be identical; you must make a right and a left rail. The dimensions and angle of notches can be determined mathematically, but it is simpler to draw out the side profile of the proposed rail and take the dimensions and angles from the drawing as shown in Fig. 6. Don't forget that now you must make the front panel larger than the back panel, to cover the longer sloped distance at the front.

Card Rack Enclosures

By using the fabricated rectangles as front and back rails instead of side rails and supporting them with side panels as in Fig. 7, an enclosure can be made with the top, bottom, front, and back accessible. By hinging the front and back panels, you have access to remove cards from the front and to service socket bus lines from the back of the enclosure. Piano hinges, which are available in different lengths, can be cut to size and are very sturdy. An enclosure for an S-100 bus system could be made up using a hinged top cover.

By now you can see the possibilities are virtually unlimited.

Cover It Up

A simple way to make a cover for the 3" x 6" x 8" enclosure described earlier would be to first make a bottom cover. Make sure this bottom plate is flush all the way around and fasten it to the rails with tapped or self-tapping screws pushed through rubber mounting feet. Or you can fasten the plate normally and use the self-stick feet that are available. *Note: If you make the front and back panels 1/16" higher than the 3" required, they can be offset down, when fastened, to cover the edges of the bottom plate when installed, to give a cleaner look.*

Bend up a clamshell to cover the top and sides as shown in Fig. 8. Don't be afraid of bending aluminum or light steel if you don't have a metal brake. A 4-foot length of 1-1/2" steel angle obtained at a junk yard, cut in half and held in a bench vise, works fine. A plastic-tipped hammer helps to sharpen the bends without denting the material. (A regular hammer and a wood block will do the same.) If you should want a semi-rounded look, the side rails can be rounded slightly with a file to soften the sharp edges. When bending wide surfaces with your homemade brake, use the vise in the middle and C-clamps at the ends to hold the angle pieces together. When making bends too deep for the vise, use an angled C-clamp at one end and the vise at the other.

If inadequate ventilation could be a problem, here is one approach. Drill holes in the bottom plate to let cool air enter. Make the clamshell cover about 1/8" or so higher than needed and fasten it up on the side rails so there is a gap between the top of the front and back panels and the cover. Warm air can escape through these gaps Make the cover 3/4" longer than the rails and overlap 1/4" at the rear and 1/2" at the front. The air gaps will not be noticed. Angle the edges of the cover at the front so it extends 1/2" at the top and is almost flush at the bottom. This gives it an attractive light-shield effect.

Concerning ventilation, if you have hesitated to drill holes in covers because you can't do it cleanly, read on. First determine the size hole and the spacing between holes which look attractive to you. Drilling out small scrap pieces of material on a trial basis might help you to decide. Carefully measure and draw out on the cover a grid of squares to locate the holes. Start from the center and work out so symmetry is retained. Use a center punch to make a

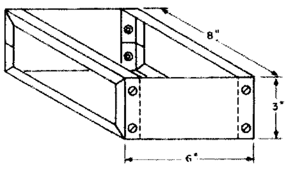

Fig. 4.

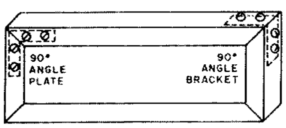

Fig. 5.

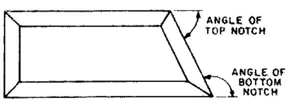

Fig. 6.

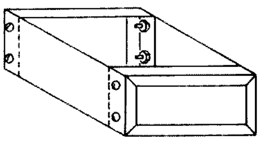
Fig. 7.

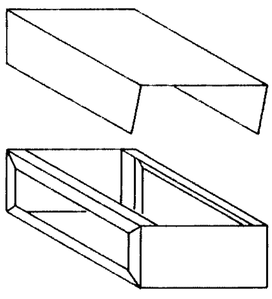
Fig. 8.

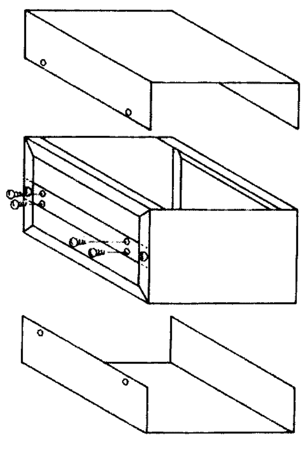
Fig. 9.

mark at the intersection of the squares of the grid. Use a small drill bit, 1/16" or so, to drill a pilot hole at each punch mark. The care with which you mark and drill the pilot holes determines the professional appearance of the end result.

Drill out the pilot holes with a drill the next size smaller than the drill you selected for the final hole size, then drill to final hole size. Keep this last drill handy. Sand down the burrs on the holes using the sturdiest sanding material you can find. The cloth-backed sanding belts from a small belt sander are perfect. Use a wood block to back up the sanding material. As the burrs are sanded down, push the drill bit through the holes to clean out the residue and sand some more. When the burrs are gone, use a finer grade of sanding material until the surface is smooth. Always use a backing block when sanding or the holes will be dished out. Keep pushing the drill through as you proceed to clean out the holes. You will end up with holes with perfectly clean edges, looking as though they were punched out.

A final word on covers: A double clamshell is a little more difficult to fit, but, as shown in Fig. 9, it may be more commercial looking. A piece of angle or strap material is fastened in the middle of the rail as shown and the two halves fastened to this when assembled. The popular bail-type handle also can be attached at the point of balance, if desired.

Dress It Up

Consider the use of a false front panel or escutcheon. When you mount the regular front plate to the side rails, use countersunk flat-head screws. If any other mountings or partitions are fastened to the front plate, countersink these also. A false-front panel will now cover up all the screw heads. This panel can be made of very thin material, painted attractively, or covered with one of the many self-stick vinyl products now available, such as wood grain. You may want to use the old trick of etching aluminum in a lye and water solution to produce a soft, satiny look. Use rub-on lettering for a professional appearance. If there are not enough switches or controls to hold the false front in place, use double sticky tape or dabs of silicone sealer (RTV).

If you are photographically inclined, you could draw up the panel, letter it, and photograph it. The lettering could be rub-on letters, carefully printed hand-lettering, or the product of a LeRoy lettering set or a Selectric typewriter. Make a print the proper size and fasten it to the false front with rubber cement. If your drawing is made on a black surface with white lettering, the print can be purposely underexposed to a medium grey and then toned to almost any color. (Ask at a photo store for toner of the color desired.) Spray lacquer applied to the print will keep it protected and looking new.

Several years ago I built my own electronic counter and used this type of enclosure. Since then I have made many changes and additions to the counter in order to keep up with the state of the art, and it has been a real pleasure to work on it. I can poke into it from all angles and add or remove boards at will. I can highly recommend that you try this method of enclosure construction for your next project.■

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How Do You Use ICs?

—part XI

Battery power amps.

The article on linear preamps probably left a lot of battery-power freaks with their tongues hanging out. It bothered me, too. There was a nice simple way to get the preamps to work below nine volts with good margin, but only one power amplifier would go as low as nine volts—the LM380CN mini-DIP—and it was going to be critical at that.

There had to be a way; there's too much of a gap there. A little more digging in the linear book came up with a real humdinger.

I think you are going to like the LM386. It has a rated output of about 500 mW—which may not seem like much, considering what I said about the LM380CN. It, too, is in a mini-DIP package, but there are a few things that this one does that really make a difference. To start with, the IC works over a range of 4-12 volts. That takes care of your nine-volt battery just fine, and it can't be matched at all by the LM380CN or its big brother, and more than makes up for the slight output.

Even this should not be downgraded. The IC will handle a 4- to 16-Ohm speaker or set of phones, and, with phones, that 500 mW will pierce your ears for you.

There is, of course, one little drawback; there had to be. This is the maximum supply voltage. You can't exceed 15 volts source. This is rather close to the 13.8 volts on which your car or truck is supposed to run. It is possible that a surge might exceed that much, or some trouble might result in more voltage than the device can handle. It would appear a simple design problem, however, to include a zener to limit the voltage swing or a regulator circuit to handle it. This would be needed only for mobile use or where there was some possibility of voltage surges which could cause trouble. I don't see it as a serious problem if you take basic precautions.

Fig. 1 shows the device and its pinout.[1] This looks a whole heap like all the other amplifier ICs, but there are some differences.

Fig. 2 gives the hookup, another minimal-part circuit. There were a few subtle differences noticed with this IC compared with the others. The 0.05-uF cap and the 10-Ohm resistor do the same job as with the others. They suppress a high-frequency oscillation which may come. The output cap value is not critical. The larger value passes

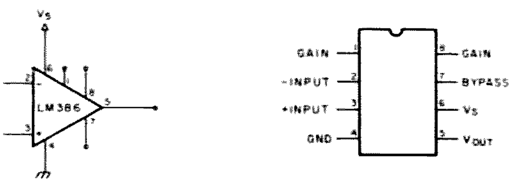


Fig. 1. LM386 low-voltage audio power amplifier.

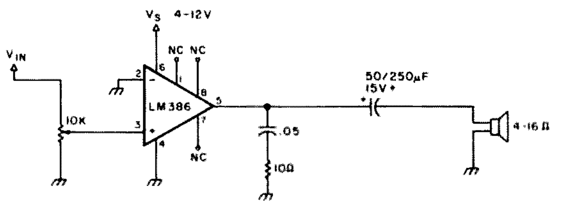


Fig. 2. Basic LM386 audio amplifier circuit.

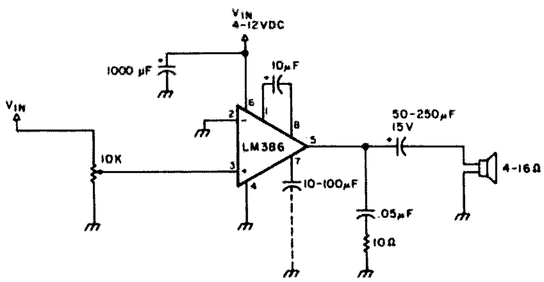


Fig. 3. LM386 high-gain circuit.

the low tones, and smaller value will cut them off, which is acceptable for communications use. The 10k volume control is not a critical value, but there should be something there, even a fixed value. With some configurations, there will be instability without an input resistor. The pin seven bypass may help in some applications, but I did not notice any gain in circuit performance with or without it.

Up to this point, we just about have a repeat of the LM380 series of amplifiers except for the voltage rating, but the LM386 has one more important trick up its sleeve. Notice that there are two pins labeled gain: pins one and eight. The circuit given here has a nominal gain of 20, which is about the same as the LM380 series. Using the gain pins can give you gain up to 200. The hookup is shown in Fig. 3. The 10-uF capacitor bypasses an internal resistor which limited the gain. With the 10 uF you get the full 200 or so gain. With a resistor in series, you can set the gain where you want it.

Fig. 4 shows that part of the circuit. The 1.2k value was shown in the application notes as giving a gain of about 50.[1] By ear, a 2200-Ohm resistor will give about the same gain as no RC network at all. The nearest variable you could use should be a 2.5k- or 5k-linear taper potentiometer. This would give you an adjustable gain option to play with. Remember that the pot gets hooked up backwards. To increase the gain, you decrease the resistance in the circuit.

Using this high-gain option has its price, too. That 1000-uF Vcc bypass is something new. I found that with this IC, a lot of supply bypassing is needed to avoid stray oscillation.

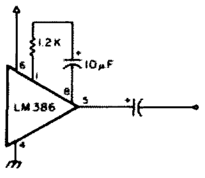


Fig. 4. 50-gain circuit.

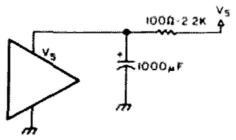


Fig. 5. Brute force bypassing for preamps or amps.

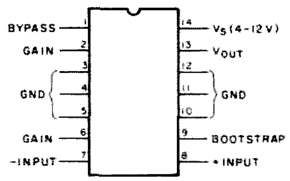


Fig. 6. LM388 1.5-Watt audio power amplifier.

This may be due to using the long power leads and test leads, but this is a high-gain IC. Even in the low-gain configuration, you may need this much supply bypassing as well as the input resistance.

Once the circuit is tame, the results are worth the effort; for sheer performance it is hard to beat. It combines in one package an effective audio-power amplifier with the sensitivity of the audio preamps. The circuit is simpler than the two separate stages would be and works just as well.

There was a bit too much measuring with the audio preamps, so this time let's stick to how it sounds. The power amplifier part actually sounds the same as the other power amplifiers, in its low-gain setup. It has a nice hefty output to your ear and should do any communications job easily. The sensitivity of the stage at low gain is about the same, too. This, by itself, is really quite sensitive. Using the mike, I was getting just about the same usable input to my ear as with the preamps and the high impedance phones of that test setup. When I went to the high-gain setup, things really got to be interesting. Once the circuit got tamed, it really took off in performance. That high-gain setup is *really* sensitive. I had no problem picking up background noise to my heart's content, but a nearby sound would scramble my brains. That thing is *loud*.

It has reinforced my feeling that there is little need for the separate preamp for most ham use. This one

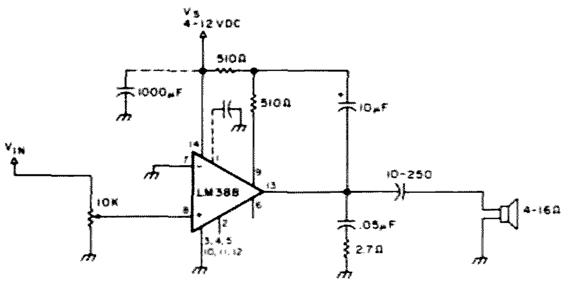


Fig. 7. LM388 basic circuit.

IC can perform the function—if needed at all—and much easier, by itself. It did bring up one serious hindsight view, however. When I did the preamp series, I used the bypass values on hand to tame the circuits. Beyond a certain point, they did not work. They were fairly low values reflecting what the application notes showed. At that time, I did not have any 1000-uF capacitors on hand. It may be that some of those high-gain stages which I found to be too unstable can be tamed with brute force bypassing.

Since the preamp current is slight, there is little chance of serious voltage drop, so you also can try *adding* a series resistor in the V_S lead shown in Fig. 5. A value of 1k or 2.2k might be a good starting point. This might tame some of those wilder circuits for serious use. I still don't think you will need all that gain, but if you do, it might be worth a try.

The LM386 appeared—by ear—to give the same functional sensitivity as the best of the preamp circuits given. They were in the 40-dB class. A gain of 200 is 46 dB.

There is one other IC in this family to watch for, the LM388, which is the big brother of the LM386. It is a 1.5-Watt, 14-pin IC power amplifier. (See Fig. 6.[2]) It is slightly more complicated to put together. The basic hookup is shown in Fig. 7. Notice the two 510-Ohm resistors and the 10-uF bypass. The high-frequency bypass circuit uses the values given also for the LM380—0.05 uF and 2.7 Ohms. Unfortunately, I was not able to get this IC from my dealers. I have never seen it or the LM386 listed, so you will have to write and see. The LM386 is available from James Electronics for $1.10.

Ordinarily I do not like to show a circuit without having tested it, but the power amps have worked so well that I think it is safe to do so. It gives you the basic information about it,

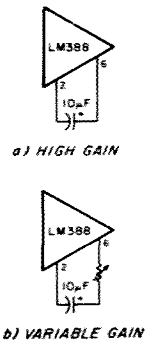


Fig. 8. LM388 gain control.

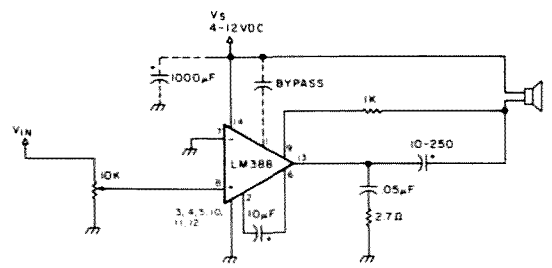


Fig. 9. LM388 load returned to V_S (gain 200).

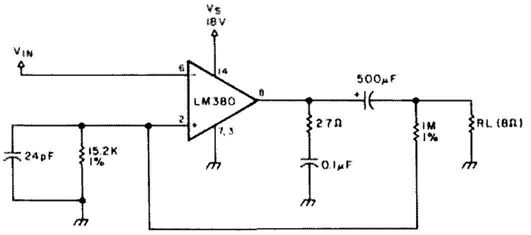


Fig. 10. LM380 high-gain circuit (not recommended!).

should they become available. The 510-Ohm resistors should be thought of as specific values in this case. They also are easily available from Jameco and other sources. The 10-uF value also is common.

This is the basic low-gain hookup—the same as the other, except for the power. I do not see a need for this for most purposes. If you are running on batteries, it means quite a bit more drain even at rest. This was a new IC, as of 1975 when my manual was printed, and there was little information included with it. I do not have the exact specs. It also has the high-gain configuration available with the addition of the capacitor between pins 2 and 6. There should be no reason why this should not be made variable as was the other. (See Fig. 8.)

There was one other circuit shown which was different from most presented. This was a high-gain circuit, but the load was returned to the V_S pin. (See Fig. 9.) I can't think of any reason why this should be a particularly desirable feature. It looks as if it might be possible for dc current to flow through the speaker winding, which might not be good for it. The manual did not say why this feature was included. My feeling would be to stay away from this circuit unless you know why you wanted it.

These ICs seem to be two-up on the LM380 series of amplifiers. They are low voltage and can be made higher gain. There is a way shown to turn the LM380 into a high-gain circuit. The specs say that, in theory, you can have gain up to 300, but they say this is hard to do and still keep it stable. The basic hookup is in Fig. 10.[3] Notice some extra parts in the basic LM380 circuit. The tip-off should be obvious. Those are one-percent resistors. I don't like one-percent resistors. Fortunately, I did not have any to try. I used a pair of resistance substitution boxes and clicked away. Very quickly, the circuit's capability showed up. For experimental use or breadboarding, it looks like a real bummer.

Without the extras, it is quite sensitive, but with them, the hum gets worse. I would assume it is the test leads. Even not counting the hum, however, the circuit didn't add anything. There was no noticeable increase in usable gain when tried with the mike input hookup. In fact, the sensitivity seemed to go down, and that's not counting the times it went into oscillation or just cut off. Even the addition of the big bypass capacitor did nothing to help.

Another bad feature of this circuit is that as you apply positive feedback to try to boost the gain, you also draw more current with the IC. This is not the healthiest thing for an IC to do. I don't think I permanently damaged any, but I wouldn't bet on it since some of them got hot to the touch. It is supposed to have built-in thermal shutdown, but why go asking for troubles like that? Stay away from this one.

I don't know why the circuit did not appear to work with any range of values tried, but that should be an indication that it is not suited to the reliable breadboard category that this series is based upon. Still, we have added one more reliable IC to the bag of solid-state tricks that are available: the LM386. It has its own strengths and weaknesses, but the battery-power option and the extra sensitivity if you need it make it a strong choice when you are planning a circuit.

Among all the linear ICs given so far, you should have something that will fit the requirements for almost any of the common audio amplifier uses. The tested circuits may not be the optimum achievable, but they should cut down on the amount of cut-and-try needed to get something that works for you. ■

References

1. *Linear Integrated Circuits*, National, February, 1975, pp. 5-51 to 5-54.
2. *Ibid.*, p. 8-2.
3. *Linear Applications*, Volume I, Radio Shack, February, 1973, Sec. AN69-7.

✓ Reader Service—see page 195

Customize Your HT144B

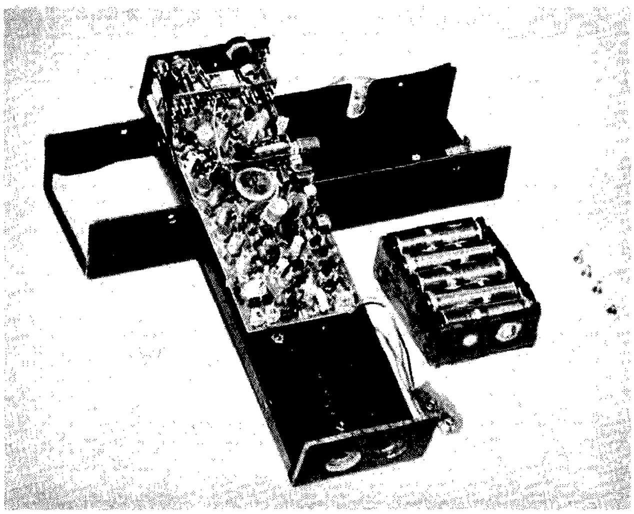
—some nifty mods

Total enjoyment of 2m.

L. Z. Sajor W2KGV
767 Lomas St.
Port St. Lucie FL 33452

Many hams have built the VHF Engineering 2 meter HT144B kit, which has proven itself an excellent handie-talkie. Here are modifications that will make it easier to service and use, therefore enlarging your total enjoyment of 2m FM. Described will be how to:

1. Modify for simplicity of crystal changing and repairs.
2. Add a "drop-in" battery charging facility.
3. Provide for an external microphone and earphone.
4. Replace the antenna with a rubber ducky.
5. Add a touchtone™ pad.



The HT144B open for inspection.

Difficulty in changing crystals is probably the only drawback of an otherwise well-designed handie-talkie, so I will start with that modification. First, disassemble your unit, removing the antenna, the printed circuit chassis, and the four standoff spacers, disconnecting any impeding wires as you go. File down the sides of two of the spacers, as shown in Fig. 1. Mount these two spacers, orienting the filed surface outward, directly to the PC board's top two holes, using lock washers and some nail polish as cement to hold the spacer securely. Mount the remaining spacers in the other two holes of the chassis in the same manner. Now, future removal of the chassis to change the crystals will only require removing the screws from the front of the case and sliding the chassis back, eliminating the twisting, clumsy maneuver previously required due to the interference of the threaded studs mounted on the side flange of the case front. Do not reassemble the unit as yet.

Now let's get to the "drop-in" battery charging feature. First, determine if you have at least a 3/16-inch space between the bottom inside of the HT and your battery pack. If not, then obtain a battery carrier that will allow you the space. Disassemble those parts of your unit still remaining that would interfere with unobstruct-

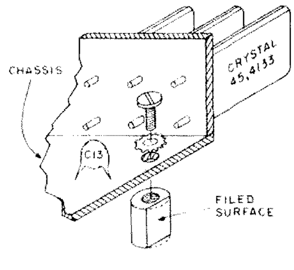


Fig. 1. How mounting studs are filed and oriented.

ed drilling of the case. Drill or punch out two ¾-inch holes as shown in Fig. 2. Next, fashion a piece of 1/16-inch-thick insulating material to fit the entire bottom inside of the case. Place it in the bottom and scribe thereon the location and outline of the holes you just made. Drill a 3/8-inch hole in the center of each scribed area. Secure this piece in place with cement or thin double-faced adhesive.

Next, we modify the battery holder. For this, you can etch a piece of one-sided copperclad PC board in the pattern and dimensions of Fig. 3 or cut out the design from thin copper sheeting.

Now, lightly "flow-tin" some solder onto the copper to provide better corrosion resistance (silver plating would be nice, if you have the facility). Affix the PC board or strips to the battery holder with cement or double-faced adhesive (to the side nearest to the snap connectors). Solder wire leads from the strips to the connectors, using care not to defeat the snap action and, more so, not to melt the plastic of the battery holder. Since this plastic melts easily, a dish of cold water for dunking immediately after soldering is a helpful precaution.

You should now have a snug-fitting battery pack when the HT is reassem-

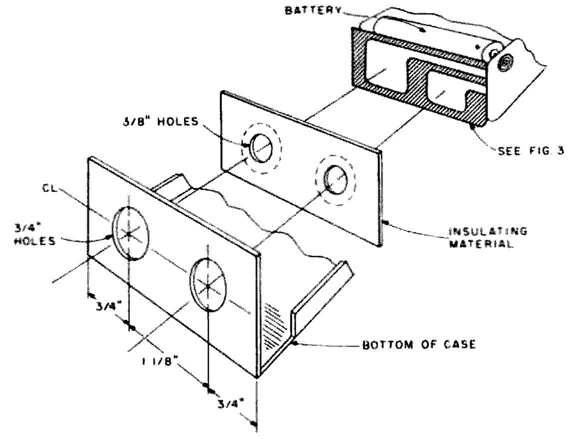


Fig. 2. "Drop-in" battery charging assembly detail.

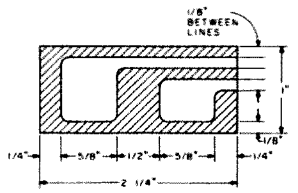


Fig. 3. Battery charging contact strip.

bled. If not, a simple cardboard shim between the battery pack and the circuit board is called for. Looking at the bottom of the HT, you should be able to see the contact strip material through the holes on the insulating board, which will be insulating them from the case by a circular area at least 1/8 of an inch wide. Paint the positive contact insulated area with red nail polish for identification.

Since it will no longer be needed, the charging socket at the top of the HT is removed and the holes used for the external mike and earphone jacks and, as a bonus, for a small LED to indicate a power-"on" condition (see Fig. 4 for layout). The LED is especially valuable, as the switch on the volume control can easily come on without enough audio being present to warn you that the battery is draining. The LED drain is minimal. Solder a "U"-shaped piece of solid #22 wire to the cathode of the LED and a 330-Ohm resistor to the anode (see Fig. 4 for configuration). Solder the other end of the "U"-shaped wire to the metal frame of the channel switch in a position that will allow the LED to slide easily into the hole left by the battery charging jack holding screw. Now, route the resistor up over and down toward the on/off switch and solder it to the proper contact so that, when the switch goes on, the LED will light.

At this point, install the microphone and earphone jacks, using closed-circuit types. Use a miniature phone jack for the microphone and a subminiature one for the earphone. Use shielded wire for the connections, as shown in Fig. 5. Wiring it in the manner shown will enable you to use the internal speaker-mike as usual, but have the convenience of using an external microphone-earphone assembly if you wish (see photo).

The Rubber Ducky

The installation of the rubber ducky is simplicity itself. Most easily obtainable and priced right is the Radio Shack #20-178 VHF. If you opt for this antenna, you can use either a subminiature phone jack or an old-fashioned pin jack. Be sure that the center contact of the jack is insulated from the case. Use shoulder washers if necessary.

Now, dig into your junk box for an old 7- or 9-pin tube socket and cannibalize it for one of the pins. It should be one that will serve as a single-pin socket for a number 16 or 18 solid, tinned copper wire. This pin is then soldered to the proper contact of the antenna jack. A 2-inch length of the solid wire mentioned above is now inserted into the pin. Slide a piece of insulating tubing about 1¼ inches long over the wire. The wire is routed straight down to the push-to-talk switch and then at right angles to the switch's

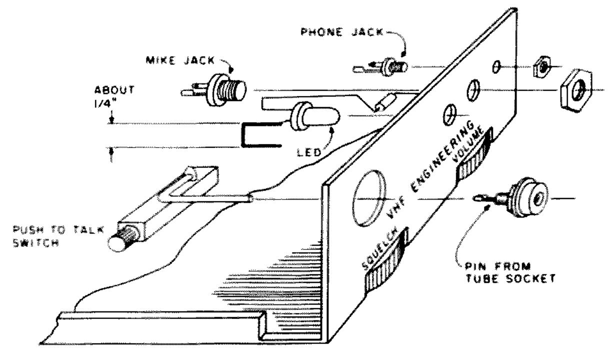


Fig. 4. Antenna and microphone plus speaker jack assembly detail.

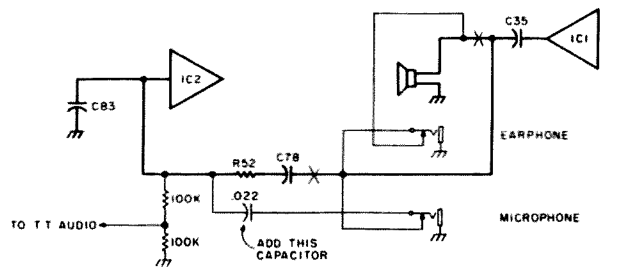


Fig. 5. Original circuit of HT 144B is in heavy lines; the modification is in light lines.

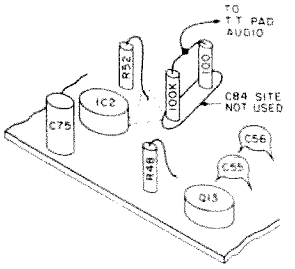


Fig. 6. Touchtone connection point showing resistor network positioning in C84 position.

antenna change-over contact. Solder it to the contact. This lead dress is important to prevent feedback. You now can avoid the chore of unsoldering the antenna connection every time the chassis is removed for crystal changes or repairs. See Fig. 4 for details.

The Touchtone Connection

By using one of the slim touchtone pads, such as one made by Barber Corp., the pad can be mounted on the outside of the HT without really adding to the bulk. If you cement the pad to the HT, you then need only one hole for the wires. Alternately, you can bolt it to the HT using small screws, but be careful that they do not intrude upon the space available for the battery carrier. The audio from the pad will need to be attenuated by a resistor network of 100 and 100k Ohms. There is a tailor-made place for the network on the chassis in the place left vacant by the unused capacitor, C84 (see Figs. 5 and 6 for circuit and layout).

Final Touches

Before buttoning up your HT, make the hole used for the push-to-talk button into a slot by cutting away the material between the hole and the edge. A nibbler does this more neatly than a hacksaw. In either case, smooth the edges, round them off slightly, and touch up the bright aluminum with flat black paint. You will now be able to remove the cover of the HT without needing to remove the push-button, which often becomes loose from frequent removals (see Fig. 4).

As a final touch and to give a nicer feel to the HT, I applied an imitation leather material to the back of it. I did not slot the push-to-talk button hole in the material, but punched out the hole and cut a slit from the edge to the hole. The stiffness of most materials will yield enough to permit passage of the button on removal or installation and yet maintain a closure at other times to give a neat appearance.

With the foregoing features installed on my HT, I use it in comfort every evening on the commuter train by holding the HT on the windowsill. With the external Plantronics headset which requires very low voice levels, there is no disturbance to fellow passengers, but it does generate a great deal of interest among them. During the several transit delays due to weather, fire, and accidents, it was comforting and useful to have the HT to advise the XYL of my homeward progress or lack of it. Autopatch or the good offices of fellow hams on the repeaters in the area provided the link. In fact, the XYL monitors the repeater for the 20 minutes prior to our usual arrival time, and, by dropping the right cue words in our QSOs, such as "This is W2KGV mobile 2 on the ConRail at White Plains station," she knows when to leave for my station to pick me up. Very convenient. ■

Reader Service—see page 195

Mark Forbes WB9PHM
1009 Beech
Normal IL 61761

Ultra-Simple CMOS Logic Probe

—a single IC does it all

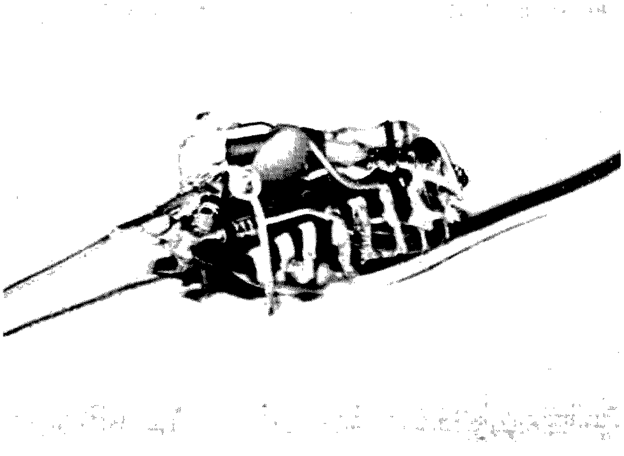
Make sure your troubleshooting is on target.

When it comes to troubleshooting digital IC projects, a logic probe is indispensable, and, with so many construction projects employing digital technology, almost anyone can use one. Most commercial probes represent two problems in the eyes of hams and hobbyists: Commercial probes cost from $25 upward; and a given probe generally works with only one type of logic (TTL or CMOS). This article describes a design for a logic probe which meets all requirements for troubleshooting digital circuits, and solves the two problems mentioned.

The circuit shown in the schematic (Fig. 1) is fairly simple. The gates are CMOS, which has several advantages in this application:

1. CMOS gates have a very high input impedance and will not load the circuit being observed.
2. CMOS may be powered from 3 through 15 volts, so that the probe may be used in both CMOS and TTL circuits.
3. The supply current for CMOS ICs is extremely small, so the probe may be powered parasitically from the circuit under test—even from low-powered battery circuits.
4. CMOS gates are easily made into "one-shots" (which lengthen out pulses to make them visible).
5. CMOS has self-limiting current sourcing and sinking, which allows LEDs to be driven without the use of series resistors.

The circuit is built using five inverters, a NOR gate, a resistor, three capacitors, and three LEDs. This configuration brings another advantage. Motorola has



This is a closer view of the probe showing the method of using the IC as the component base. The capacitor lead is used for the probe tip.

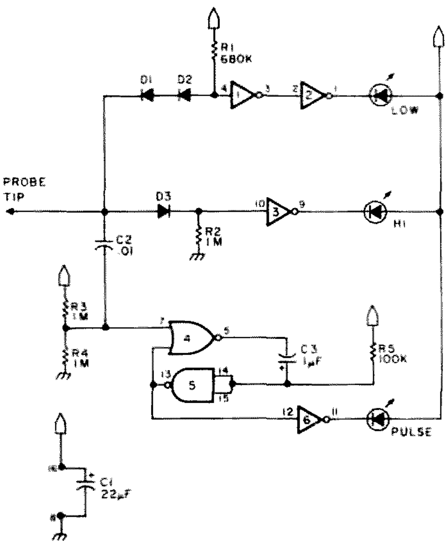


Fig. 1. Single IC logic probe.

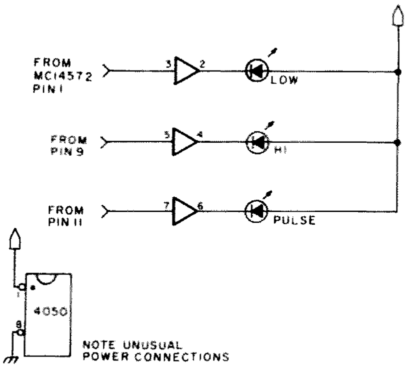


Fig. 2. Using a 4050 for extra drive.

produced a CMOS package, appropriately called a HEX gate, which contains 4 inverters, a NAND gate, and a NOR gate, which sells for about 50¢.[1]

Operation

The operation of the circuit is as simple as the circuit itself. If the probe tip is touched to an active high (or "1") signal, inverter 3 turns on the high LED, while inverters 1 and 2 keep the low LED off. When a low (logical "0") is identified by the probe tip, inverters 1 and 2 cause the low LED to turn on, and inverter 3 keeps the high LED off. The two inverters on the low line are there for buffering purposes.

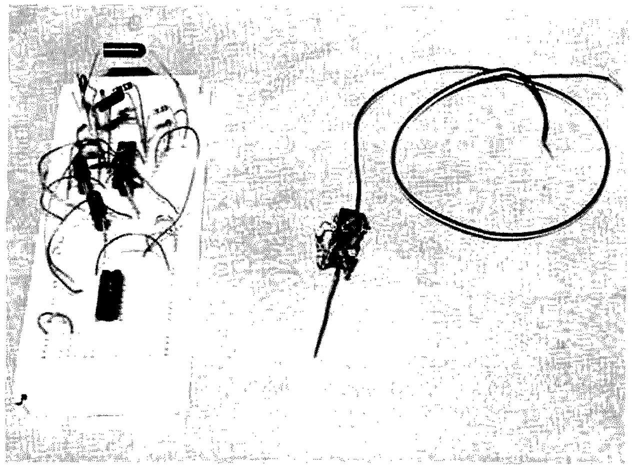
When idle, the 1 meg resistors split the supply voltage, letting R5 pull the output to a high state. This charges up the capacitor, C3, which then applies a high to the NAND (being used as an inverter), which holds the inputs to the NOR and inverter 6 low. When a negative edge of a pulse occurs, it is slowed up by the R1-C2 time constant (since the capacitor voltage cannot change instantaneously). This lengthened pulse changes the NOR output to high. Again, the pulse is lengthened by the time constant of C3 and the pull-up resistor, R5. The input to the NAND slowly changes (compared to the input pulse!) from high to low. The gate characteristics cause more of a "snap-action" than the rise and fall of the capacitor voltage. This is further squared off by inverter 6. The high signal is fed back to the NOR, which brings the output low again. (This is the "one-shot" effect.) When inverter 6 receives the lengthened pulse, it illuminates the pulse LED for the duration of the pulse.

CMOS can exhibit some memory action when the input is removed from a signal source and left floating. The diodes and pull-up and pull-down resistors eliminate this memory problem to ensure normal operation of the probe. The resistor values are fairly critical. With the values shown, the probe operates well from 0-9 volts. At more than 9 volts, some leakage current will cause the high LED to light dimly. This is easily distinguishable from a true high, however, and it will go out on a low.

Construction

If it is desired, a printed circuit board can be made. However, the author and several other builders found it easier to trim leads short and either solder or wire-wrap directly to the IC. This provides an extremely compact circuit.

The probe, when built as described above, can be mounted in about anything that is convenient.

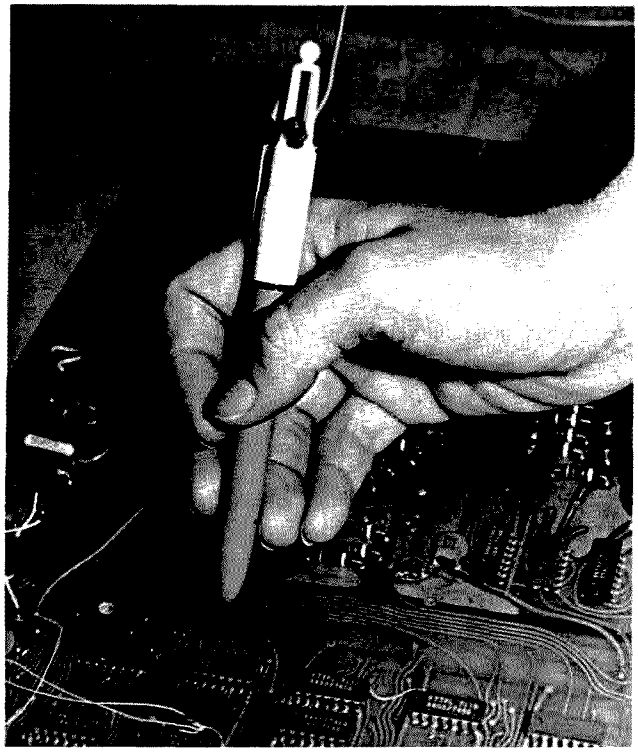


Here are two different prototypes. All the components in the left-hand version are in the right-hand version, except for the 4050 at the bottom of the protoboard. Also, smaller LEDs were used.

My model was mounted in the casing of a Bic 4-color pen. This provides extreme portability, with the pocket clip allowing the probe to be carried around.

If desired, the LED outputs could be used to produce high and low tones, using 555s for an audio logic probe.

I have two final construction notes. The 22-uF



This is the final assembled version. A Bic 4-color pen was used as the case. The LEDs and power leads can be seen at the top, and the tip is probing an IC at the bottom. Practically anything can be used as a case, such as a cigar tube or cylindrical plastic mailing tube. You could even leave it in the "rodent" form!

Parts List

IC 1	Motorola MC 14572 CMOS integrated circuit
D1-D3	Small signal diodes, 1N914 or similar
R1	680k, ¼-Watt
R2-R4	1 meg ¼-Watt
R5	100k ¼-Watt
C1	2.2 uF tantalum (see text)
C2	.01 uF ceramic disc
C3	1 uF tantalum
LED1-LED3	miniature LEDs—color reader's choice
Optional	
IC 2	4050 CMOS hex buffer (non-inverting)

tantalum capacitor between Vcc and ground is to provide additional filtering. This value is not too critical, and the circuit may work on a good power supply without it. Also, while the LEDs are not too bright, they are sufficiently bright for normal work. For a few cents more and an additional IC package, a 4050 CMOS hex buffer can be used, if desired, to provide added drive, as shown in Fig. 2. For ultra-simplicity and small size, however, the single IC version is recommended.

Conclusion

While a logic probe may be the most useful tool in a ham shack, commercial models can be fairly expensive. This probe can be built even on a poor man's budget, and, for anyone working with digital circuitry, a cheap logic probe is practically a must. ■

Reference

1. The MC 14572 is available from Graham Electronics, 133 S. Pennsylvania St., Indianapolis St., Indianapolis IN 46204, and from other Motorola distributors.

Reader Service—see page 195

"The Voice of Wolf Creek"

—the KGCX story

How to operate a radio station without a license.

Dr. William C. Hess W6CK
PO Box 19M
Pasadena CA 91102

Beginning in 1924, the late Joe Jacobs 7TF operated an unlicensed broadcasting station on his ranch in the wilds of Montana. In late 1925, this station was moved to the tiny village of Vida, Montana, where its illegal operation was continued by the local banker, E. E. Krebsbach. The following transcript of a 1930 speech given by Krebsbach to the Lions Club of nearby Wolf Point, was recently presented by the Krebsbach family to their long-time friend, Dr. Hess, because of his abiding interest in the history of KGCX. It details the trials and tribulations involved in operating this clandestine radio station until it was licensed and the services of a licensed operator were secured.—Ed.

Five years ago, in 1925, when I returned to Wolf Point after undergoing surgery at the Mayo Clinic, some of the local radio enthusiasts told me of hearing "The Voice of Cow Creek" on their radios. Of course, I knew at once that it must be the work of Joe Jacobs, eastern Montana's radio wizard. And it was.

At that time, Joe had a license only for operating an *amateur* station, but he was going on the air with musical programs on a wavelength of over 200 meters, which was strictly forbidden by the Department of Commerce.

Being interested in seeing a real broadcasting station which could transmit voices and music, I went down to the Jacobs Ranch as soon as the condition of the roads permitted. Joe had the transmitter sitting on a small table, and while it was not the neatest piece of construction I have ever seen, it did the work that any transmitter is capable of doing, and it did mighty well, as you all remember.

Instead of using high-priced meters such as we are using now, which cost anywhere from twelve to twenty-five dollars each, he was using old discarded seventy-five cent voltmeters. The panel was only two-feet square.

He had a hand-held microphone which had to be carried around the room to pick up organ music, phonograph, or whatever type of music they could get at their ranch home. The microphone had to be held up to the organ frame so the vibrations could be picked up; the same was the case with the phonograph music. The mike had to be attached to the phonograph cabinet, otherwise the volume of pickup would not be sufficient for broadcasts.

We all got a great deal of pleasure out of it, and I suggested that I bring the Vida Syncopators Orchestra down to the ranch and broadcast our music. Mr. Jacobs suggested that the set be taken to Vida instead, as we had more room there to broadcast from the Community Hall.

So, it was not long before Vida had a direct connection with the outside world—a pure and simple bootleg, wildcatting radio station. We operated Sunday afternoons only, and from the number of letters we received, we had a great many listeners to the foolishness we put out. I believe that at first we tried to make ourselves as foolish as possible.

In a very short time, Mr. Jacobs perfected what is known as the electrical phonograph pickup. Whether it was an innovation on his part, I don't know (he used a headphone to make it), but I do know that it was the very first time phonograph music was broadcast in the entire middlewest by the now-common electrical pickup process. Other stations at that time were broadcasting phonograph music by the now entirely obsolete system of merely placing the microphone in front of their phonographs. With that system, the quality, of course, was not nearly as good as with the electrical pickup process. It was at least a year before other stations started using our

system. This is one thing in the broadcasting game in which we were absolutely the pioneers.

We became so interested in the novelty of broadcasting that we applied to the Department of Commerce for a broadcast license for Vida—a town of twenty-five inhabitants. Of course, we assumed they would forget to look up the population of the fair city. We received a reply stating that a ban had been placed on all further radio station construction, and that the number of radio stations was to be reduced, not increased.

Still, we kept on broadcasting, not knowing the penalty. The penalty for operating a radio station without a license was $500 and six months in the coop. We did not know this, but *did* know that the practice was not exactly according to Hoyle.

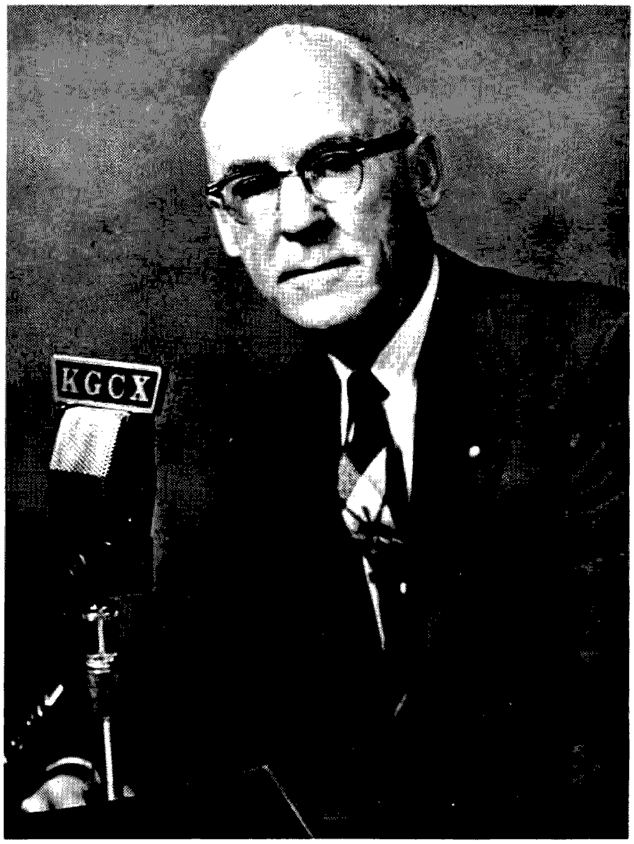
This shows Mr. Krebsbach operating the original KGCX transmitter at Vida, Montana, in 1926. Note the crank of a hand-wound phonograph at the left edge of the picture.

We started reaching out quite a distance with our broadcasts, and, finally, a bit too far, as we were heard at Froid, Montana. A certain gentleman there (this is not the term we applied to him at that time), who did not approve of Vida having a radio station when Froid could not have one, immediately sent in a complaint to the radio inspector at Seattle stating that an illegal broadcasting station was operating at Vida under the name of "The Voice of Wolf Creek."

We had changed the title of the station to this appelation when we moved it to Vida, since Vida was near Wolf Creek. Naturally, the radio inspector knew who to write to at Vida since we had submitted our application for a broadcast station to him. We knew that the applicant for a station had to be a reliable person or firm, so we had used the name of the bank where I was the cashier. So, the inspector wrote a letter at once to the First State Bank at Vida, asking the name of the owner and operator of the station at Vida—not licensed by the government—so that he could commence prosecution at once.

All was not so good around Vida (especially in the bank) for a week or two! Paul (my brother) would come in every now and then, saying, "I told you so" and "now don't get me into it"—all nice, cheery remarks, you know. The final outcome was that Mr. Jacobs lost his amateur license, and nothing further was done.

I asked a number of my friends in the surrounding towns to write to the inspector telling him that Joe was brokenhearted and felt terrible over the abrupt ending of his chosen career. About two weeks later, Joe received a letter from the Department of Commerce asking whether he wished to be reinstated



This is a picture of Mr. Krebsbach in the 1950s, at the KGCX microphone.

—and Joe was soon restored to the status of being a full-fledged amateur operator, *but* he refused to have any further connection with the bootleg radio station.

Naturally, we thought that that was the end of our broadcasting career, as we surely now had a black mark with the Department of Commerce about a foot wide. In the meantime, I got in touch with Mr. Willson of the Fobes Radio Supply, at Butte. Mr. Willson happened to be a close friend of Mr. Redfern, who was the supervisor of this 7th Radio District. I don't know what Mr. Willson did, but I do know that he was instrumental in getting our first license with the call letters KGCX. We started unlicensed broadcasting at Vida on October 1, 1925, and received our license at Vida on October 6, 1926.

At first, we started on a one-day schedule per week, broadcasting only on Sunday afternoons, as we had done without a license. However, now that we were a legitimate station, we increased the broadcasting schedule to Monday, Wednesday, and Saturday during the noon hour, and very shortly went on a daily schedule from 12:15 to 1:15 pm.

To show you how much nerve we had (that is not the exact word, but will do), we did not have a resident licensed operator as required by the government. Since we badly needed someone with a First Class radio operator's license, we decided to go to Butte on the day the assistant radio inspector was scheduled to be there giving radio examinations, so that Joe could take the First Class operator's exam.

On the designated morning, we walked over from our hotel to the Post Office building where the examination was to be held. Joe sat down, waiting for the test to start, and I went back to our hotel, about as nervous as I have been here with this station at times. I phoned Mr. Willson and told him Joe had started the examination. "Well," he said, "if he is not back at the hotel in an hour, he will have passed his code test, and then everything will be hotsy totsy."

I sat in the lobby of the hotel with my back to the door and watched the clock. For the first fifteen minutes, I was slightly nervous, and before the hour had expired, I was a nervous wreck. Each time the door to the lobby opened, I would think it was Joe coming back. The hour passed and Joe did not come; another hour passed and finally it was lunch time. I asked Mr. Willson to lunch, and we both went up to see Joe. He said he had failed the first two code tests, but that Mr. Clark, the examiner, was very nice to him and allowed him a third try at the code test, which he passed.

I thought that that was all there was to it, as surely Joe could not fail the technical part of the examination. In those examinations, you are required to know the construction of a ship transmitter, a land transmitter, and the construction and maintenance of storage batteries. You must be able to draw a complete diagram of a transmitter, and you must know ten of the radio laws. You must know what the source of the trouble is when a milliammeter, voltmeter, radio-frequency ammeter, or other meters fail to respond. And this is about half of the work in the examination, which ordinarily takes a full day to complete.

Joe finished his examination at 3 o'clock, and we went to a movie to relieve the strain. We were both happy, to say the least. We had finally conquered!

We stopped at a nearby drugstore, and phoned the radio inspector and asked for results. Joe had *flunked* by a mere three points. It was just a small matter of forgetting to connect the motor generator to the transmitter, in the diagram which Joe had drawn.

Right there and then, all of the joy went out of our lives completely. We were homesick, sick at heart, and what not. We went back to our hotel room, and Joe paced the floor on one side of the room and I on the other side. We phoned Mr. Willson and he asked us to come down to his office, which we did, and he asked us out to his home for dinner. On the way out, I remarked with a good-sized lump in my throat, "Well, that's the end of KGCX."

Mr. Willson said, "Why?"

"Well," I said, "I can't operate the station any longer without a licensed operator and risk being caught—I'll be fined $500 and spend six months in the hoosegow."

He said the $500 fine and six months in jail did not apply to operating a station without having a licensed operator, but rather to operating a station without a license.

He also said that the penalty for operating without a licensed operator was merely revocation of the station license, and that if you quit broadcasting now, you will have to surrender your KGCX station license, and then you will be through as far as getting another station license at Vida is concerned.

He further said that if you continue broadcasting without a licensed operator and get caught, the worst that can happen is that your station license will be revoked, and even if that happens you won't be any worse off than if you quit now.

He continued, "but if you continue broadcasting, Joe can take the operator's examination again in three months and will surely pass then."

Right at this point is where Wolf Point nearly never would have had a broadcasting station as, if we had followed our dictates and stopped broadcasting then at Vida, Wolf Point would not have a radio station today. The much-coveted license would have been gone forever.

We returned to Wolf Point, and it was pitiful to see Joe so nervous and disappointed over his failure. I should say at this point, that there is absolutely no disgrace in one's inability to pass the First Class operator's examination on the first attempt. I know that I would not attempt to take it at this time.

We continued to operate the Vida station, and everything went smoothly until the following June when we received word on a Friday evening that the radio inspector would arrive at Wolf Point on the following Monday morning to inspect KGCX at Vida.

The first thing to do was to hotfoot it to Wolf Point and get in touch with Mr. Johnson, at Havre, who was the holder of a First Class operator's license. He agreed to come to Wolf Point on the Sunday morning train, but he did not show up. I wired him, and he phoned back advising that he had missed the train, but that he would come on Number 4, that evening, for sure.

He did, and we spent all night rehearsing the manner of operation of our transmitter, its construction, our broadcasting schedules, etc., so that he would be fully informed and be able to deceive the radio inspector into think-

ing that he, Johnson, was actually the licensed operator of KGCX. Actually, Johnson had only been at Vida on one other occasion, when he visited there briefly just to satisfy his curiosity about our transmitter. As you know, there was only one other radio station in the whole state of Montana at that time, besides ours.

Next morning, Mr. Clark, the assistant radio inspector, was to arrive from Seattle. I had arranged that Mr. Johnson would be taken to Vida that morning on the first ferry crossing over the Missouri River. I had also arranged to have Joe Jacobs on hand early in the morning at Vida, so that he could give Johnson a final "brush-up" on our transmitter, so that we would be sure to deceive Mr. Clark about Johnson being our licensed operator.

Naturally, Johnson knew very little about our transmitter, having seen it only once before. My brother, Paul, was in a terrible sweat, and later told me this was quite sufficient for him, and that he did not want to be "in" on any radio station venture of mine, ever.

Mr. Clark arrived on Number 2, Monday morning as scheduled, and I stalled around Wolf Point as long as I could in order to give Joe as much time as possible to "clue in" Johnson about our station at Vida.

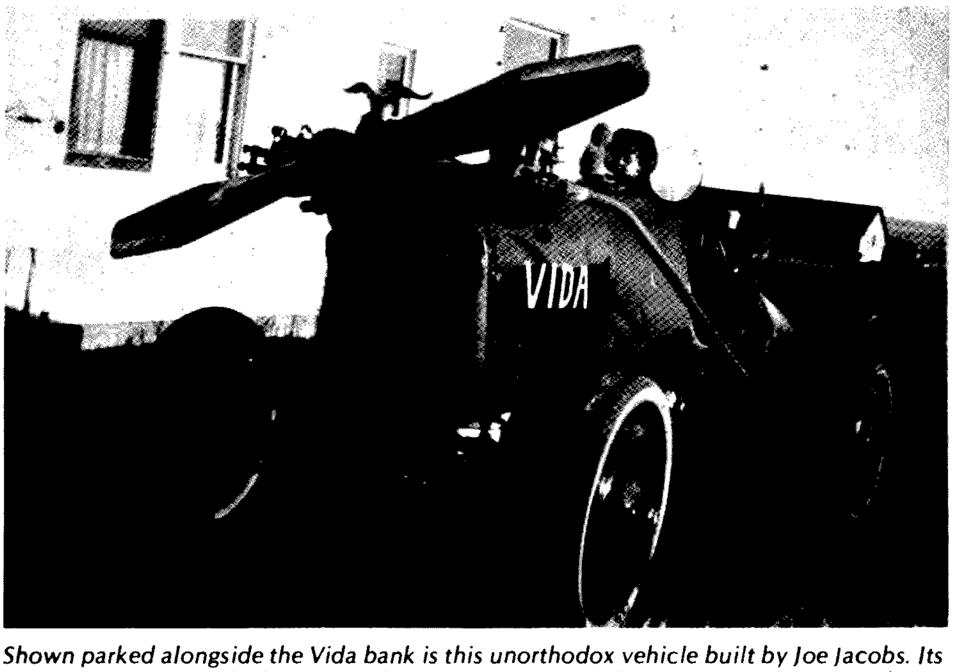
During the trip to Vida, I was preparing Mr. Clark for the shock he might get when he first viewed our transmitter at Vida, as it was just a cheaply assembled set. To all this, he said, "Well, don't worry about how the set looks as long as your broadcasts go out all right."

When we reached Vida, Joe Jacobs was sitting leisurely on the front steps of the bank, apparently unconcerned about the approaching dignitary from Seattle.

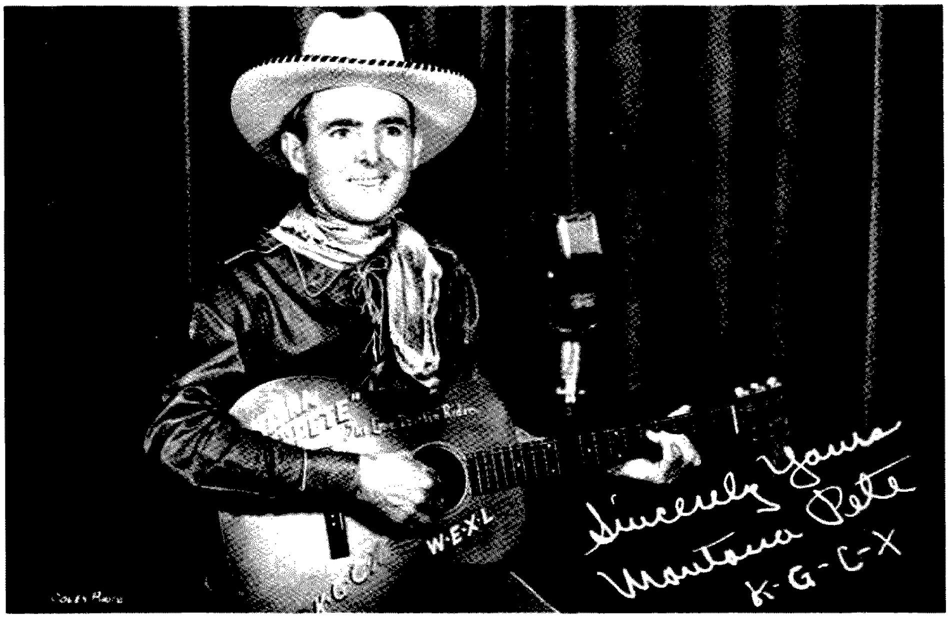
In the event that the radio inspector might happen to go into the village general store and Post Office, for any reason, and to help give the impression that Johnson was indeed a resident of Vida, who worked at the store when he was not on duty as the licensed operator of KGCX, a bit of flummery was arranged. So, when we arrived at Vida, Johnson was already in back of the counter at the store with his coat off, busily selling butter and eggs, and posing as a clerk in a store which he had just entered for the first time in his life. Obviously, the storekeeper was a part of the conspiracy to deceive the Department of Commerce, since he wanted Vida to be able to keep the radio station, as did everyone in the surrounding community.

Joe stepped into the bank with Mr. Clark and started his First Class operator's examination. I went over to the store and asked Johnson to come over to the bank. During Joe's examination, Mr. Clark inspected everything about our transmitter, the antenna system, etc., and asked Johnson to turn on the transmitter and transmit a phonograph record. This came through nicely, and the inspector then asked for an announcement through the micro-

Marcellus Jacobs poses to give prospective customers an indication of the size of the Jacobs wind electric plant.



Shown parked alongside the Vida bank is this unorthodox vehicle built by Joe Jacobs. Its airplane motor would whiz it over the prairies at 40 mph. In winter, it was equipped with skis. Note the antenna insulators and ground system of KGCX at the left. Seated in the vehicle is young Clair Krebsbach, now General Manager of 50-kW KERR.



Montana Pete performed for years on KGCX. When he departed for greener pastures, KGCX held a farewell party for him in the form of a barn dance, with live coverage of the affair provided by the station. Mr. Krebsbach, acting as master of ceremonies, intended to say into the mike, "We shall certainly miss Pete." Unfortunately, he transposed the first letters of the last two words. His profuse apologies to the hundreds of KGCX listeners, and to those present at the party, only made the situation worse.

phone. Johnson talked into the mike, but the inspector, who was listening on a radio in another room, said nothing came through. We were then using a desk-stand telephone as a microphone. Jacobs looked up from his exam papers and saw the telephone receiver hanging on the hook (which short-circuited the mike), and quietly told Johnson to take the receiver off the hook, which brought a faint smile to the face of Mr. Clark.

At dinner that evening in our living quarters in the bank, with Mr. Clark as a dinner guest, my young son had to help things along by telling his mother, "*Mama, Mr. Johnson is here again, isn't he?*"

It may be that Mr. Clark sensed that something was, indeed, amiss, but he said nothing. In any event, he was very nice to us, and Joe had passed his examination and all was well.

I was startled again at the ferry when we were returning to Wolf Point. Johnson, of course, had to return to Havre. Mr. Clark was going east. As I was starting home, Mr. Clark bid me goodbye *and on came Johnson to also bid me goodbye.* Rather strange for my operator to bid me goodbye.

I am sure that because of the remark my young son had made, and because Johnson bid me goodbye, there was little doubt in the mind of Mr. Clark that I had been operating KGCX without the services of a licensed operator. However, he said nothing.

We operated KGCX at Vida until February 1, 1929. At that time, I took over the Westland Oil Company agency at Wolf Point. I thought it would be very nice if we could continue operating a radio station in this area, so I applied to the Federal Radio Commission for permission to transfer the Vida station to Wolf Point. They replied that they would approve the transfer, but that they would not allow us to use the small 7½-Watt transmitter we had used at Vida. They told us we must use either 100 Watts or 250 Watts up to sunset, and 100 Watts after sunset. We first planned on 100 Watts, but Mr. Hooper, of Regina, informed us that a 250-Watt set would cost but little more, so we made application for that power.

We had no knowledge whatsoever as to what information we should put in the application relative to the rating of the tubes, the type of transmitter, and other such items, and this necessitated a trip to Regina to get the required information from Mr. Hooper, who was chief engineer of radio station CKCK, up there in Regina, Canada, about 175 miles north of Wolf Point. We made the trip via airplane, as the roads were impassible, and after going through some hair-raising experiences on the trip (two forced landings with a dead motor), we brought the necessary information back to Wolf Point and submitted our application to the Government.

We thought that we would have our construction permit in two or three weeks, but six weeks went by with no word from the Commission. I telegraphed Senator Walsh and Congressman Leavitt, in Washington, and within twelve hours I had a telegram from Mr. Leavitt advising me that the permit had just been granted and that we were assured a 250-Watt station in Wolf Point. ■

Author's note: The foregoing speech was never given a title by Mr. Krebsbach. It occurs to me that the name of a popular magazine would be an apt and accurate title for the subject speech, viz: *True Confessions.*

The village of Oberammergau, in Germany, is famous for its Passion Play, and the town of Hemet is well known in California for its annual outdoor Ramona Pageant, but for sheer audacity and raw courage on the part of its actors, the tableau just described, which was presented at Vida by Mr. Krebsbach, First Class Operator Johnson, the village storekeeper, et al, in attempting to deceive the Department of Commerce of the United States government, has no equal.

Joe Jacobs and his brother, Marcellus, did a great deal of experimenting with wind chargers on their ranch. Later, they established a large factory in Minneapolis and were able, through their 260 dealers, to sell twenty million dollars worth of wind chargers to farmers, airports and railroads throughout the world, an impressive accomplishment all stemming from the electrical tinkering of two young men on a Montana ranch.

Joe Jacobs passed away in 1962. In 1933, Marcellus invented the cathodic pipeline device which has saved pipeline companies millions of dollars. He still carries on electrical experiments in a large laboratory near Fort Myers, Florida, where another electrical tinkerer, Thomas A. Edison, developed many of his patents.

CB to 10

—part XIX: Lafayette SSB rigs

They work like champs.

Fred H. Gerken WB0LLP/5
7009 Knight
Lewisville TX 75056

Recently, due to the extinction of 23-channel CB radios, several amateurs have converted SSB CB rigs to ten meters with great success. The fun of QRP operating, and the band openings lately, have contributed to their present popularity. The following information is a basic description of how to convert two of Lafayette's 23-channel SSB radios to ten.

The first step in any conversion is to decide on a frequency scheme. Since most SSB activity on ten seems to be around 28.6 MHz, and since the phone

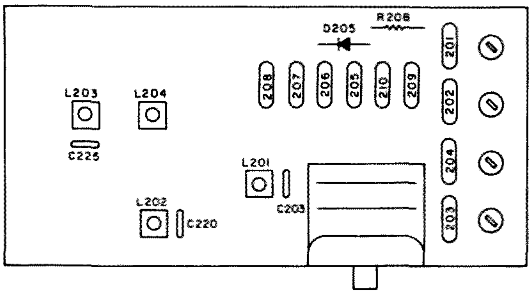


Fig. 1. Xtal-plexer.

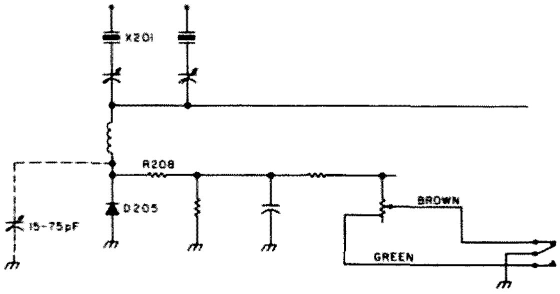


Fig. 2.

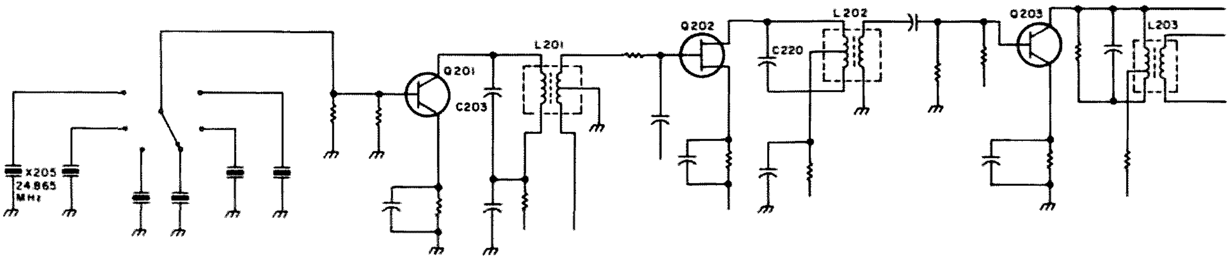


Fig. 3.

band begins at 28.5 MHz, I used the frequency/channel scheme shown in Table 1.

In order to produce the frequencies shown in Table 1, new xtals must be purchased and substituted for xtals x-205 through x-210. Table 2 shows the new xtals that must be installed.

The new xtals can be of the third-overtone type, which is less expensive than a fundamental type. Note that any one xtal will give you four channels, so if you need only 40 kHz of the band, only one xtal needs to be installed.

Installing the New Xtals

First, remove the old xtals directly behind the channel selector. I recommend the use of a solder wick, as the circuit board is very easily ruined by excessive heat. Next, install the new xtals in the proper locations. Note that the xtals are not in order. Locate C203, an 86-pF capacitor, remove it and in its place put a 68-pF mica capacitor. Locate C220, a 15-pF capacitor, remove it and in its place put a 10-pF mica capacitor. (See Fig. 1.)

Tuning Up the Xtal-plexer

Place the channel selector to channel 1. This switches x-205 and x-201 into the xtal-plexer's circuits. If x-205 is a 24.865 MHz xtal as specified, then tune L201 to resonance at that frequency. Measure the frequency and signal amplitude at the gate of Q207. Note that a 14.910 MHz signal is also present at the gate of Q207. If the 14.910 MHz signal prevents you from tuning the 24.865 MHz stage, then ground the source end of C219 (10 pF). Once L201 is tuned, begin tuning L202. (Remove the ground from C219 if you grounded it in the previous step.) The L202 stage should tune to resonance near 39.775 MHz. Measure frequency and signal amplitude at the collector of Q202. Next tune coil L203 for peak output, and measure signal amplitude at the cold end of C227 (1 pF).

Channel	Frequency
1	28.500 MHz
2	28.510
3	28.520
4	28.540
5	28.550
6	28.560
7	28.570
8	28.590
9	28.600
10	28.610
11	28.620
12	28.640
13	28.650
14	28.660
15	28.670
16	28.690
17	28.700
18	28.710
19	28.720
20	28.750
21	28.760
22	28.770
23	28.800

Table 1.

Xtal #	Old Xtal	New Xtal
x-205	23.330 MHz	24.865 MHz
x-206	23.380	24.915
x-207	23.430	24.965
x-208	23.480	25.015
x-209	23.530	25.065
x-210	23.580	25.115

Table 2.

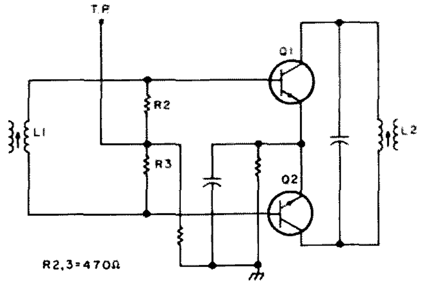


Fig. 4.

Next, tune L204 for peak output, and measure signal amplitude at the base of Q17. Then go back and tweak L202 and L201 for maximum signal at the base of Q17 with the channel selector switched to channel 11 or at the center of your frequency scheme. Tweak L203 again for maximum output.

Receiver Tune-Up

Select channel 1. Inject a modulated signal at 28.5 MHz at the antenna connector or, if a signal generator is not available, connect a 10 meter antenna. Place the mode switch to AM and tune L18 and L19 for maximum audio output or maximum band noise. The S-meter can be used as a tuning indicator. Slowly decrease the injected signal strength, and tune L18 and L19 for maximum receiver sensitivity. This completes receiver conversion. Switch the mode switch to USB and run through the channels; if the band is open, and an antenna is connected, signals should be heard.

Fine Tuning Modification

There are two proven modifications to the fine tuning. One uses the original varactor diode circuit, the other requires that a variable capacitor be added.

Modification 1 is the easiest and requires only that the green wire on the fine-tune pot be moved from the tap to the wiper. The brown and green wires are both on the wiper after modification. This allows the transmit and receive frequencies to track together ± 600 Hz.

Modification 2 requires that a 15-75-pF variable be mounted in place of the fine-tune pot, and that D205 and R208 be removed from the xtal-plexer board. (See Fig. 1.) A wire from the variable capacitor is connected to the circuit board where the cathode of D205 was originally. This modification allows the transmit and receive frequencies to track ±2.5 kHz. (See Fig. 2.)

Transmitter Tune-Up—USB and AM

Place the mode selector

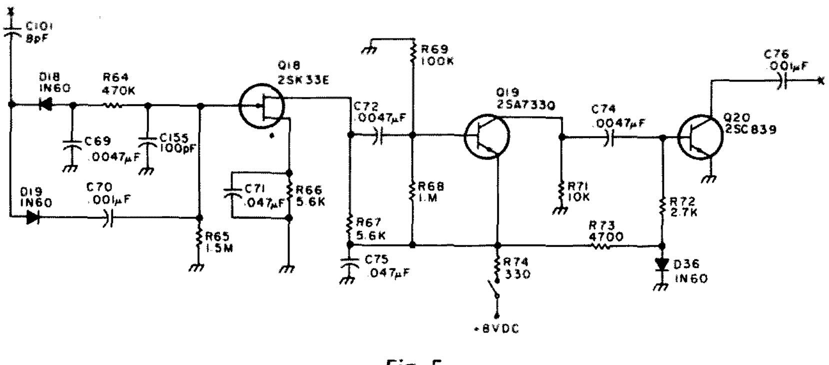


Fig. 5.

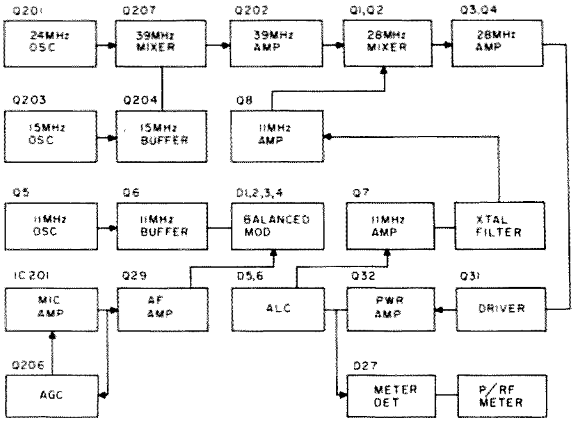


Fig. 6. Transmit USB.

switch in the AM position. Connect a dummy load to the antenna connector through a power indicator. Now, while keying the mike, adjust L2 for maximum output of rf. This will be fairly low, perhaps less than 1 Watt. Next, in order, tune coils L3, L4, L5, L7, and L6 for maximum rf output. In the AM mode, full output power is about 3.8 Watts with 13.8 V dc supplied. Switch the mode switch to USB and whistle into the mike. About twice the rf should be indicated on the output. Remember to check the frequency of the rf at the antenna. Remember also that 28.5 MHz USB is very close to the phone band's edge!

Transmitter Tune-Up—LSB

This part of the conversion is optional. If LSB is desired, follow the next few steps. Change C131 to 36 pF and change C91 to 36 pF; put the removed C91 (39 pF) in place of C94 (47 pF). Place the mode selector in the LSB position. Key the mike, remembering to use a 50-Ohm dummy load on the antenna. Tune L15 for maximum rf. The frequency should be about 17 MHz, depending on the channel you have selected. Tune L16 and L17 for maximum rf while monitoring at the junction of R2 and R3. (See Fig. 4.) Now modulate the rig. An LSB signal should be present at the antenna. Check the receiver for good sensitivity. It may be necessary to retweak L15, L16, and L17 for best results.

Noise Blanker

Lastly, I noted that the SSB-75 does not incorporate a noise blanker circuit, although the SSB-100 does. Actually, the foil pattern for the blanker is on the SSB-75 circuit board, and the components can be added for less than $10.

A schematic of the blanker used in the SSB-100 is shown in Fig. 5. Components are common, but substitution of semiconductors is not recommended. These exact semiconductors are available from Fugi Svea Electronics.

Summary

This collection of notes is provided for your information, and may not work in all SSB-series radios. However, two SSB-75s are now on the air at this QTH and working like champs. Good luck! If you run into trouble during this conversion, drop me a line, and maybe I can help. 73.■

✓ Reader Service—see page 195

At Last! A Really Simple Speech Processor

—5 dB for $10

Add some punch to your signal.

Jeff Stadelman W9UT
Bob Steingart WB9OEC
Box 38
Pound WI 54161

Amateurs are always looking for ways to add a little extra punch to their signals. I guess it's just a natural inborn ham instinct to want to be louder than the other guy. And, of course, one of the most popular methods to get just a little bit more out of that transmitter is through speech processing.

There have been countless articles written on this type of signal enhancement, but many are very complex and present problems to the casual builder. This processor, however, while very simple and inexpensive, is highly effective. The builder can expect to see a 2-5-dB improvement in signal strength. The total cost of this project should be no more than ten dollars, using all new components.

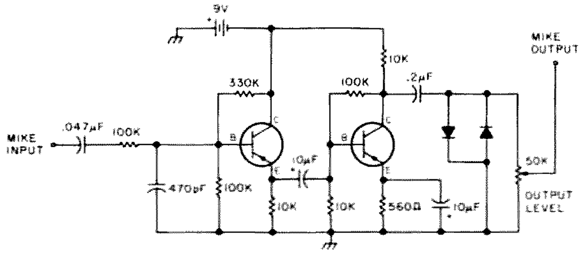


Fig. 1. The processor circuit. Transistors are 2N408, GE2, or Radio Shack RS2004. Diodes are any germanium diodes, such as 1N270.

The processor is constructed on perfboard, wired point-to-point, and enclosed in a metal box. The individual builder, however, may wish to design and etch a circuit board, or incorporate the unit directly into the transmitter. The input, output, and voltage-switching circuits have been left unfinished. The builder may want to incorporate a switching network of his own design.

The authors have used this processor in many contest and DX situations, and have received nothing but glowing reports from listeners. This simple, inexpensive processor should make a worthwhile addition to nearly any station. ■

Parts List

1 330k
3 100k
3 10k
1 560Ω
1 50k pot
1 .047 uF
1 470 pF
2 10 uF electrolytics
1 .2 uF
2 2N408, GE2, or RS-2004 transistors
2 1N270 diodes or similar
Box, hardware, switches

New Life for Tube-Type Dippers

—simple circuit reads out on your frequency counter

From tube to transistor—without tears.

Randy Prewitt K4LJA
2013 Sherwood Ave.
Monroe LA 71201

Don't misunderstand me. There's nothing technically wrong with the old Knightkit grid-dip meter. It's just that whenever I wanted to measure the frequency of a coil, the ac line cord was too short or I would invariably drape the power cord across a simmering soldering iron, nearly electrocuting myself.

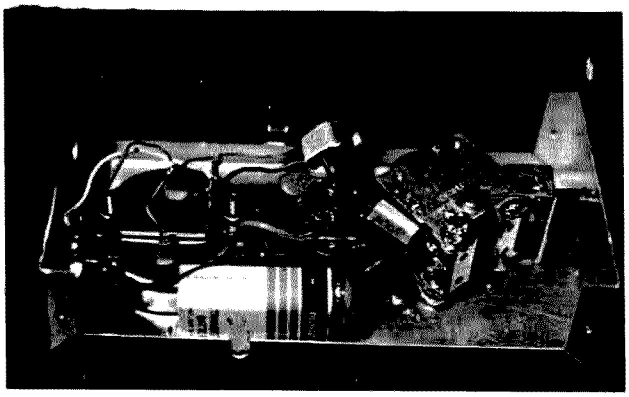
So, something had to give, hopefully the line cord. And it did, but not as quickly as initially planned. About a year ago, I started noticing an abundance of articles proclaiming the miracles of field-effect transistors (FET) and bipolars replacing tubes in many simple circuits. Then the light dawned and I planned my attack. After all, I needed a portable, cordless gdo to take to my beam antenna for measurements, and to get into tight spots in other electronic projects.

Needless to say, not all attacks are successful, and my first few weren't. Oh, I managed to transistorize the beast alright, but ended up with numerous false dips and erratic meter readings. Plus, the dial left much to be desired as far as accuracy goes. Since I had just completed a frequency counter, more lights began dawning.

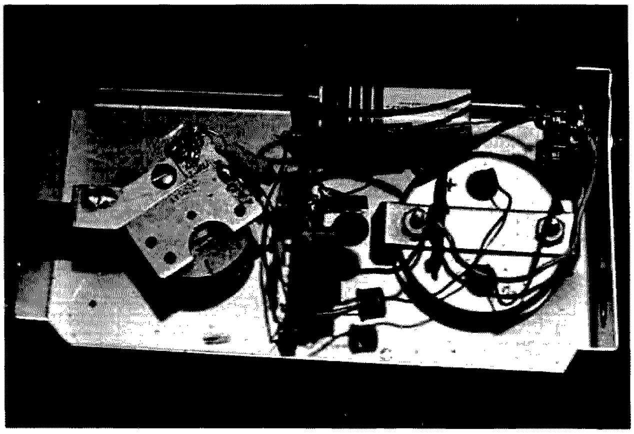
About the same time that I was mentally abusing myself for being so stupid as to louse up a perfectly good tube gdo just because it had an ac line cord, Fred Teague W4RHJ showed me a breadboard gdo circuit he was playing with. I tried it, making a few modifications for my particular needs, and, amazingly, it worked the first time.

Since I had already stripped the bulky tube components from my

Photos by KA4AAH



Side view of gdo, showing existing tuning capacitor, battery, and vertically-mounted perfboard with circuit.



Top view of gdo, showing vertical mounting of perfboard transistor circuit and main tuning.

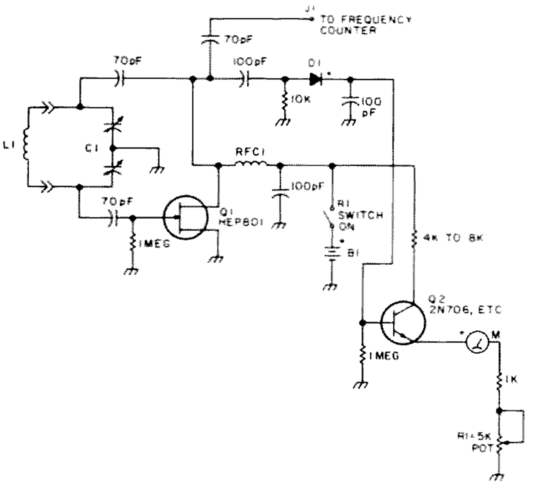
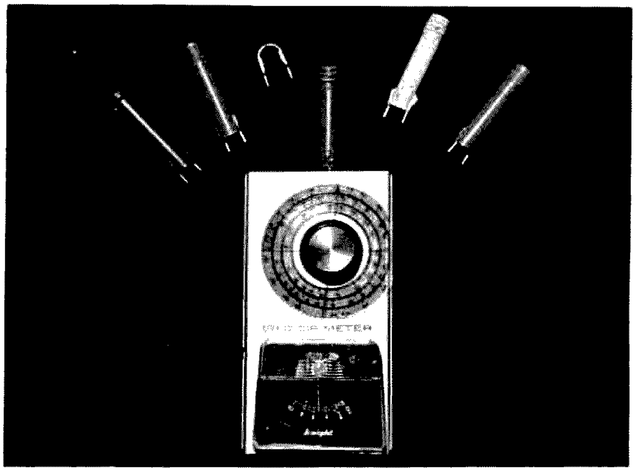


Fig. 1.



View of converted tube gdo, showing normal selection of coils.

Knightkit, it was a simple matter to clean up the breadboard version and install the small perfboard circuit vertically in the Knight case. About all I kept from the original were the case, coils, variable capacitor, meter, and the combination switchpot.

You'll find the new circuit to be simple, noncritical concerning parts, and reliable if good, sensible rf wiring is followed.

One of the novel features is the placement of diode D1. Through the pick-off capacitor, it rectifies a small amount of rf and drives the meter amp. Many circuits have it reversed, but this method allows using a less expensive transistor since we're dealing with dc and not rf. It makes the circuit less critical, too. Another feature is an rf pick-off used to feed a frequency counter. This allows you to read the dip from the meter and glance over at the frequency counter for the numbers. Super accuracy. Of course, you should retain the existing Knight dial for those times when you're hanging off the tower trying to get a dip on your new beam's frequency. At times like that, you sure don't need another piece of equipment like a frequency counter bonking you in the head as you dangle from the tower.

If you wind your own coils and build the unit from scratch, use ½-inch forms with an RCA pin plug on the bottom and a mating plug on the gdo. The lower frequency coils use thin Litz wire and the higher frequency jobs use #24 wire, progressing to #22 wire for the highest range coil. Using a frequency counter, you can calibrate the dial right on the money.

Personally, I couldn't get along without mine now. And by the way, this tale does have a moral. Actually, it has two. First: Don't throw anything away which can be converted. Second: If the conversion doesn't work, don't despair. A better circuit will come along in the future. Welcome to the future; here's your better circuit. ■

Parts List

L1-L6—Existing coils from Knight grid-dip meter, or custom-wound coils can be wound on ½-inch forms
C1—Dual 50-pF variable, retained from original circuit
D1—1N914, or similar
Q1—ECG 132 Sylvania, or similar HEP
Q2—NPN garden variety
B1—Nine volt battery
RFC—1 mH
All resistors 1/8 Watt, capacitors in pF (mmf) unless specified
M1—Existing meter in Knightkit, or 1 mA basic dc movement
J1—Pin jack

Coil Information

1.5-3.5 MHz	75 turns, pi-wound Litz, three pis
3.0-8.5 MHz	30 turns, 3-pis Litz wire
8.5-20 MHz	30 turns, #24 close wound, ½-inch form
19-45 MHz	12 turns, #24 close wound, ½-inch form
45-115 MHz	4 turns, #22, spaced over 1 inch, ½-inch form

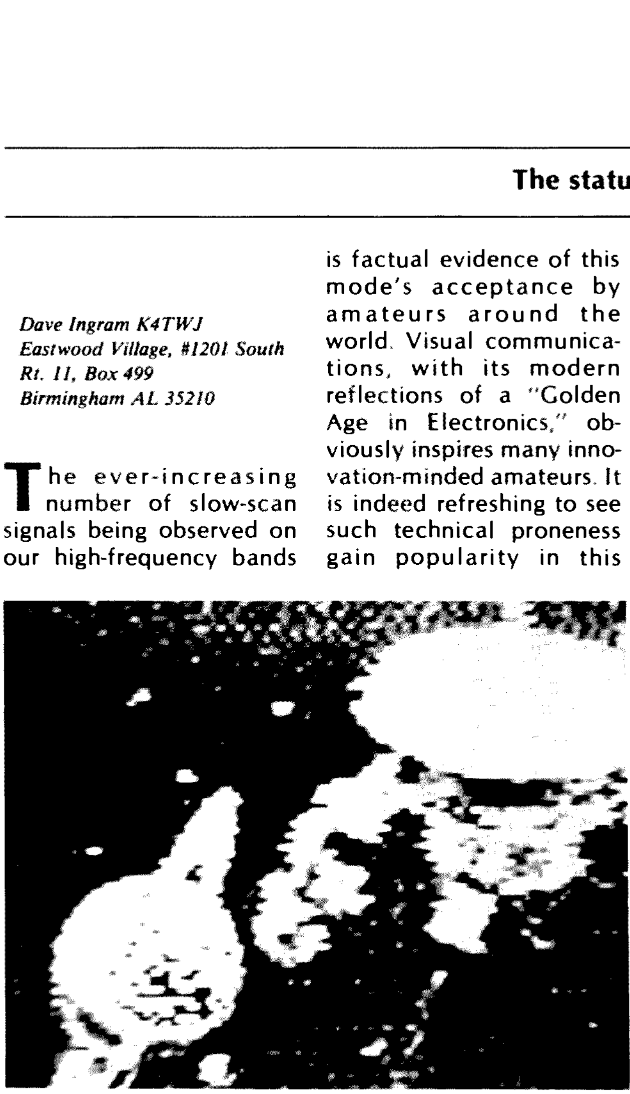
You Ought To Be in Pictures

—here's what the guys on 14,230 are doing

The status of SSTV.

Dave Ingram K4TWJ
Eastwood Village, #1201 South
Rt. 11, Box 499
Birmingham AL 35210

The ever-increasing number of slow-scan signals being observed on our high-frequency bands is factual evidence of this mode's acceptance by amateurs around the world. Visual communications, with its modern reflections of a "Golden Age in Electronics," obviously inspires many innovation-minded amateurs. It is indeed refreshing to see such technical proneness gain popularity in this modern computer age. Many technical and operational expansions have favorably affected the world of SSTV recently. This article is presented as an "update account" of these expansions. Some of the more prominent technical innovations will be considered first, then I will discuss the operational and future aspects of slow-scan TV.



This SSTV picture, which was received from Dick K6SVP, shows the Voyager spacecraft approaching the planet Saturn. The large white object in the top right-hand corner of the picture is a parabolic dish on the spacecraft. The "gear"-looking item on the left of the Voyager is part of the unit's probe. The "snow" at the top of the picture was due to noise on 20 meters.

Digital-Scan Conversion

The unlimited expansions associated with digital scan conversion have definitely established this method as the ultimate technique for serious SSTV work. Home-brew scan converters, however, are becoming somewhat scarce in the US since Robot's Model 400 gained popularity. This is simply because one cannot build a slow-to-fast-scan converter (with its associated 65K of memory) for less money. Building a digital scan converter without the use of prefabricated PC boards is also a hair-pulling experience.

Robot's 400 is perfectly suited for technical expansions, the most promising one presently being dual 65K memories. This approximately $180 addition can be used for implementing real-time color, restricted motion, and special processing of interference-ridden pictures. Dr. Don Miller W9NTP and Dr. Robert Suding WØLMD are presently the leading pioneers in these areas. (W9NTP may still have these "second memories" available. If interested, send Don a large SASE for full details.)

Medium-Scan TV

One of the most outstanding new concepts to affect our world of visual communications recently is the evolution of the medium-scan TV system. This super-expansion of SSTV combines the best features of both the fast-scan and slow-scan worlds and results in a high resolution-motion TV system capable of international communications. The prime instigators of this system are W9NTP, W3EFG, WB8DQT, W6MXV, and WØLMD. Additionally, W9NTP has demonstrated this system to several European amateurs interested in operating

medium scan from their areas. The prime objective of this amateur "special interest group" is to be the first to effect transatlantic communications with live, motion TV.

Technically speaking, medium-scan TV is a 128 horizontal line by 128 vertical pixel double-interlaced system with a 35-kHz bandwidth. There are 7.5 fields transmitted each second, and a 4-bit sync code is used to designate the specific fields. Color may be employed with this system by properly encoding each field with red and green signals while also integrating the black and white components to produce the "Y" signal. Special Temporary Authorization from the FCC has been granted to the previously-mentioned amateurs to permit transmissions of these wideband signals on the high end of 10 meters.

A simplified block diagram of medium-scan TV is shown in Fig. 1. Since narrowband FM is employed in this system, some easily assembled circuits and an ordinary FM receiver replace the station's regular high-frequency transceiver. A Robot 400 or similar scan converter with dual 65K memories is used to decode and reconstruct the received pictures and present them to a conventional fast-scan television.

Simultaneous Audio and Video

Several techniques for multiplexing sound and SSTV have been investigated, but this form of communication hasn't yet gained widespread acceptance. The simplest and least expensive method of multiplexing audio and video involves using a Motorola MC1596 in its conventional AM modulator/demodulator configuration. These circuits are included in recent issues of Motorola's applications notebooks.

Single-Memory, Compatible-Color SSTV

Mike Tallent W6MXV has been developing a single-memory color system which has substantial promise for SSTV use. This system, which is fully compatible with our existing black and white SSTV system, employs slight modifications of the R-Y, B-Y parameters used in conventional fast-scan TV concepts.

Initially, a 737.5-Hz color subcarrier is modulated in quadrature (in phase and 90 degrees out of phase) with color-difference information, while luminance SSTV modulates the regular 1500- to 2300-Hz bandwidth. At the receiving end, a continuously-transmitted color pilot signal is processed and used to reproduce the color-burst phase reference and control clocking of the D-to-A converter. Basically, this concept permits the interlaced and phase-shifted color information to be loaded in main memory along with the regular SSTV. Next, this information is accelerated to fast-scan rates, removed, and used to construct R-Y, B-Y, and Y signals which drive a conventional fast-scan TV.

While Mike's system suffers the same problems associated with our present NTSC (fast-scan) system (high black and white resolution but poor color resolution), it has the definite advantage of low-cost compatible color. This experimental concept may well prove to be tomorrow's accepted method for real-time color SSTV.

This is an SSTV picture of a human eye operation. The operation jig which holds the probe is fitted to the eye during such operations as cutting the pupil area and inserting a new lens. The picture was the first of a series received from Dave W5DUU.

The Software Situation

There is a natural tendency for specialized modes of communication such as SSTV to attract a larger number of technically-oriented amateurs than on-the-air operating enthusiasts. As a result, SSTV developments have outpaced meaningful on-the-air usages. Naturally, we would like to encourage more "applications-oriented" video enthusiasts to join our ranks. If you have ideas or are involved with activities which can be shared with others through visual communications, the world of SSTV is a haven for endless opportunities. Possibly the following brief discussion of some recent amateur accomplishments with SSTV will help spur your thoughts along these lines.

N6V and the gang at the Jet Propulsion Labs were true pacesetters of SSTV programming with their on-the-spot reports and views of Mars during 1977. The JPL gang is continuing these activities during 1979 with SSTV retransmissions from the *Voyager* spacecraft on a mission to Jupiter, Saturn, and Uranus.

Dave W5DUU, an accomplished eye surgeon in Texas, frequently transmits pictures of human eye operations which are fascinating to view. Dave's accompanying explanations

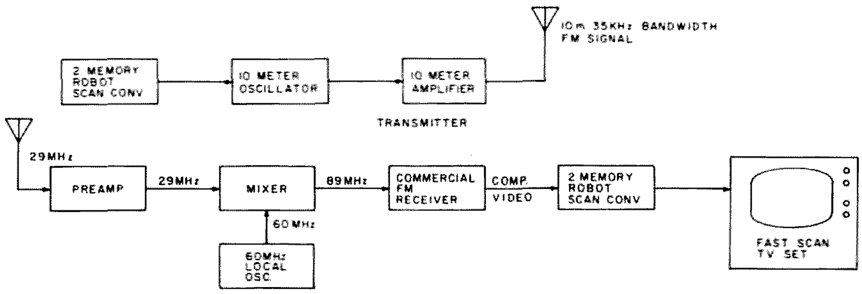


Fig. 1. W9NTP medium-scan TV system which may be used on the high end of 10 meters.

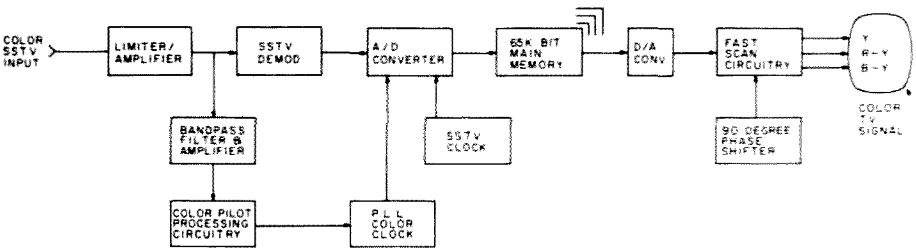


Fig. 2. Simplified block diagram of W6MXV single-memory color SSTV system.

of these operations provide a detailed account of modern optical techniques.

Meanwhile, W1BGW continues retransmitting SSTV pictures received from our weather satellites, W6KZL shows his hydroponic greenhousing, and XE1JOF describes the Mexican pyramids and points of interest in his area.

These examples of SSTV applications illustrate many aspects which are possible when our mode is effectively put to use. We need to see more transmissions of this nature on the HF bands.

ISSS

During early 1978, I began planning to form an International Slow-Scan Society. The prime objective of this organization will be to affect SSTV expansion and acceptance from both technical and operational standpoints on a worldwide basis. Thus far, a number of slow scanners have joined in this effort (providing whatever services are consistent with their interest and ability), and we have established liaison with countries in four of the six continental areas. Eventually, we plan to sponsor our own contests and activities, provide an SSTV "newcomer assistance" service, establish hardware and software library services (which will function like QSL bureau systems), produce a quarterly SSTV newsletter, and much more. Naturally, we need the support of all active slow scanners to ensure that these plans succeed. If you are interested in supporting ISSS, send me one or two SASEs and a brief note describing your particular areas of interest. Your first SASE will be returned when the next ISSS newsletter is produced, and the other SASE will be held until a subsequent newsletter (or specifically requested information) is available.

I would like to hear particularly from amateurs interested in joining my ISSS plans to assist some poverty-stricken areas in our "third world." Some countries are not self-sufficient because their yearly rainfall will not support the needs of their populations. Missionaries and engineers try to teach the inhabitants modern techniques of water engineering—irrigation, contour farming, and so on, but their success is somewhat restricted by a lack of native acceptance. This is an ideal chance for SSTV to prove its merit while also helping mankind!

Getting Started in SSTV

I hope that many non-slow scanners are reading this article out of curiosity, and I would like to encourage you to investigate the fascinating world of SSTV. An "arm and leg" investment isn't necessary for one to equip his station with slow-scan capability. The W6MXV monitor, for example, performs very well and costs approximately $100 to build.

Another great home-brew unit is the WØLMD video-sampling monitor. Larry Prior WA9MFF sells PC boards for this outstanding P-7-type unit. Amateurs interested in "going first class" can purchase a Robot 400 for approximately $700 and be set for any innovations that may evolve in the foreseeable future. If you don't care to purchase a commercial video monitor to use with the 400, Robot's optional VHF oscillator will allow this scan converter to drive your regular TV set via its antenna terminals. I've used this method for several months with my 400 and Sony TV, and it works great.

Summary

The world of SSTV continues to be a wide-open field for amateurs interested in enjoying new modes of communication. It has reached a high degree of technical advancement and become an accepted mode of long-distance visual communication. We are now interested in using this mode to its fullest capability and sharing our world with others.

Whether you are a technical innovator or operating enthusiast, consider this article an open invitation to join our ranks. If you need additional information or assistance, simply contact our SSTV net which meets each Saturday at 1800 GMT on 14,230 kHz . . . or ask any SSTVer. ■

Floyd Fellows WA4CLG
2449 Duncan Drive
Belleair Bluffs FL 33540

How to Toot Your Own Horn

—and stay on key

Try out this simple pitch generator.

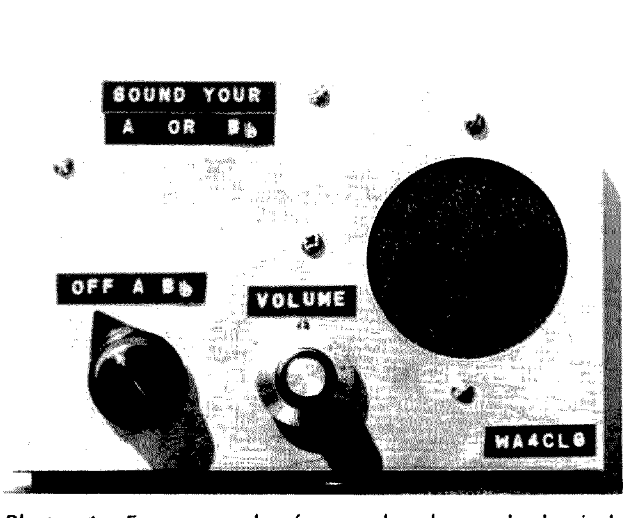


Photo 1. Front panel of completed standard pitch generator.

Chances are that if you are not a musician, then you probably have a "harmonic" who is. But if not, you just gotta have musical relatives or friends! So, you are bound to find some use for a simple electronic circuit which produces an accurate "A" or "Bb" for tuning orchestra or band instruments.

Construction is easy, and will not take much time to complete. See Fig. 1. The oscillator is quite standard; it is one shown by Jan Crystals on their catalog sheet. The oscillator produces 4400 kHz or 4662 kHz.

Through the use of four 7490 ICs, a dividing circuit is set up whereby the oscillator frequency is divided by 10,000. This gives you 440 Hz and 466 Hz. These are, of course, in the audible range and are the musical tones "A" and "Bb"—tuning frequencies used by band and orchestra instruments.

The photos and drawings are self-explanatory. You should have no problem putting the components on the .1" x .1" perfboard (Fig. 2). Also, a drilled PC board is available for $5.18 postpaid from Rick Allran, PO Box 974, Waynesville NC 28786.

I used sockets for ICs and the transistor. It is recommended that you use wire-wrap IC sockets since the extra length of the terminals allows easier solder attachment of the wires. Of course, you can wirewrap if you like. An octal

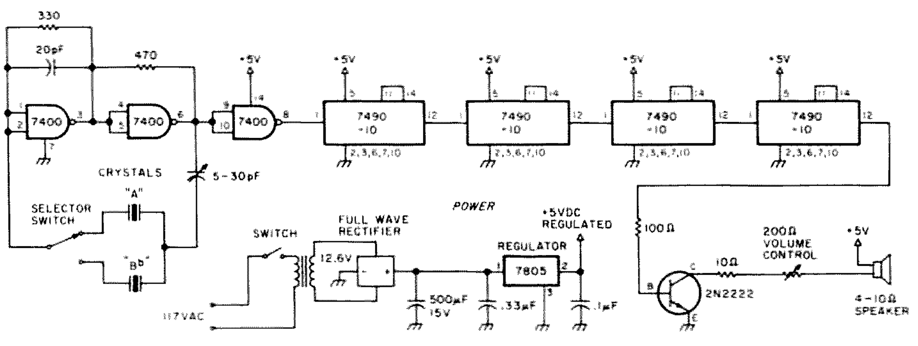


Fig. 1. Schematic of pitch generator and power supply.

socket is used for mounting the two crystals. I removed the unused socket terminals. Proper drilling of the perfboard allows you to mount the octal socket by bending the terminals.

The crystals I used were not expensive specials—simply .005% accuracy. They are in the $2 class.

When the perfboard is completed, you can mount it and the other components in any suitable cabinet. The power supply is my version of a compact "Japanese" assembly, mounted on a 3-lug terminal strip. Photo 2 and Fig. 3 show this neat setup. The voltage regulator socket (a transistor socket), filter capacitor, rectifier, and bypass capacitors, are all mounted together. The cabinet acts as the heat sink for the voltage regulator.

If you have trouble finding a cabinet, as I did, the Radio Shack chassis in the parts list is an economical substitute. I closed the back of the chassis cabinet with a piece of perfboard. You can add a ¼-Amp fuse to the 120-volt ac power input. For true portability, the unit could be powered with batteries, in which case you should use the alternate ICs listed—the 74C00 and 74C90s—because their current drain is less.

I selected the volume control value to allow some audio to be heard even when set at minimum. This helps you to remember to turn off the unit.

When you have the project buttoned up, you are ready to sound a near-perfect "A" or "B♭". You can be sure you're in tune when you match this tuner.■

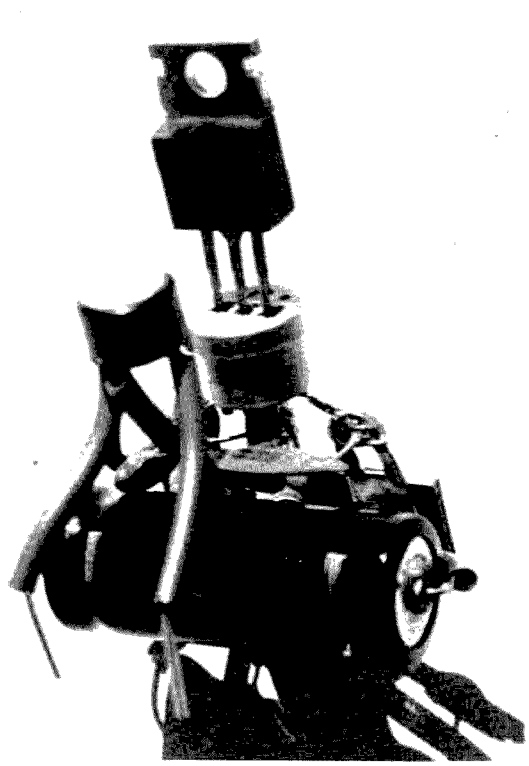


Photo 2. Method of mounting power supply components.

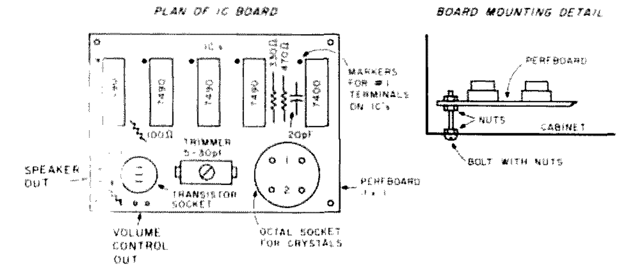


Fig. 2. Component layout.

Parts List

1—7400 IC. } Consider low-current ICs such as
4—7490 IC. } 74C00 and 74C90, If battery supply is used.
1—4400-kHz crystal, Jan .005%, or equivalent.
1—4662-kHz crystal, Jan .005%, or equivalent.
1—Selector switch, 2-pole, 3-position. Use Radio Shack #275-1386. Omit 3 positions.
1—2N2222 Transistor.
1—Speaker, miniature—4-10 Ohms.
5—IC sockets, 14-pin wire-wrap.
1—Resistor, ¼-Watt, 330 Ohms.
1—Resistor, ¼-Watt, 470 Ohms.
1—Resistor, ¼-Watt, 10 Ohms.
1—Resistor, ¼-Watt, 100 Ohms.
1—Volume control, 150-200 Ohms.
1—Trimmer capacitor, 5-30 pF.

Power

1—Transformer, 117/12.6 volts—300 mA or higher.
1—Full-wave rectifier, 1A, 50 volts or higher.
1—Regulator, 7805 (5 volts).
1—Capacitor, 500 uF, 15 volts or higher.
1—Capacitor, .33 uF tantalum.
1—Capacitor, .1 uF (disc).
1—Perfboard—3½" x 2½", with .1" x .1" perforations.
1—Cabinet (Radio Shack Chassis #270-247).
1—Cabinet back.
1—Line cord—117 volts, with plug.
Misc.—Grill cloth, bolts, nuts, cabinet feet, markers, etc.

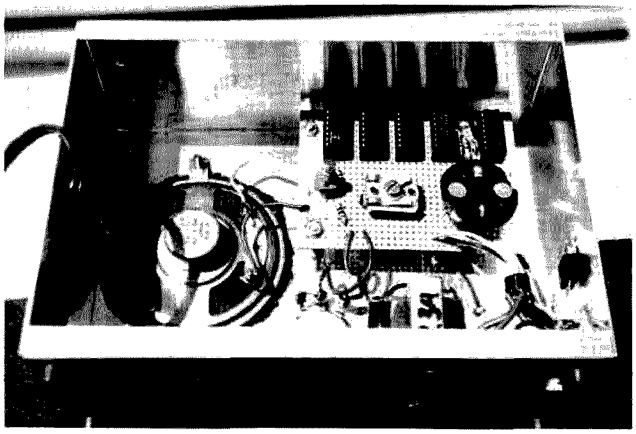


Photo 3. Interior of standard pitch generator.

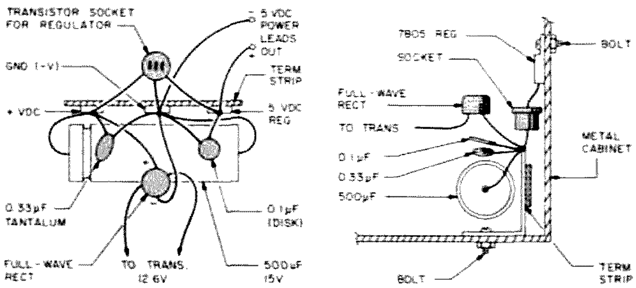


Fig. 3. Power supply component mounting details

A Junk-Box HT Charger

—power to the portables

Very nice at a $5 price.

Sunny Mitchell WB9JLY
Box 438
Sparta WI 54656

Wouldn't it be nice to have a charger for the Wilson HT on the bedside stand, in the living room, garage, or wherever else you might like to monitor? This would allow you to listen and still keep your batteries charged so you could pick it up and go.

I decided that I would like one, so I checked the spare parts department (junk box) for necessaries and home brewed a cheap charger that works as well or better than the factory model.

Its features include:

Constant charge rate in both high and low mode;

Low charge rate adjustable so batteries will stay charged while monitoring;

Use of voltmeters and milliammeters if desired and available, but they are not necessary (more on this later).

Construction

Any small box will hold the parts; I prefer the 5¼"× 6" × 3" box from Radio Shack. The transformer should deliver about 25 volts at the secondary. I found one with 48 volts center-tapped and used one side for 24 volts. A bridge rectifier is used. The capacitor value is not critical; in fact, you can even leave the capacitor out and the charger will work. I measured the current drain of my Wilson (in standby) and found it to be 25 mA instead of the 14 mA stated in the specs, so I adjusted resistance to give 30 mA on low charge and 55 mA on high charge. This is about the correct rate (50-60 mA) for slow-charging AA nicads. You could fast-charge at 150-200 mA without any problems, but I think it is easier on the cells to use the slow rate of about one-tenth the Amp-hour capacity.

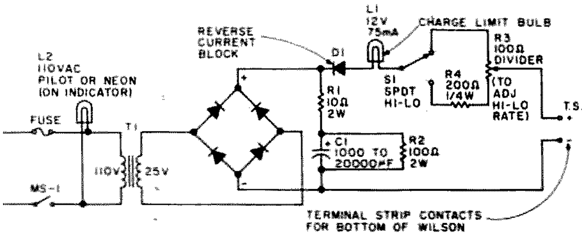


Fig. 1.

A 0-15-volt dc meter is a helpful option across the output terminals to determine the condition of the cells. At full charge, the meter will show approximately 14 volts with the HT in the charger. Also, the condition of the cells is determined by the voltage drop observed by transmitting with the Wilson in the charger. If the cells are good, a 2½-Watt HT will cause a voltage drop of ½ to 1 volt. If the voltage drop is much greater, it is probably caused by a weak or dead cell. A milliammeter is an option, but one should be used to adjust the values of resistance to set the proper charge rate when constructing the charger.

The problem of contacts for the charge terminals on the bottom of the Wilson is solved by using a barrier terminal strip and spade lugs bent to 90 degrees with a short length of #12 solid copper wire soldered into the spade lugs. The hole in the top of the case is cut with tin snips and the edges are smoothed and covered with rubber molding or tape. Pop rivets are handy for mounting the barrier strip and transformer, and a hot-melt glue gun can be used to hold some small parts. The 100-Ohm voltage divider makes adjustment of high-low charge rates simpler. Be careful to handle the 110-volt primary side of the circuit with care. I advise grounded plug and chassis, a fuse at one Amp, and the use of a microswitch to turn the primary on/off when the charger is in or out of use.

It is also a good idea to insulate or cover all 110-volt connections inside the case. Don't forget the rubber grommet to protect the power cord and to provide some sort of strain relief (a knot will do).

Summary

The fourth charger I built was completed in about two hours from mostly junk parts, and it works like a charm. So get busy and have some fun building one or more. They are not critical; just watch the milliamp charge rate. Considering that the commercial version is about $40, these are very nice at about $5, depending on what you find in your junk box. I found the box, which I bought, to be the most costly item at about $4. ■

Protect Your Home-Brew Panels

—no more spraying

The slick way to slick fronts.

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So you've finished your latest project. Now you're ready to label it. A popular way to do this is to use rub-on lettering, such as Letraset. This gives a professional look to your work, something which is impossible with label-makers. But with Letraset, your project will soon look awful if you don't protect the lettering from scratches. To overcome this problem, many builders spray their panels with Krylon or some equivalent. This is the method I used until I came across one which I believe to be better.

The method I use now is to cover the panel completely with the material which is used to cover identification cards and other things. Basically, this stuff is clear plastic with an adhesive backing. While more expensive than using clear spray, the method does have the advantage that only a very sharp instrument can scratch either the lettering or the panel.

The material I used is called "Protecta." It costs me $2.50 for a sheet 18 by 72 inches. This, or another brand, should be available just about anywhere. Just go to your local stationary store and ask for that adhesive plastic stuff which is used to cover ID cards and books.

Now for some info on using this panel-protecting method. First, be sure that the panel is clean and that all the holes have been deburred. Is the lettering just as you want it? Adhesive plastic is fairly permanent. If you want to remove it later, you will have to discard it, and you may even pull off some of the lettering.

The next step is to cut the plastic to size, with about ¼ inch extra on each side. Pull the paper backing from the plastic. Apply the plastic to the panel slowly and evenly. Watch out for air bubbles. If you see any of these, pull off the plastic a bit and reapply it with some pressure. With luck, you now have the plastic down with no air bubbles.

Go over the panel, applying pressure all over. Turn the panel over onto a solid surface. Use a sharp knife to cut the excess plastic from the edges of the panel. Once again turn the panel over, so that the plastic is facing you. With the sharp knife, clear out the holes. Use a downward motion and cut the plastic right at the edges of the holes. For the smaller holes, the knife may not work too well, and I'd suggest using a sharp, tapered instrument such as an ice pick. Simply push the implement through the plastic until it fits the hole. Now your panel is ready.■

✓ Reader Service—see page 195

Now You Can Possess Instant Recall

—don't tell 'em the computer helped

The call is the key.

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How often have you been driving along monitoring your favorite frequency and heard someone with a familiar callsign, but you just couldn't remember the name that went with it? And if they gave you a call, they always threw your name in along with your call, of course. Sometimes it seems like a deliberate challenge designed to see if you can come back with the right name. Wouldn't it be nice if you could always respond with the name as well as the callsign the first time? Wouldn't it be even better if you could return a comment or ask a question about the fellow's hometown, favorite topic, or some other subject close to his heart?

Those of you with instant and total recall may be excused now. Described in this article is a recipe guaranteed to help the rest of us. Those of us, that is, who have either a computer or at least access to one. The two programs listed here are designed to provide the capability of storing, maintaining, and listing in alphanumeric order by callsign, the call, name, and telephone number (or city) of all the mobile contacts you've made and wish to remember. Along with all that information, there is also room for comments and remarks about anything, such as the special interests of each of those operators (e.g., RDF, DX, computers, flying, sailing, etc.).

The goal is to produce a list of stations worked by a mobile operator in a format that is convenient to use while driving (if that's possible). In order to be convenient, the list must be printed in alphanumeric order by callsign on standard-size paper (8.5 by 11 inches). The alphanumeric sequencing is obviously required if a call is to be found easily in any list. The notebook-size paper lends itself to use on a clipboard, often standard equipment for the mobile operator.

The BASIC programming language was chosen for the simple reason that BASIC is the most machine-independent language commonly used on both commercial and hobby computer systems. The particular version shown here uses video display terminal (VDT) cursor positioning control during the data entry and file maintenance functions. Also, the VDT "control keys" may be used as a shortcut to stopping the program or for bypassing the "change" function. More about these features later. If your system does not support these special features, the appropriate program statements may be easily modified without changing the logical operation of the programs. The only other statements that may need minor changes are the input/output statements (READ, WRITE, and PRINT) where, again, ad-

vantage was taken of the extensions available on my own particular system.

As written, the "file maintenance" program requires about 1K of memory, and the listing program needs about 700 bytes. Each data record consists of from 6 to 58 characters, depending upon how many actual characters were entered for each record. Even on systems that support only fixed-length records, a typical floppy disk will still have enough room to store well over a thousand different contacts. Remember, the idea is to produce a listing for mobile contacts, not your entire log.

The key to the whole operation is using a direct-access (also called a random-access) disk file with the callsign being used as the "key" to each record in the file. The file management part of the operating system software automatically keeps each record in the proper sequence by "sorting" the keys as each new record is added to the file. The keys are kept in one area of the disk and the rest of the data in each record is kept in another area contiguous to the first area. Both areas together comprise the whole data file.

Although there are several techniques used by different systems in handling direct-access data files, the result is basically the same. Each record may be retrieved directly without scanning the entire file looking for the particular record desired. This obviously saves a lot of time getting any specific record. At the same time, the fact that each record has its own unique key eliminates the possibility of duplicate records being stored in the same file. Still another advantage of direct-access files is the fact that no separate sorting of the records is required if the records are to be listed in order by their keys. By starting at the beginning of the file and reading it sequentially without specifying any key, all of the records in the file may be read and printed in alphanumeric order by callsign (key) automatically, since the file management system uses the keys area (usually called the "Directory") of the file to get to the physical records anyway.

File Maintenance

File maintenance simply means adding new records or changing or deleting old records in a data file. Program statements 0010 through 0502 in the file maintenance program define the names of the data items to be used in the program and OPEN the data file where all the records containing the information about the mobile contacts will be stored. Statements 100 through 1050 clear the VDT screen and display the heading information which indicates the name and description of the program being executed as well as the date. Each column of information is labeled with the appropriate name. The two-letter sets enclosed in apostrophes are special print control commands for output devices such as the printer and VDT. The CS means "Clear Screen" and is valid only for the VDT. LF means "Line Feed" and causes a blank line to be printed on the printer or displayed on the VDT.

Many computer terminals have special keys called "function keys" or "control keys." These keys may be used as a shortcut method of indicating specific actions to be taken by a program if that program has the ability to interpret them when they are used by the terminal operator. Since this program allows the operator to use these special keys, the actual functions that some of them are programmed for are also displayed when the program begins.

Program statements 2000 through 2440 handle the actual data entry portion of the file maintenance function. Each of the four data items is entered separately, and each is terminated by pressing the carriage return key (CR). The variable (data item) named "F$" was initially defined in statement 0070 to be a string of 30 characters. A very special character ("Control-Period" on my terminal) was included in the DIMension statement for F$ between the quotation marks following the size specified for that data item. This special character does not exist on the printer used to list the program, but it does appear on the VDT screen and looks like the cursor, which, on my own terminal, is a solid-looking block that entirely fills one character position. Actually, this is an "inverted period," but the dot representing the period is so small, it's almost invisible. Several of these characters displayed together look like one long, continuous cursor. Although entirely unnecessary, this little trick enhances the aesthetic quality of the display and emphasizes the particular data field be-

```
0010 REM "HRMLFM".HAM.RADIO.MOBILE.LOG.FILE.MAINTENANCE.
0020 BEGIN
0060 DIM C$(6),N$(10),P$(8),R$(30)
0070 DIM S$(30," "),F$(30,"")
0080 IOLIST C$,N$,P$,R$
0502 OPEN (2)"HRF2"
1000 REM
1010 PRINT 'CS',"HRMLFM",@(10,1),"HAM RADIO MOBILE LOG FILE MAINTENANC
1010:E",@(50,0),DAY
1030 PRINT 'LF','LF'," CALL     NAME       TELEPHONE  INTERESTS, HOBBIES,
1030: & REMARKS"
1040 PRINT "------ ---------- --------- ------------------------------
1040:"
1050 PRINT @(64,0),"CONTROL-KEYS:",@(66,1)," I = CR",@(66,2),"II = 'NO
1050:'",@(66,3),"IV = 'END'"
2000 REM
2010 LET L=5
2020 PRINT @(0,5),'LD','LD','LD','LD','LD','LD','LD','LD','LD','LD','L
2020:D','LD','LD','LD','LD','LD','LD','LD','LD','LD','RB'
2100 PRINT @(0,L),F$(1,6)," ",'RB',
2110 INPUT @(0,L),C$
2120 IF (C$="END")OR(CTL=4)GOTO9000
2130 IF (LEN(C$)=6)GOTO3000
2140 IF (LEN(C$)>6)GOTO2100
2150 LET C$=C$(1,LEN(C$))+S$(1,(6-LEN(C$)))
2160 GOTO 3000
2199 REM ------------------------------
2200 PRINT @(7,L),F$(1,10)," ",
2210 INPUT @(7,L),N$
2211 IF (CTL>1)OR(N$="*")GOTO6030
2215 IF (N$="DELETE")GOTO6000
2220 IF (LEN(N$)<11)GOTO2300
2230 PRINT @(7,L),'RB',
2240 GOTO 2200
2299 REM ------------------------------
2300 PRINT @(18,L),F$(1,8)," ",
2310 INPUT @(18,L),P$
2320 IF (LEN(P$)<9)GOTO2400
2330 PRINT @(18,L),'RB',
2340 GOTO 2300
2399 REM ------------------------------
2400 PRINT @(28,L),F$,
2410 INPUT @(28,L),R$
2420 IF (LEN(R$)<31)GOTO4000
2430 PRINT @(28,L),'RB',
2440 GOTO 2400
3000 REM ------------------------------
3010 READ (2,KEY=C$(1,6),DOM=2200)IOL=80
3020 GOTO 5000
4000 REM ------------------------------
4010 WRITE (2,KEY=C$(1,6))IOL=80
4020 LET L=L+1
4030 IF (L<21)GOTO2100
4040 GOTO 2010
5000 REM ------------------------------
5010 PRINT @(0,L),C$,@(7,L),N$,@(18,L),P$,@(28,L),R$
5020 LET L=L+1
5030 PRINT @(0,L),C$
5040 GOTO 2200
6000 REM ------------------------------
6010 REMOVE (2,KEY=C$,DOM=6020)
6020 PRINT @(60,L-1),"DELETED",'RB'
6030 PRINT @(0,L),'CL',
6040 GOTO 2100
9000 REM ------------------------------
9010 CLOSE (2)
9020 PRINT 'LF','RB',"DO YOU WANT A NEW LISTING NOW?: ",
9030 INPUT C$
9040 IF (C$="YES")OR(C$="Y")RUN"HRMLAL"
9800 PRINT 'LF','RB',"FINISHED...",
9999 END
```

Fig. 1. Program listing—file maintenance.

```
0010 REM "HRMLAL".HAM.RADIO.MOBILE.LOG.ALPHABETICAL.LISTING.
0020 BEGIN
0030 PRINT 'CS',"HRMLAL",@(25,0),"HAM RADIO MOBILE LOG/LIST",@(70,0),D
0030:AY
L060 DIM C$(6),N$(10),P$(8),R$(30),K$(6)
0080 IOLIST C$,N$,P$,R$
0500 IF (C$(1,3)<>K$(1,3))AND(L>1)PRINT(5)""
0520 OPEN (2)"HRF2"
0550 OPEN (5)"LP"
0600 LET N=1,P=1
1000 REM ------------------------------------------------------------
1010 PRINT (5)'FF','EP',"WB5UTJ MOBILE QSO LIST  ",DAY,'LP'
1030 PRINT (5)" CALL     NAME      TELEPHONE   INTERESTS,HOBBIES, & REM
1030:ARKS              PAGE",P
1040 PRINT (5)"------ --------- -------- --------------------------
1040:------"
1100 LET L=1
2000 REM ------------------------------------------------------------
2010 READ (2,END=9800)IOL=80
5000 IF (C$(1,3)<>K$(1,3))AND(L>1)PRINT(5)""
5010 PRINT (5)C$(1,3)," ",C$(4,3),@(8),N$,@(19),P$,@(29),R$,@(61),N
5020 LET K$=C$
5100 LET L=L+1,N=N+1
5110 IF (L<51)GOTO2000
5120 LET P=P+1
5130 GOTO 1000
9800 PRINT (5)'LF','EP',"ORT"
9999 END
```

Fig. 2. Program listing—alphabetical listing.

ing requested by the program.

The first thing the program requests is a callsign. When a call is entered, the program verifies that the call does not exceed six characters in length (the maximum size defined for the keys in the data file). If too many characters are entered, the program rejects the entry and requests the callsign again. Each time a call is requested, the VDT audible "beep" signal is sounded by the RB command included in statement 2100. RB means "Ring Bell," and, even though that name came originally from the older teletypewriters which actually did have a bell inside, the name stuck and is used to indicate the "beep" signal used on most video-type terminals.

I might mention, by the way, that, even though this program is intended for use with a video terminal, it will run on hard-copy terminals if the statements containing "F$" are simply removed.

Automatic Mode Change

When a valid callsign is entered (actually, any six characters will be accepted), the program immediately checks the data file to see if that callsign had been entered previously. If it is a new call, the next data field is "lit up" (or underscored, if your terminal uses the underscore character for a cursor) and a name can be entered. The next field may be used for either a telephone number or city name, and the last field may be used for any comments you may want to remember about that particular operator. Each new line entered remains on the screen until 20 lines have been entered, at which time statement 2020 sends 20 "Line Delete" (LD) commands to the VDT at row 0, line 5, causing the last 20 lines entered on the screen to be "scrolled" up and out of sight. This prevents the heading information at the top of the screen from being lost after the last line on the screen has been used, since most VDTs automatically scroll all the lines up one line each time the last line is used.

The process continues until a call is entered that is already "on file." When this happens, the information previously entered for that operator is displayed under the appropriate column headings. The callsign is then displayed again on the next line down and the program requests something to be entered in the "name" field. If the information displayed on the previous line is correct as is, you can simply press the "Control-II" key, and the computer will leave that record unchanged and request another callsign. If your terminal doesn't have function keys, the program will accept a single asterisk (*) as the indication that the record displayed is not to be changed. If, however, you do wish to change anything in that record, simply reenter each of the three remaining data items as they appear in the line above, making the changes as desired. Upon receipt of the last item, the old record is replaced by the new information and another callsign is requested. Simple.

If you wish to completely delete any particular callsign from the file, just enter the callsign. When that record is found and displayed on the screen, enter the word "DELETE" in the name field. The program will remove that record completely from the data file and display the word "DELETED" by that line on the screen (statements 6000 through 6040), and then request another callsign.

Typing the word "END" (or hitting the "Control-IV" key) when the program is requesting a callsign will terminate the file maintenance program. Before it stops, however, it will ask if you want a new list to be printed immediately. If you enter "YES" or "Y", the second program will be executed automatically, saving you the trouble of having to run it yourself. This allows you to enter several new contacts or make a few changes as convenient, without actually producing a complete new listing each time you run the maintenance program.

Printing the List

The second program may be run separately whenever an updated listing is desired, as well as automatically at the end of the file maintenance pro-

WB5UTJ MOBILE QSO LIST 02/13/78

CALL	NAME	TELEPHONE	REMARKS	PAGE 1
K5 ANW	CHARLES		RDF, COMPUTERS, (DP FORMS SLS)	1
K5 FOO	JOE	461-7505	RACES, RDF, ARLINGTON RADIO CLUB	2
K5 IHD	DON	292-4703	TRSUR. OF WR5AER, 4709 CARLYLE	3
K5 IID	TOM		FOREST HILL	4
K5 IIL	KEN RIDOUT	271-3935	NOVICE TEST, SAILPLANE OWNER	5
K5 JLB	AL		COPERAS COVE, TX	6
K5 KOR	NIKE GUSKY	271-3826	FLYING, COMPUTERS	7
K5 RHZ	CHARLIE	297-9210	SHOP: 926-1869, DX, SS, RACES	8
K5 TER	DON	634-9810	(OFFICE #)	9
K5 YL	RUTH	267-0407	TOM(K5YM)	10
K5 YM	TON CHANCE	267-0407	RUTH(K5YL), EX-WA5VJX, ARRL OFCR	11
N5 DK	DICK		ARLINGTON, (AA PILOT)	12
N5 TE	BOB		EX-WB5TEA	13
N5 UN	GARY	834-8413	EX-K5BVJ, DX, (TV STN)	14
W5 DIF	BILL		CONFEDERATE AIR FORCE	15
W5 FL	WEN	498-0240	DX, RACES, (DESIGN ENGR)	16
W5 GES	ED	267-4089	RDF, NAVYMARS, RMT. CTL. AIRCRAFT	17
W5 HVF	MACK	589-2619	RDF, NAVYMARS, RACES, COFFEE	18
W5 JDL	PAPPY		OWNS OAK GROVE AIRPORT	19
W5 GFN	BILL	926-3113	KC CLUB, RACES	20
W5 TAW	ADRIAN	283-0052	COMPUTERS, (BUILDER)	21
W5 TI	BILL	737-7891	FIELD DAY STN OF KC CLUB, RACES	22
W5 UXP	EDDIE	451-6100	RACES ORCR, RDF, P-51, (INSUR)	23
W7 ERM	JOEL		COMPUTERS, 22/82, (MOSTEK)	24
W8 BZB	JONATHAN		SAN ANTONIO, TX., (DATAPOINT)	25
WS TIF	KARL	238-0773	COMPUTERS, 22/82	26
WA4 IXN	"WOLF"	284-9794	OWNS A SCORPION-2, RACES, (FWPD)	27
WA5 AKD	ED	429-0596	NEIGHBOR, ARMYMARS	28
WA5 JCQ	JEAN	924-7990	RACES, KC CLUB TREASURER	29
WA5 JFD	JESSIE	267-7386	(RAILROAD)	30
WA5 MHW	TRACY	293-2275	RACES, (ELECTRONICS RETAILER)	31
WA5 QPZ	DUDLEY	499-3804	HOUSTON, TX (GA COMPUTERS)	32
WA5 USY	FRED		(ARLINGTON ELECTRONICS)	33
WA5 UVU	DON	838-0275	RDF, RACES, (DEPUTY SHERRIF)	34
WB5 CPG	BILL		COMPUTERS, DX, (ARL ELECTRONICS)	35
WB5 DMR	BETTY	268-2666	RACES OFFICER, KC CLUB	36
WB5 FIV	JERRY		AGGIE	37
WB5 FLQ	CLAUDE	923-4400	RACES, FISHING(WHITNEY), SAILING	38
WB5 FPI	ED (VELON)	293-0565	429-7200, (KNOK), RDF, CMTRL OPR	39
WB5 HFH	BEN	624-8978	RACES OFFICER, CD OFF. 335-5754	40
WB5 KCK	ROGER	478-5819	JEAN(WB5UXV), RACES, KCC OFCR	41
WB5 KUB	DALE	748-6601	BICYCLING, SPORTS, GE PROG, (CPA)	42
WB5 NXS	DENNIS	485-2196	RDF, NAVYMARS, RACES, COFFEE	43
WB5 OMR	BOB		NEIGHBOR, ANTENNAS, DX, COMPUTERS	44
WB5 PXF	CHERYL	232-1530	JACK(WB5PYG), RDF, KCC MAIL LIST	45
WB5 PYG	JACK	232-1530	CHERYL(WB5PXF), RDF, RACES	46
WB5 RFA	GARY	478-8470	COMPUTERS, UHF, VHF, CB, RDF, RACES	47
WB5 TQJ	DAVE	460-8627	RACES, NAVYMARS, (ARLINGTON PD)	48
WB5 ZPN	JIM	268-5550	RDF, NAVYMARS, AGGIE, (USED CARS)	49

Fig. 3. Sample run of the mobile QSO list.

gram. Having two separate programs keeps the amount of memory required to a minimum. The listing program simply READs the previously described data file sequentially by callsign (key) and prints the information stored in each record in a format I have tried and found to be most convenient to use while operating mobile. As previously mentioned, each record is automatically stored in alphanumeric sequence by the file management system. Thus, no separate sorting of the records is required. Each record is read sequentially and printed in callsign order.

It is possible (and actually quite easy) to have the program rearrange each callsign in such a way that the sorting order is the same as that used in the *Callbook*—that is, all calls in the same call area listed together. However, this method did not seem to have any advantage for the mobile operator who needs to locate a specific call quickly and easily. Although I would not want to see the *Callbook* listed this way, it does speed up the search if you include the call area in the prefix and keep all the Ks, Ws, WBs, etc., together in this kind of list. I also found that printing a space between the prefix and suffix of each callsign greatly improved the readability of the list. Still further improvement was obtained by leaving a blank line between each different prefix group. The listing program simply skips a line whenever there is any difference between the first three characters of the next callsign to be printed and the first three characters of the last callsign printed. The combination of separating the prefixes and the suffixes and leaving a blank line between each different group makes it extremely easy to locate a particular call quickly (assuming, of course, that the call is in the list).

You will probably notice from the prefixes and some of the remarks in the sample listing that it was compiled from contacts in the Dallas-Fort Worth "metroplex" area. Certainly there are no restrictions on how the list is used. If I had been equipped to operate 75 or 40 meter mobile, I think the list would have been even more valuable.

There are always tradeoffs to be considered when writing new programs. One touch of laziness must be admitted here. I did not bother to do any "processing" of the callsigns, except to ensure that none were longer than six characters in length. I also chose to manually enter a blank at the beginning of all 1 × 2 and 1 × 3 calls in order that those would be listed in the "proper" sequence. This could have been taken care of by the program, but the extra program steps did not seem justified based on the fact that it is so simple and easy to just enter the blank when entering such a call.

The listing program prints 50 calls on each page and puts a sequence number on each line down the right-hand side of the listing. Since the printer I use has the ability to produce "Expanded Print" (EP) for any specified line, I used this feature to print the heading line at the top of each page. Each of the four data columns is labeled, of course, and each page is consecutively numbered. If you don't have a separate printer on your system, you can easily change the listing program to print the list on your terminal if it is the hard-copy type. ■

Richard J. Lutz
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Calcu-Trip

—a program for the open road

Silence those questioners.

"Did you make good time?"

"What route did you come?"

"When did you start?"

"How long did the trip take you?"

"How fast did you drive?"

The first half-dozen questions after every trip home have to do with the trip itself. If this has happened to you, on trips home or anywhere else, you know that most of the curiosity can be satisfied with average miles-per-hour—and then you can get on to less mundane matters.

Here's a simple-minded program for your HP-55 calculator, adaptable to other programmables, which will answer the questions. *RCL 7* provides the last calculated average mph, *RCL 6* provides total accumulated rest stop time, *RCL 1* helps you remember when you started, and *R4 minus R0* tells you the miles you've covered.

The next time you arrive, you can walk in prepared—with calculator in hand. Better yet, hand your HP-55 to the curious and let them figure it out while you wash the trip off your face! ■

Display Line	Code	Key Entry	Comments
00			KEY IN current odometer reading & KEY R/S.
01	33	STO	Stores current odo reading in R4 for use later in
02	04	4	calculation.
03	84	R/S	KEY IN current time in format HH.MMSS.
04	33	STO	Stores current time
05	02	2	in R2.
06	34	RCL	Recalls starting time and subtracts it from
07	01	1	current time to determine time since trip
08	32	g	began, still in format HH.MMSS.
09	41	H.MS-	
10	31	f	Converts time since trip began to
11	01	H←	decimal hours.
12	33	STO	Stores this in R5.
13	05	5	
14	34	RCL	Recalls accumulated time out
15	06	6	from R6,
16	31	f	converts it to decimal hours, and
17	01	H←	subtracts it from time
18	51	-	since trip began.
19	33	STO	Stores active driving time
20	05	5	in R5.
21	34	RCL	Recalls current odo reading from R4
22	04	4	and then
23	34	RCL	recalls beginning odo reading from
24	00	0	R0 and subtracts to get miles traveled.
25	51	-	
26	34	RCL	Recalls active driving time from R5 and
27	05	5	divides it into miles traveled
28	81	÷	to derive mph average.
29	33	STO	This is STOred in R7 for later recall
30	07	7	by hand if desired.
31	24	FIX	Fixes one decimal place (but by modifying
32	01	1	step 32, any number of places can be used).
33	-00	GTO00	Returns program to beginning.

At Start of Trip:
A. STOre starting time in format HH.MMSS in R1.
B. STOre base odometer reading in R0. For cars with a trip odo, this can be left as 00.00, or car's accumulated odo can be used.
During Trip:
C. If you want mph averages based only on driving time, add each rest stop in format HH.MMSS to R6. (RCL 6, KEY IN latest time out, f, H.MS+, STO 6.) Ignore this step if you want overall average mph regardless of stops.
D. To calculate current average mph, KEY IN current odo reading and punch R/S. Then KEY IN current time (HH.MMSS) and punch R/S again. OUTPUT will be average mph attained.

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Charging Up the WE-800

—a convenient alternative

External operation, internal charge.

The Wilson WE-800 is a versatile, synthesized two meter FM portable transceiver. It operates from an external 13.8-volt source or internal nicad batteries with the mere flip of a switch on the rear apron. Unfortunately, there is no provision for charging the nicads while operating from external power. Anticipating that this would be a useful feature, I immediately went to the books to find a suitable constant-current charging circuit.

Experiments were run using a series current-limiting resistor while charging the nicads from a 13.8-volt regulated power supply. Various resistances ranging from 10 to 36 Ohms were tried, but in every case the starting current was either much too high (100 mA plus) or it dropped off rapidly to well under 50 mA within the 16-hour charging period. (My GE nicads specify a charging rate of 40-50 mA for 16 hours.) Experiments with various pilot lamps in place of the resistor yielded much less variation between the starting and fully-charged currents. Either a 47 or a 1847 bulb (6.3 V, 150 mA) produced charging currents in the 50-mA range. I found that individual batteries, even new ones of the same make, may affect the charging rate and it is wise, therefore, to substitute batteries and monitor the charging rate during the experimental period.

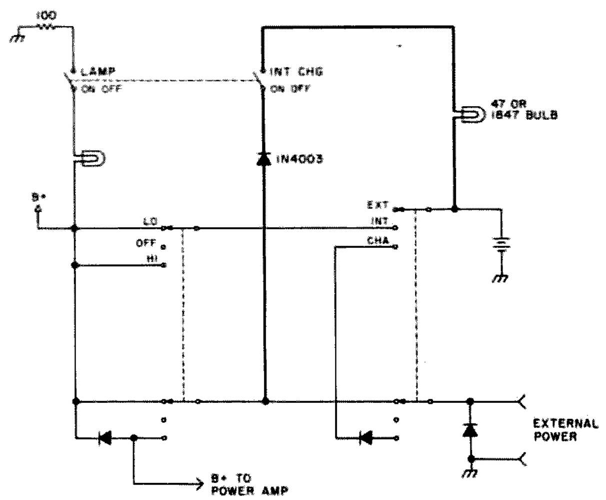

Fig. 1. The new circuit is shown in bold.

Fig. 1 shows the final charging circuit. The 1N4003 diode prevents current flow from the nicads to the external power source. The dial light on-off switch is used also to turn the internal charging circuit on and off. Just remove the existing wires from one side of this switch and use that side to control the charging function. Nicad memory dictates that the batteries should be fully discharged before full recharging, and this switch allows controlled charging. With the circuitry shown, the nicads charge if the charge switch is on, even if the rig's power switch is turned off. When the power switch is turned off, the nicad charging current can be read directly with a milliammeter in line to the external power socket.

The charging current to discharged nicads starts at approximately 75 mA and drops slowly to approximately 50 mA over four hours. This rate holds for the remaining 12 hours. Very similar results are obtained in the car, but there is reduced charging current until the engine and alternator are running. This is because the charging current is determined by the relative voltage of the charger and chargee.

Incidentally, the Wilson WE-800 Owner's Manual does not contain a caution against charging the nicads directly from a regulated power supply, and it probably should. A charging current well in excess of 150 mA was measured with this direct hookup.

With the modified WE-800, I can operate two meters at home or in the car while the nicads are simultaneously charging. With a little imagination, similar circuitry could be installed in almost any nicad-equipped rig. ■

References

Arvid G. Evans K7HKL, "Regulated Nicad Charger," *73 Magazine*, June, 1977, p. 117.

Hank Olson W6GXN, "Battery Chargers Exposed," *73 Magazine*, November, 1976, p. 98.

The Radio Amateur's Handbook, 1978 edition, p. 134.

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Kingsley MI 49649

Where Have All the kHz Gone?

—are ham bands an endangered species?

Prophets of doom vs. masters of deceit.

Paradise lost; that could be the story of our beloved old 40 meter band. What fun we had! If we wanted to work Australia, we looked from 8000 to 9000 kHz, Europe was from 6000 to 7000 kHz, and the USA hams had 7000 to 8000 kHz exclusively to roam around in. We never heard of intruders, and all was beer and skittles until the ARRL started to "preserve" our bands.

Let's take a graphic look (Figs. 1 and 2) at our workhorse bands that were admittedly preserved by the ARRL. They very graciously (and with great publicity) provided the sum of $100,000 to protect bands that were worth a king's ransom, bands so valuable even today that you cannot put a price on them.

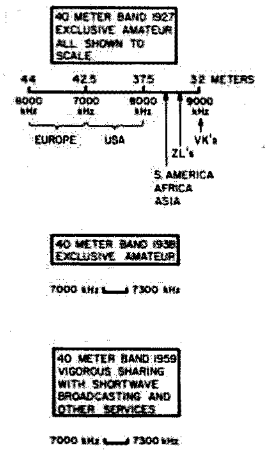

Fig. 1.

Pretty gruesome, isn't it? But that "ain't" the total story. When shortwave stations began to appear in our bands, our vigilant ARRL, with great poise and indignation, coined the word "intruder" and established the intruder watch. The purpose of this is to enable you to let off steam and have you think that something is being done about the problem. This intruder watch is a real exercise in frustration. So you report them, and years later they are still going merrily on their way. You know why? Because no one ever objected at the proper time to their being there. International law says that these frequencies are requested from and assigned in Geneva and, after assignment, other countries have a year to object to the allocation before it is final and the station goes on the air. After the station is on the air, it's too late.

This intruder thing may break our backs at WARC '79. Believe it or not, the dear broadcasters are now looking at *us* as intruders and want to throw *us* out! The extent of the intruders on 40 meters at night is horrendous and is rendering the band useless. Now you are begining to see them appear in daylight. At night, 40 is one mass of heterodynes and signals.

Have you ever wondered just how many stations are in there? *World Radio and TV* lists 414 stations all within 7000 to 7300 kHz. There are powers listed from 10 kW to 250 kW. Ninety percent of the powers are listed as 100 kW, 8% are listed as 250 kW, and 2% are over 50 kW. The Voice of America has 40 stations in this band, with powers of 100 kW to 250 kW. It's no wonder we hear a raft of intruders!

Our USA broadcasters took 100 kHz of our 160 meter band, and recent events indicate that they are going after more of this band. Other bands have gradually disappeared. Ham radio has been, and is, being piecemealed to death. After each WARC (and between some), we lose kilohertz and privileges. We are forced to develop new technology to cram more and more of us into a smaller and smaller space. It won't be long before we will have to develop "negative frequency." It's sad, and a sad commentary on our ability to preserve our bands.

Our dear ARRL writers have labeled men like me "prophets of doom." I have a name for them: "masters of deceit."■

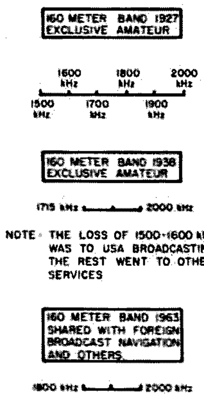

Fig. 2.

June 1979

Novice, QRP, 200 w, deluxe — good, better, best — $299, $369, $399, $699, $869, $899, $1069. TEN-TEC has them all. A choice of seven HF transceiver models — a choice of power levels — a choice of operating features (and accessories) for beginner or old timer. Best of all, there's a wide choice of prices to fit every amateur budget.

TEN-TEC "OMNI" TRANSCEIVERS — REALLY CHOICE.
Top of the line. Deluxe in every respect. Deserving of a place in the finest of operating positions. All solid-state 100% duty cycle 200-watt final amp.; 8-bands (160-10 m plus convertible 10 MHz and "Aux" band positions); broadband design for no tune-up; built-in VOX and PTT; built-in Squelch; 4-position CW-SSB filter and 8-pole crystal filter with separate mode switch to permit using all filters in all modes; 2-speed break-in; 2-range offset tuning; optimized sensitivity from 2 μV on 160 m to 0.3 μV on 10 m; greater dynamic range (typically better than 90 dB) plus PIN diode switched 18 dB attenuator; WWV at 10 MHz; front panel control of linear/antenna bandswitching; phone patch jacks; "timed" crystal calibrator (on "A" model only); zero-beat switch; SWR bridge; adjustable ALC and sidetone; dual speakers; plug-in boards; "clamshell" aluminum case with black vinyl covering plus warm dark metal front panel; full shielding, optimum size for convenient operation: 5¾"h x 14¼"w x 14"d. Model 545 OMNI-A with analog dial, only $899; Model 546 OMNI-D with six 0.43" LED digital readouts, $1069. Model 645 keyer, $85, Model 243 Remote VFO, $139, Model 248 Noise Blanker, $49, Model 252MO AC Power Supply, $119.

TEN-TEC "ARGONAUT" TRANSCEIVER—QRP CHOICE.
The challenge and excitement of working the world on 5 watts. And every feature you need: all solid-state; 5 bands (80-10 m); full amateur band coverage SSB/CW; sensitivity less than 0.5 μV; offset tuning; 4-pole IF crystal filter, 2.5 kHz bandwidth; analog dial; vernier tuning; automatic sideband selection; built-in speaker; 5-watt input to broadband push-pull final amplifier; PTT; full CW break-in; adjustable sidetone volume and pitch; built-in SWR bridge; TVI filter; plug-in boards; small and light weight enough to go anywhere (4½"h x 13"w x7"d and 6 lbs.). World beating price, too: Model 509 only $369; Model 210 AC Power Supply just $34.

TEN-TEC 540/544 TRANSCEIVERS—POWER CHOICE.
200 watts from the bottom of 80 m to the top of 10 m — SSB or CW. No compromise from the leader in solid-state HF technology. Instant band change without tune-up; sensitivity 0.3 μV; offset tuning; 8-pole crystal-lattice filter; WWV at 10 & 15 MHz; push-pull solid-state final amp.; 100% duty cycle; adjustable ALC with LED indicator; built-in SWR bridge; PTT; full CW break-in; adjustable sidetone pitch and vol.; zero-beat switch in Model 544. Choose the value leading Model 540 with analog dial and built-in 25 kHz pulsed calibrator for just $699 or the Model 544 with six 0.43" LED digital readouts for $869. Model 240 160M converter, $110; Model 262M AC Power Supply with VOX, $145; Model 252M AC supply only, $119.

TEN-TEC CW TRANSCEIVERS—BUDGET CHOICE.
The "Century 21" series. Unique. Modern technology with old-fashioned value. Fine performance, reliability, and simplicity of operation, all at low cost. Win raves from novices and confirmed brass pounders alike. All solid-state; 5 bands (80-10 m) full amateur band coverage; receive CW and SSB, transmit CW; sensitivity 1 μV or less; offset tuning; 3-position selectivity (2.5 kHz, 1 kHz, 500 Hz); 70 w input to push-pull Class C final amp.; broadbanded for no tune-up or resonating; full break-in; adjustable side-tone level; built-in AC power supply. Choose Model 570 with analog dial for only $299; Model 574 has a 5 LED digital readouts for only $399.

The choice is all yours when you choose TEN-TEC HF transceivers; see your nearest dealer or write for full details.

arma

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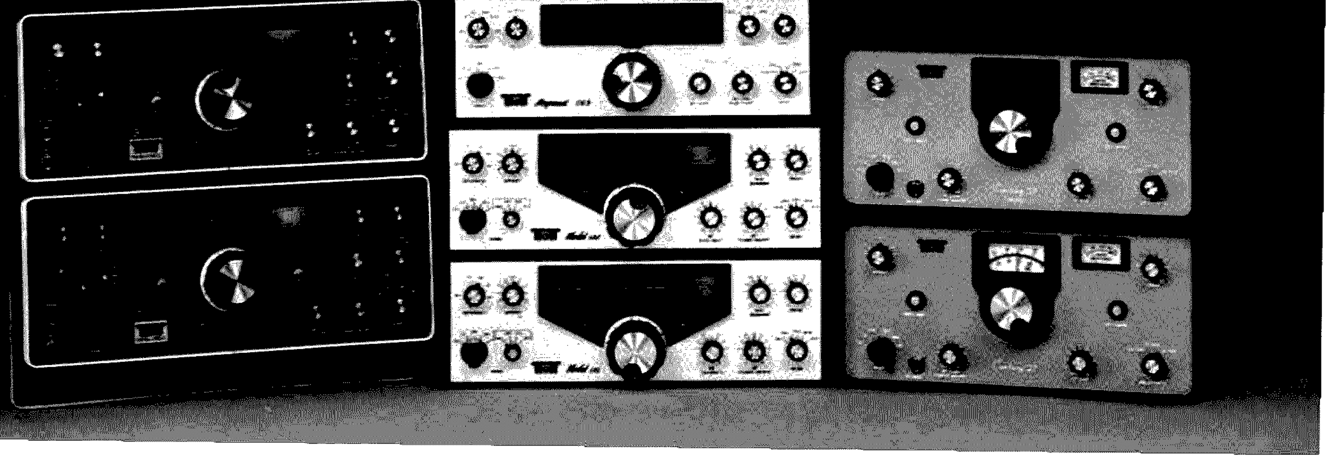


The Ramsey 2m Amp Kit

—has a high Watts-per-dollar ratio

Compete with the big guns.

Tim Daniel N8RK
7 Peabody Drive
Oxford OH 45056

A few weeks of operating a Drake TR-22C convinced me that it was a good rig, but the 1½-Watt output just did not do the job. Unless you live next door to the repeater, your signal needs some kind of boost. For me, this booster had to meet the following requirements:

1) Low cost—leaving me enough money for another project.
2) Easy to construct—no tricky circuits or oddball parts.
3) Portability—usable at home, mobile, and in the field.
4) Adaptability—having other possible applications.

The portability requirement ruled out any antenna scheme. While an amplifier seemed to be the only option left, a quick check of the catalog file showed that such units are available, but the prices just didn't agree with my tight budget, and the fact that my workbench was already cluttered with several unfinished projects ruled out homebrewing.

One day, as I was scanning the ads in my favorite magazine (*73*, of course), I saw it: the Ramsey Electronics PA-1. It's a two meter power amp kit which features 8 Watts out for one in, and as much as thirty out for four Watts in. The best part was the price. At $22.95, it looked like a real bargain. It looked *too* good to be true, however, so instead of running out and buying it, I promptly forgot about it.

A few months later, at the Wheaton, Illinois, hamfest, the Ramsey people had a sample PA-1 on display. At first I thought it wouldn't work—it was just too simple. However, the reduced hamfest price got rid of any fears I had left, and I bought it.

The heart of the amplifier is a Motorola VHF power amplifier transistor. Its hefty construction convinced me it could easily handle the claimed thirty Watts if properly heatsinked. Class C operation is used, so. the unit is suitable for either CW or

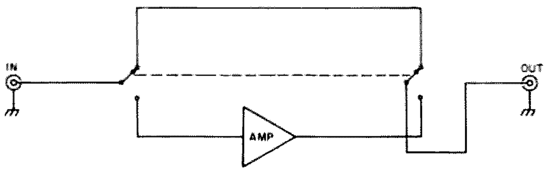


Fig. 1. A DPDT toggle switch or relay (see Fig. 2).

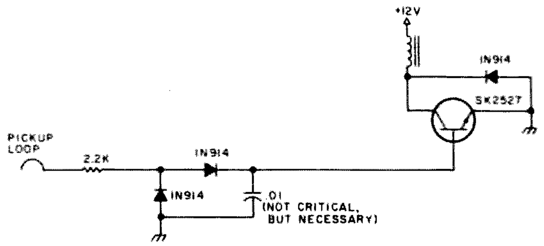


Fig. 2. Rf-sensing, relay-driver circuit.

FM operation. This also allows power consumption to drop to zero when receiving, so that battery life is extended in portable operation. Its wide input-to-output range makes it great for hooking up to rigs with different power output levels. Trimmer capacitors and a choke keep the unit running clean.

The instruction sheet takes only a few minutes to read. It is clear and to the point. Construction took me only two hours, but it could be done easily in half that time by a determined worker. The best part was the coil winding—it was over in less than five minutes. Soldering the transistor is the only critical step, and it is done last, so you have plenty of practice. I used plenty of heat-sink goop and made sure it was securely fastened to the chassis. The circuit board was the best I've seen in any kit; solder flowed on it with no problem. All parts were tack-soldered to one side of the board, so it helped to use plenty of heat.

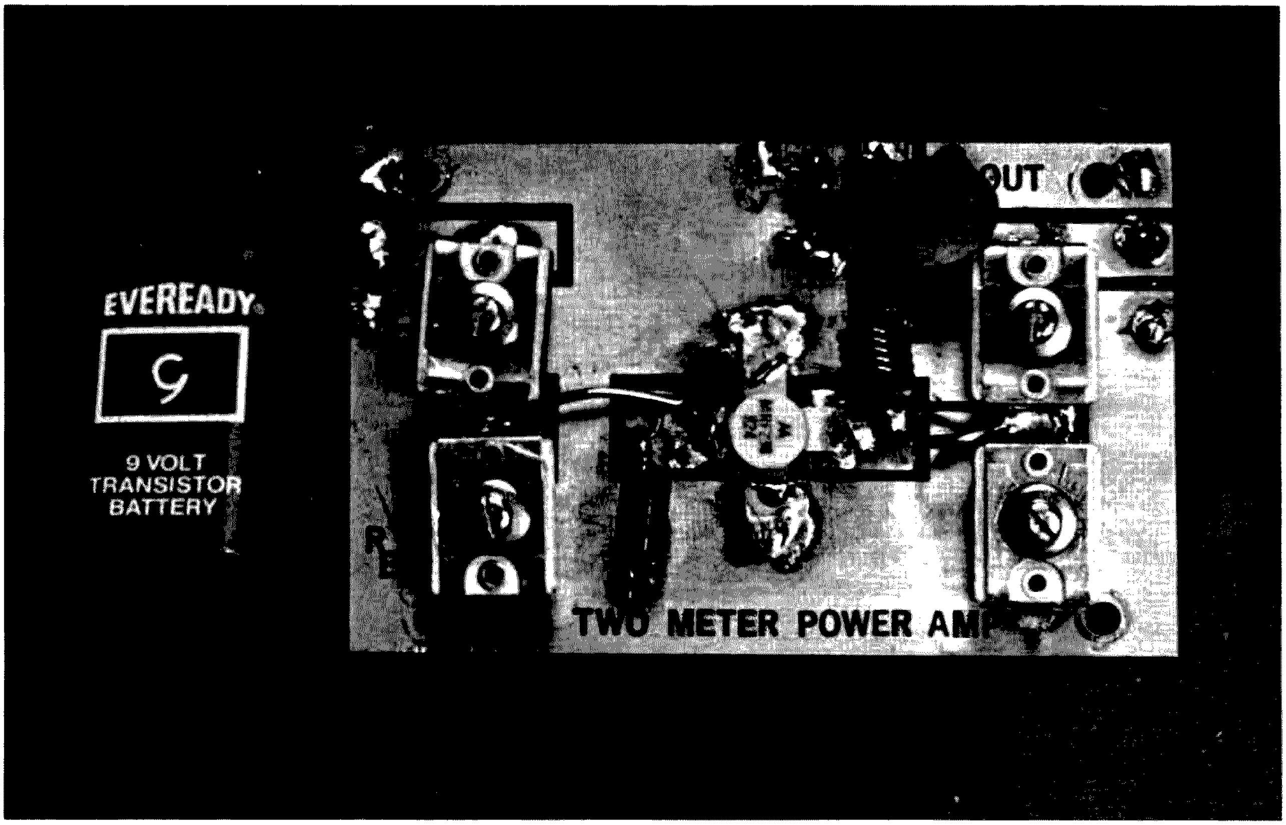
Tune-up was as easy as construction. A wattmeter or some other measuring device is needed. The trimmers are adjusted for maximum output, and the amplifier is ready to go on the air. A check with a Bird wattmeter showed the amplifier output to be greater than nine Watts when driven by my TR-22C. The gain at that level is 8.9 dB, very close to the transistor spec-sheet 9-dB rating. Current drain was 1.2 Amperes, so efficiency was about 65%.

The kit comes with a circuit board and all the parts that go on it. No hardware, connectors, case, or switching circuitry are included. These can be obtained easily at an electronics supermarket if you don't already have them in your junk box. I bought a 5.25 x 3 x 2-inch aluminum minibox to house the circuit board and act as a heat sink. It is a bit larger than the board, so I have room for a receiver preamplifier or other additions at a later date. SO-239 connectors are mounted on either end of the box. I used the single-mounting-hole type, since they require less hardware and chassis work.

The instruction sheet includes a schematic for a T-R switching circuit. A DPDT relay is driven by a two-transistor sensing circuit. Since my junk box didn't have a relay that works on 12 volts, I decided to use a toggle switch instead. This simple approach, shown in Fig. 1, works well despite the inconvenience of having to flip a switch after every transmission. Later I was able to replace this cheapskate approach with a relay purchased from a surplus vendor. I simplified the suggested rf-sensing and relay-driver circuit by eliminating a transistor, two resistors, and a capacitor. A short length of hookup wire looped around the input line provides plenty of drive. The result, shown in Fig. 2, was wired on a small piece of perfboard which is glued to the relay case.

Someday my PA-1 will serve a second purpose as part of a simple exciter for OSCAR use. The PA-1 is one of several kits by Ramsey which I have built. All of them have met my expectations. The PA-1 has proven to be a real help in bringing up repeaters and in greatly improving my simplex range. Thanks to the PA-1, I can now compete with the big guns.■

Photo by W3GAT



Ramsey Electronics' 30-Watt two meter power amplifier.

Paul A. Hudson WA6AVJ
4135 Jackson St.
Riverside CA 92503

An Improved Display for the TR-7400A

—very sensible

Simple, fast, effective!

The Kenwood TR-7400A 2 meter FM transceiver is a fine radio, but it can be improved, operationally speaking, by a simple modification.

This modification:

1. Eliminates out-of-band operation forever;
2. Provides instant monitoring of a repeater input frequency;
3. Costs nothing, requires no parts, and is easily restored.

To proceed, disconnect the power to the radio and remove the bottom cover. Looking at the large receiver board from the front, locate wire-wrap pin "TS" at the left front edge of the board near the relay. Remove the wire end from the pin by unwrapping. Now locate wire-wrap pin "RS" located at the right front of the board somewhat in from the right edge. Remove the wire from the pin by unwrapping. Slip this wire back through the cabling until it will reach pin "TS". Trim off excess bare wire and solder to pin "TS". Finally, splice about three inches of insulated wire to the remaining wire and solder to the "RS" pin.

Voilà! The "TX OFFSET" switch now becomes an "RX OFFSET" switch. The radio will now transmit only the frequency displayed on the LED readout (and the selector switches). No more accidental out-of-band transmitting when operating above 147.400 MHz! The "RX OFFSET" switch now affects only the receiver frequency and provides the +600 and −600 kilohertz offset function as marked. When working through a repeater, the operator may instantly check the input frequency by flipping the switch to "SIMPLEX" to see if the station being worked can be heard directly, indicating that a move to a simplex frequency would be in order. Simplex operation is the same as before modification.

As a final touch, a white decal letter "R" may be applied in place over the "T" above the offset switch and the caption "TRANSMITTER FREQUENCY" can be applied above the LED readout. Shouldn't all transceivers operate this way?

Credits to the Anaheim (CA) Amateur Radio Club and WB6ZFU for providing the information on the "RS" and "TS" functions.■

✓ Reader Service—see page 195

Gary Kriss VE7CGK
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Maple Ridge BC
Canada V2X 1K1

Inexpensive Scope Tuner

—"budget here is QRP, OM"

Build your own.

After I looked for a long time at the Heathkit SB-614 monitor scope and the Yaesu YO-100, I realized that I had no choice except to build my own tuner for my 3" general-purpose oscilloscope. Building the tuner according to the *Handbook* would cost too much here in Canada, and besides, it lacked the simplicity I wanted.

I built the tuner with parts I had on hand, so I hesitate to place any dollar values on them.

The balun was a kW 50-75 Ohm one. R1 is used to broaden the frequency response of the balun.

C1 and C2 can be changed to suit the power output.

The unit was tested with my Yaesu FT-101B on 10, 15, 20, 40, and 80 meters. Minimum meshing of the tuning capacitor, C2, was required on all bands.

Use RG-58/U or RG-59/U to connect the tuner to the scope.

It is important that the box is rf-leakproof! The Radio Shack metal cabinet I used has vent slots, and when I keyed the rig, my digital clock went into orbit!

My next project will be to reduce the size of the tuner and combine it with an swr bridge in one cabinet in order to eliminate the box and the coaxial jacks.■

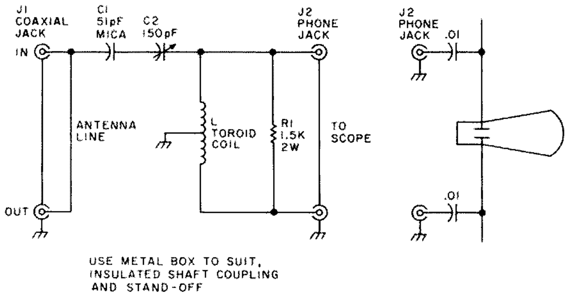


Fig. 1. Modification to a general-purpose oscilloscope to allow direct input to the vertical deflection plate. The capacitors are 1-kV discs.

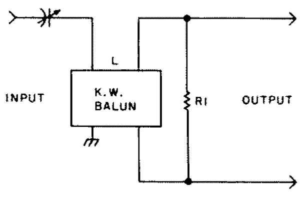


Fig. 2. General arrangement.

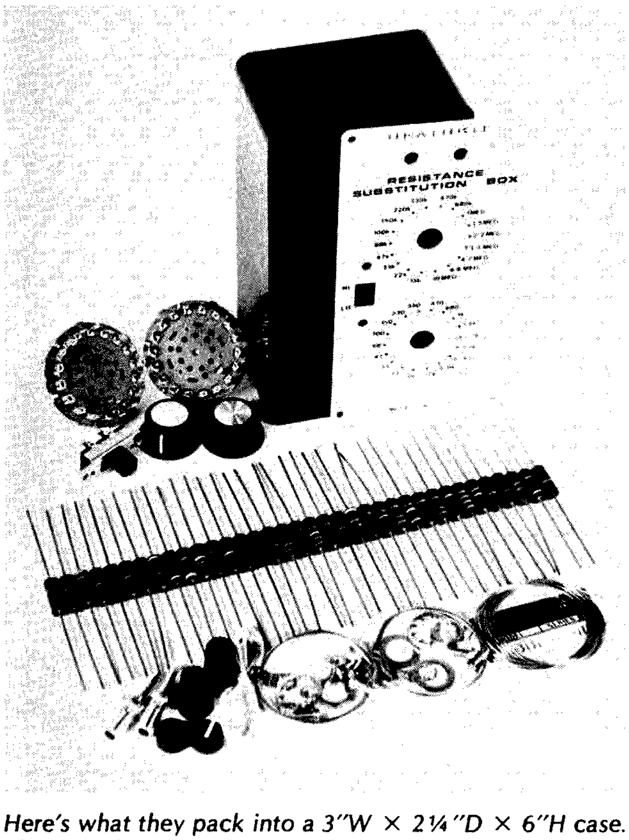
✓ Reader Service—see page 195

Alexander MacLean
WA2SUT/NNN0ZVB
18 Indian Spring Trail
Denville NJ 07834

The Resistance Substitution Box

—a ham's forgotten friend

Does a lot for a little.



Here's what they pack into a 3"W × 2¼"D × 6"H case. These are husky parts, too, not flimsy.

In previous articles, I have been known to breezily advise readers to adjust a resistance value. If you are sitting there with a 100k, ¼-Watt carbon film resistor trying to figure out how to adjust it, you are probably thinking about getting me alone in a room for five minutes and adjusting me. That's not fair.

In self-defense, and to help solve the problem, I will tell you about one of the most useful pieces of test equipment and tools available to the experimenter or anyone who repairs equipment.

I have wanted to write this article for a long time, but I kept putting it off, trying to see if it couldn't be presented as a nice easy construction project which would save all sorts of money. What it kept coming down to was that I could save a few dollars rolling my own, but a reader might not be able to duplicate it easily, and the few bucks wasn't worth the irritation.

The tool is a resistance substitution box. A kit version represents one of the best dollar values around. The price for the whole kit is so close to what the parts would cost that it actually represents a greater value. Everything is done for you. You just have to put it together. That's getting most of the hand labor almost free.

I bought the Heathkit model IN-3137 in kit form. The first thing you notice is that you get a husky handful of parts. In spite of the relatively small price, this is a meaty kit.

The Heath instructions are well known and there were only a few sticky places not really pointed out. They are in the area of general construction hints.

When mounting the two binding posts, it helps to put a small nail or something through the little hole so you have a handle to hold the hole in position when you tighten the mounting nut. This way the pieces will be lined up the way you want them rather than just randomly as they happen to hold.

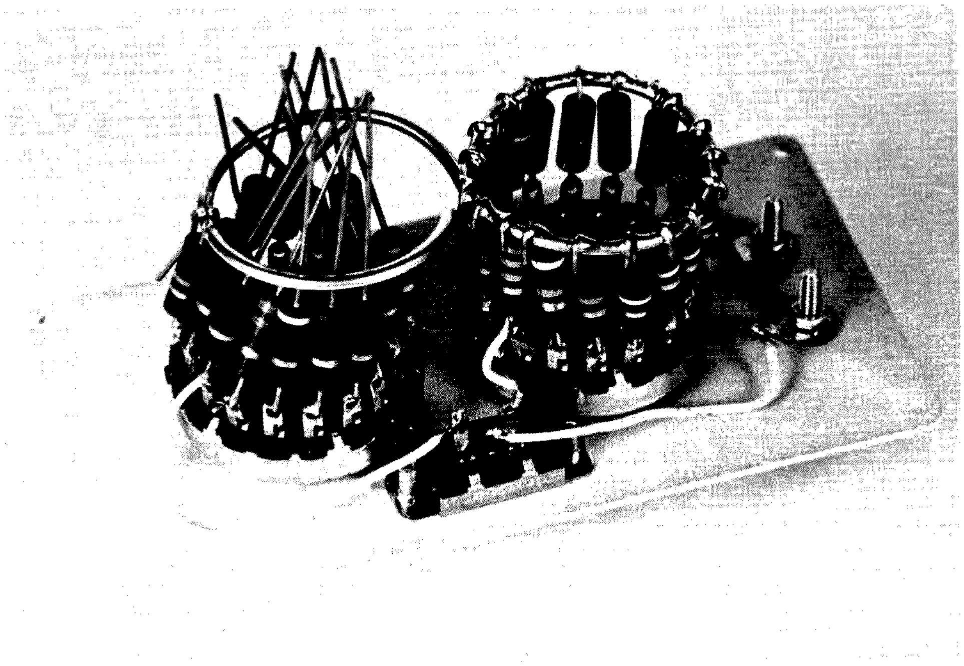
The only fussy job in the kit is soldering the mounting ring that holds the ground end of all the resistors. This shows in the photo. It just takes a little care and forethought. You want to have the resistors mounted evenly and the ring at the correct height so that the finished assembly will fit in the case.

Do the first resistor at the right height as per the instructions, and then choose a resistor at the other end of the ring and do it. If you space about four resistors around the ring, it will let you set the ring at the correct height easily and make a fairly rigid assembly to mount the other resistors to without worrying about the lead length. I did not think of this until after I did the soldering of each resistor in order, so mine looks a bit lopsided.

There really were no problems putting the kit together, and I could only fault it slightly in a few areas.

I would have liked to have color-coded binding posts—one red, one black—to tell which one went to the big lump of metal. It can be marked on the case.

It would have been nice to have a couple of color-coded insulated clip leads supplied. With all the test gear hooked up for testing, that's one thing you may be shy of when you go to use the box. It doesn't cost much to make your own, but you won't think of it until you are working and need them NOW.



The only sticky part is mounting this S-ring full of resistors. The text gives some hints.

There are a few other construction hints to keep in mind. As you put it together, remember that you may have to take it apart.

Unless you just plan to look at it on the bench, you will probably fry a few resistors along the way like the rest of us. They will have to be replaced. Don't wire them in for the ages.

It may still seem a bit exorbitant to spend that much for a box of resistors and a few switches. I got along without one for a while, but, once I had one, I did not want to do without it.

Years ago, I would use clip leads and wire in a resistor near what I wanted from the junk box. I had an assortment of values, none too complete, but it did work. The problem was that it was clumsy and it took far too much time. Also, the box is a lot more precise than you might think.

In Fig. 1, the problem is to determine the resistance value to allow only so much current to the LED. From looking at circuits, you have some idea of the current range most LED circuits take.

Let's fill in some more. You don't know what the junk-box LED is rated at, so you want to go easy. You can tell a bit from the way it lights, assuming you don't blow it right off the bat.

Hook up the VOM to read milliamperes (low range) and the box in place of R1. Start at a high value of resistance—in this case 10k. You might as well get into the habit of starting at the very top. Slowly click your way down range. Watch the meter and the LED carefully. At some point, the LED will just start to light and the meter start to read.

Most LEDs can handle about 10 mils or so. As you watch the LED, watch the meter. The LED will probably light dimly at first and get brighter as you lower the resistance and increase the current.

You may reach a point where an increase in current only makes a slight increase in actual brightness. This is about the maximum current point. For the best results, increase the resistance a notch or so until the LED starts to drop off the other way. Somewhere in that range is where you want to be. Not dim, but not the brightest it will go. That 10-mA figure is a good target for an unknown LED.

This is the best working range for the LED. If you have to save current—perhaps you are running a lot of LEDs from a battery—you might even want a dim light and a smaller current. Here, current would be the main factor.

The point is that, using individual resistors and clip leads, you would have only had time to try one or two in the time it took to read this. Using the box, you would probably have completed the job in that much time and in a far more controlled and safe manner.

Let's take another job. You are working in an audio section. You have a

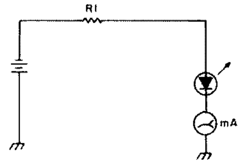


Fig. 1.

dead triode amplifier stage. You look in and find that the plate load resistor is fried to a crispy color. What was it?

You can get a hint from similar circuits or maybe what else is in the set, but, if you want to get it going fast, it's easy.

First check for other damage, like a shorted bypass capacitor that caused the resistor to draw too much current, or any other trouble in the circuit which should be corrected before replacing parts (you don't want to burn up the replacement resistor, particularly the one in your substitution box).

Clip the box into the circuit set at its highest value. Then click down as you monitor the stage. If nothing else is wrong with the stage, it should click in at some point. Play around and choose the best value for operation, then replace the box with the fixed value.

Of course, you can see how handy the box would be for experimental purposes if you were designing a stage. It makes it a breeze to try values and evaluate performance quickly. The nice thing is, the box will work just as well with tube or transistor circuits. The one-Watt values are good for most tube circuits and a higher percentage of transistor work.

The one way you can immediately damage it is to send too much current through one of the resistors. The use of a milliammeter is recommended. Also, the switch is rated at only 500 volts.

A little common sense about what you hook it to can help, too. Before you start clicking, use your pocket calculator to figure Ohm's Law for a few of the values and see what the current and power would be.

The completed box has a nice husky feel to it and won't get lost on your bench.

Most of the time, a little thought will keep you on the safe side of the power ratings. Once in a while, you may hit the box too hard. Get out the iron and welcome to the club.

There is one big thing to watch for. If the circuit calls for a power job, or you see one in there already, keep the box out of there. Even for a short test, it's risky.

Sooner or later you will put too much current through one or more of the resistors. This happens to everybody. It is the fate of the experimenter. A little bit of preventive care and knowledge will go a long way toward helping you over this problem. Besides care in construction, you should have a bit more detailed knowledge of what's in there.

When you build, or buy, your RC box, hook up your best ohmmeter to it. I hope that you have something that is fairly accurate.

I keep a few 1% resistors handy to check mine with. It doesn't have to be a lab meter. Mine is rated a nominal 3%. The box resistors are within 10%.

Go through the whole range of resistances and write down what they all measure when the box is new. File the information with the book that came with it. Then it's easy to go back and check it every now and then or when you think you might have fried something. You will have a known set of standards to compare with.

When you make the chart, do not fuss if they do not seem to be exactly right on the nose. They are only supposed to be within 10%. At 100k, you could read 90k to 110k Ohms.

If you have it wired correctly, they should all be within tolerance. You might possibly have one or two out. It could be a faulty resistor, or maybe it got too much heat. If you have more than that, you had better check your meter out with a friend's before complaining.

To repair the box, just measure the values and replace the ones that got out of tolerance. You can assume that they will age and they will get some current once in a while.

While the values seem far apart when compared to the chart of available resistor values, they are effectively within range of each other. The in-between values will make a difference in actual circuit operation, but the box values will make what might be called a significant difference. It's big enough that the difference will be noticeable, but not so much that it doesn't have a safety margin. With care, you should have plenty of notice that you are getting near a danger point of operation.

While it won't do your fine pruning, it will put you in the range you want to be and should give you an operative circuit value.

One obvious question is, what about all those 1% transistor circuits you seem to have to work with? Well, they would be a problem no matter what you were using. The basic problem is that there really is no such thing as a 1% circuit in electronics. It may be that when it rolls off the assembly line (most aren't), but give it a while and it will be out of tolerance.

For most uses, you have no business making a circuit that is that critical. Most tube and transistor circuits are nominally within ten percent when new.

After regular use, most circuits I've worked with were within 20%. Most

well-designed circuits will work with parts values ±50%.

Often an out-of-tolerance circuit will work just fine and not be the trouble you are looking for. You may also have the problem that it would cost too much to go through the entire equipment and bring everything up to tolerance.

With precision equipment, this is not desirable, but there comes a point where it costs too much. In this case, you don't have to worry so much about tolerance. Does one of the values work? Put in a precision replacement.

If you are designing your own equipment, aim for noncritical design and standard parts values. That little bit of theoretical advantage in optimizing can be quickly offset by normal aging and servicing problems.

Another thing. If you are trying a range of values and the circuit is critical as to value, it may be a strong indication that its design is wrong.

Most functions can be performed by noncritical circuitry. The added stability to be gained thereby can be quite valuable.

Save the critical circuits for where you need them. Even then, it pays to use common sense about values. Is it something you are going to be able to get a replacement for in X amount of time? That's something to think about.

If you repair your own equipment, or if you like to bench-design your own gear, the resistance substitution box is a hard piece of equipment to beat. For the job, its speed, versatility, and low cost make it a real test and tool bargain. ■

Reader Service—see page 195

C. Stewart Gillmor W1FK
Spencer Road
Higganum CT 06441

Vodka Amongst the Penguins

—hamming with the Russians in Antarctica

Mirnyy, 1961.

"Stew, how would you like to go to Antarctica for a year with the Russians?" Professor Bob Helliwell asked me one morning at Stanford University, California, in November, 1960.

"Sure," I said, "when do I go?"

"Well," said Helliwell, "you'll leave right away. That is, *if* you get the job!"

He explained that the National Bureau of Standards at Boulder, Colorado, under a National Science Foundation grant, was sponsoring a US exchange scientist to go with the sixth Soviet Antarctic expedition to Mirnyy Base, Antarctica. They were interviewing several people at Boulder right then.

"Something happened to the original candidate, and his replacement must be chosen and must leave for Antarctica immediately," Helliwell said. "The candidate will meet the Soviet expedition ship in Capetown if he can get there in time, and the ship has already left Leningrad!"

I was hoping to finish my E. E. degree in a couple of months. I had taken one leave from school already, to work in the Azores Islands and also to study at Edinburgh, Scotland, but this chance was too good to miss. Bob Helliwell knew I was interested in Antarctica, since he was a Scoutmaster and remembered that I had narrowly missed being chosen as the Boy Scout to accompany the USIGY Antarctic Expedition. Also, I was familiar with the research work proposed by the National Bureau of Standards, since I had operated similar equipment during summers when I had worked for the Stanford Research Institute.

Photo A. The diesel ship OB *is wedged in sea ice near Mirnyy, Antarctica.*

Well, I was lucky enough to get the job. I was briefed quickly at NBS and at the National Science Foundation in Washington. I then left New York City in a DC-7 bound for Capetown, accompanied by crates of gear weighing over 12,000 lbs. In Capetown, I met the Soviet ice cargo freighter *OB* (named for a large river in Siberia) and proceeded to Antarctica, where I spent the next 13 months at Mirnyy, the Soviet's largest base. (See Photo A.)

Not only did I do radio-

physics research and meet and get to know many Soviet colleagues, but I also became one of the operators of UA1KAE, which was for some years Antarctica's only active Soviet ham radio station. During my interesting time with the Soviets, I traveled to numerous locations in the Antarctic. These included the Soviet Vostok station at the southern geomagnetic pole, where the world record for minimum temperature was set (−126.9° F., recorded in August, 1960), and the US station at the geographic South Pole.

I spent most of my time at Mirnyy station, located at about 93° E, 67° S, on the coast of eastern Antarctica. (See Photo B.) Mirnyy is situated on continental ice anchored by underlying rock formations near the sea. There is a dangerously steep 50-foot cliff overlooking the sea to the north; two hills protrude from the ice. UA1KAE, the ham station, and the rest of the radio transmitting equipment (shown in Photo C) are located on one of these hills—"Sopka Radio," which means Radio Hill. Mirnyy had a population of about 100 persons in the winter, including 20 assorted geophysicists and meteorologists. (See Photo D.) Most of us lived in separate buildings having from 3 to 12 occupants each, and, when weather permitted, we traveled along "Lenin Avenue" (see Photo E) to a central dining hall for meals, meetings and movies.

My main purpose in going to the Antarctic, besides serving as a guest and exchange scientist with the Russians, was to initiate a program of cosmic radio noise measurements in the Antarctic. To make these radio noise measurements, I brought along two Riometers. The Riometer was first designed to study auroral radio-wave absorption in Alaska, and the name was coined from *R*elative-*I*onospheric-*O*pacity meter. The instrument itself was based on noise-measuring gear developed for radio astronomy. But whereas a radio astronomer would use such a receiver to measure galactic radio noise, I would use stellar radio noise as a signal source to measure the *absorption* of this noise at HF in the ionosphere. The absorption I measured is caused by, or associated with, solar storms, aurorae, and other geophysical events.

Study of the upper ionized layers of the Earth's atmosphere, both from ground level and from rockets and satellites, is important not only for increased knowledge of plasma physics, wave propagation, and geophysics, but also it contributes to our daily efficient use of the radio spectrum for telecommunications. Back in 1925, Merle Tuve and Gregory Breit, at the Carnegie Institution's Department of Terrestrial Magnetism in Washington DC, first studied the ionosphere vertically using a pulsed, vertical-sounding transmitter and receiver—a crude radar. This technique was further developed during the 1930s and during World War II, and the standard instrument which evolved came to be known as the Ionosonde.

This device, often using a delta or half-rhombic antenna aimed at the zenith, sends pulses skyward over a broad range of frequencies from 2 to about 25 MHz. The reflected signals received at the ground allow one to measure the "height" of the ionospheric layers and the electron density at the peak of the reflecting layers. This type of approach has been used even in the polar areas for many years.

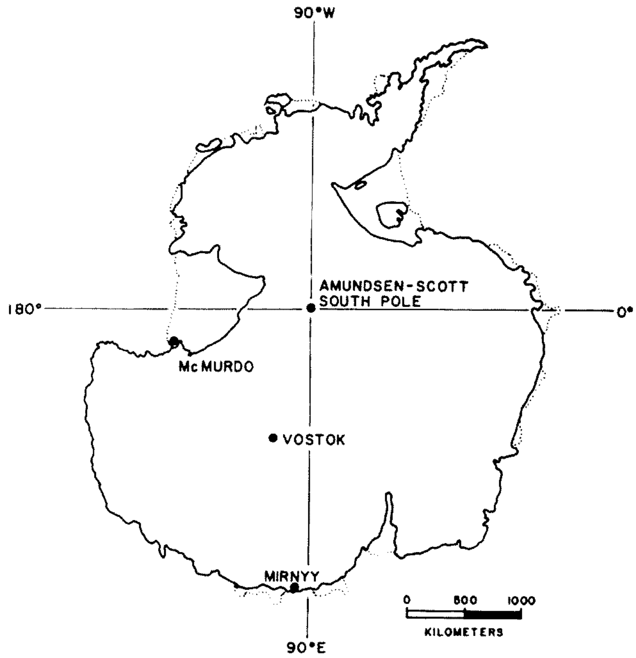


Photo B. This is a picture of a map of Antarctica which was drafted by the author's wife. It shows the location of the four stations.

Lt. Malcolm P. Hanson, of the US Naval Research Laboratory, constructed equipment and made the first such polar measurements while on Byrd's first Antarctic expedition, in 1929-30. Edward V. Appleton, who won the Nobel Prize in physics in 1947 for his ionosphere researches, utilized similar equipment in northern Norway during the 2nd International Polar Year in 1932-33. (The general history of radio research in Antarctica is covered in my essay, "Early History of Upper Atmospheric Physics Research in Antarctica," L. J. Lanzerotti and C. G. Park, editors, in *Upper Atmosphere Research in Antarctica*, American Geophysical Union, Washington DC, 1978.)

The Ionosonde has definite limits to its use in polar regions: The man-made signals have to pass through the ionosphere twice, being absorbed on

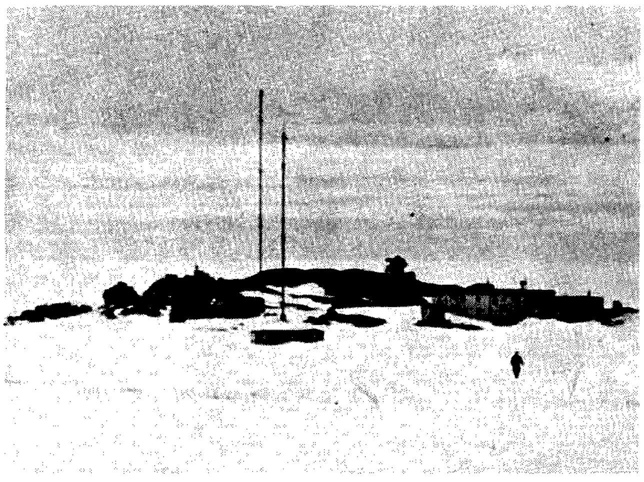


Photo C. "Sopka Radio" (Radio Hill), where the Mirnyy transmitters and UA1KAE were located.

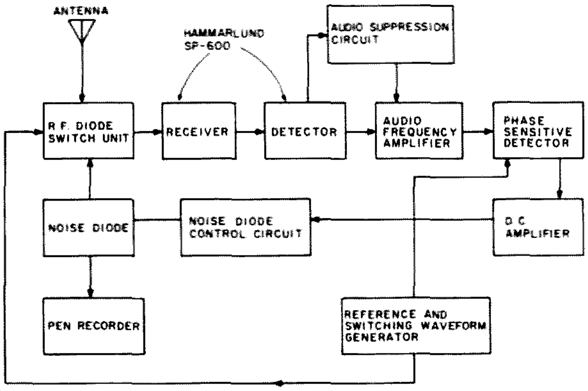


Fig. 1. Block diagram of Riometer.

passing up from the ground and then absorbed again upon returning down towards the receiver. During active auroral events or after solar storms, the absorption of radio waves at MF and HF is frequently so high that no signal is received on the ground, and the ionosphere is said to be in "blackout" condition. It is so-called because the Ionosonde record shows no evidence of returning pulses.

It is just *during* these events, however, that so much of importance happens in radiophysics. C. G. Little and H. Leinbach, the designers of the Riometer (*Proceedings, I. R. E., 47*, p. 315, 1959), realized that if a signal source could be placed outside the Earth's ionosphere, the signal would suffer much less absorption. The device could then report continuously, even during total radio communications blackouts. In addition, the Riometer could measure absorption at frequencies as high as 50, or even 150 MHz, where no vertical pulses under normal conditions would be reflected from the ionosphere.

Of the two Riometers I brought with me, one was for use at 30 MHz as the primary unit and the other was a backup unit which could also be used at 50 MHz. (See Photo F.) Ionospheric absorption usually varies as the inverse square of the frequency; thus the 50-MHz unit could be expected to measure $(30/50)^2$, or about 0.36 as much absorption as the 30-MHz unit. The Riometer needed as its heart a good receiver. We chose the Hammarlund SP-600, since it was capable of operating with a bandwidth of about 13 kHz and covered the HF bands up through 6 meters, thus allowing me to operate either unit on 30 or on 50 MHz.

Photo D. A cold and windy "May Day," 1961, at Mirnyy; the author is third from the left. The power lines are from diesel-powered electric generators and run to the buildings where heat coils feed hot water radiator systems.

Basically, the Riometer is a servo-controlled, self-balancing receiving system designed to measure ionospheric absorption by monitoring "cosmic noise." The block diagram of an early version is shown in Fig. 1. Reference to this diagram will facilitate interpretation of the following description.

The diode switch unit switches between the antenna and the servo noise diode at an audio rate. The resulting signal is fed into a low-noise receiver (the SP-600) whose detected output consists of alternated noise from the antenna and from the servo noise diode. If the two inputs are balanced, the detector output looks like an audio square wave.

The receiver-detector output is fed through an audio suppression circuit and an audio amplifier into a phase-sensitive detector. (The audio suppression circuit breaks the servo loop when a strong interfering signal is present.) The dc output of the phase-sensitive detector depends in amplitude and sign on the unbalance between the noise-diode signal and the antenna signal. The output of the phase-sensitive detector is fed to a dc amplifier whose output constitutes the input signal to the noise-diode control circuit, which functions in such a manner as to bring the noise output of the servo noise diode into equality with the noise signal power from the antenna.

The plate current of the servo noise diode is directly proportional to the input power of the antenna signal and is recorded on a pen recorder. Additional refinements, such as sweeping the local oscillator of the receiver through 100 kHz and using a minimum signal detector, serve to minimize the effects of interference on the Riometer. Solid-state Riometers having digital output and automatic data processing are now in use, but my vacuum tube units at Mirnyy in 1961 were quite similar to the original design of Little and Leinbach. They required daily calibration and adjustment.

The Riometer was a big improvement over merely measuring receiver noise power, since the noise-diode current could be carefully measured each day and receiver-gain changes with tube aging had only a minor effect on the system. We wanted results accurate to one- or two-tenths of a dB over periods of a year. I had a very fancy ac-powered pen recorder, but I found the 50-Hz power at Mirnyy varied by several Hz throughout the day, so I went back to using two old standard spring-wound Esterline-Angus pen recorders which I could adjust to record with an accuracy of about plus or minus a couple of minutes a day.

In addition to the Riometers, I had assorted test gear: two Hewlett-Packard 'scopes, an rf bridge and signal generator, an H-P VTVM, and a Hickok tube-tester. I also had the loan of a fine Collins 51J4 receiver, courtesy of Mike Villard W6QYT of Stanford University. With this, I hoped to monitor shortwave-broadcast-station signal strengths after solar storm events and also try to listen for around-the-world echoes (and maybe long-delay echoes) from Villard's experimental transmissions on 21 MHz. I

never heard any long-delay echoes, but in free hours I did get quite a bit of pleasure from monitoring baseball and football games broadcast over Armed Forces Radio, and I often caught Willis Conover's Voice of America Jazz Show.

For a student research project at Stanford, I had constructed a large, 84-element, 4-boom log periodic antenna array on a rotating 60-foot tower, combined with a 25-to-35-MHz sweep-frequency receiving system for solar and planetary radio astronomy investigations (see *Electrical Engineering, 81*, p. 22, 1962). Of course, I couldn't bring the LPA array with me, but I did bring the receiving system. I hoped to erect a rhombic antenna and continue my measurements at Mirnyy. Although I made a few measurements, my first priority was to the Riometer work, and I didn't do much with the sweep-frequency radio astronomy gear.

In addition to the above, I also brought with me an Ampex tape recorder and a small solid-state (remember, we called them "transistorized" in those days) Develco audio amplifier and loop antenna to record geophysical noises in the VLF range from about 100 Hz to 10 kHz. Bob Helliwell had loaned this equipment to me. VLF recording was becoming of great importance to upper atmospheric and space physics research. Today, VLF research has assumed even greater importance for plasma geophysics *and* telecommunications research. Lightning strokes and other natural phenomena sometimes propagate as radio frequency energy along magnetic field lines from one end of the Earth out thousands of miles and then re-enter the atmosphere at the other end of the field line.

Each different frequency—say, of the lightning stroke—propagates with a different velocity, so that a pulse which sounds initially like a "click" near the source may sound like a long whistle, decreasing in pitch, at the other end of the Earth. As it turned out, a Czech visiting scientist had recorded "whistler" and VLF activity at Mirnyy station for some months before my arrival. Thus I sent the whistler gear on to Vostok station, a unique location with *geomagnetic* coordinates near 90° S—something like Thule, Greenland, in the north. No one then knew what sort of whistler activity would be heard at Vostok, since it was at such a high geomagnetic latitude.

Although modern VLF work in the Antarctic dates from the late 1950s, VLF work in the polar regions was initiated on Byrd's 2nd Antarctic expedition in 1933-34 by John Dyer (now W1BJD). In those days, there were hopes of connecting "whistlers" with meteor sightings. Dyer never published his fascinating VLF observations, but correctly he noted no correlation between whistlers and meteors. My VLF measurements had only limited success, but my Riometer results were first in what has been a continuous and growing use of this radio wave-absorption measuring technique in Antarctica.

When I first arrived at Mirnyy, I wished I had brought an HF transmitter with me for ham radio purposes. I had been licensed first in 1953 as WNØODE, as a high-school freshman in Grandview, Missouri, and I had kept somewhat active as WØODE and at the Stanford student station, W6YX. Looking through my stock of vacuum tubes, I figured that I could build a CW transmitter using a 12AU7 or 6AH6 as a vfo, a 6AG7 driver, and push-pull 6L6s running 75 Watts on 40, 20, and 15 meters. I knew I wouldn't have time to do any rig-building for several months, since we all had so much work to do to get the general aspects of the expedition in order and to get the various scientific experiments working.

For example, the anten-

Photo E. This is "Lenin Avenue," the main drag at Mirnyy. The picture is taken from Radio Hill looking north to the other rocky hill, which is at the edge of the sea ice.

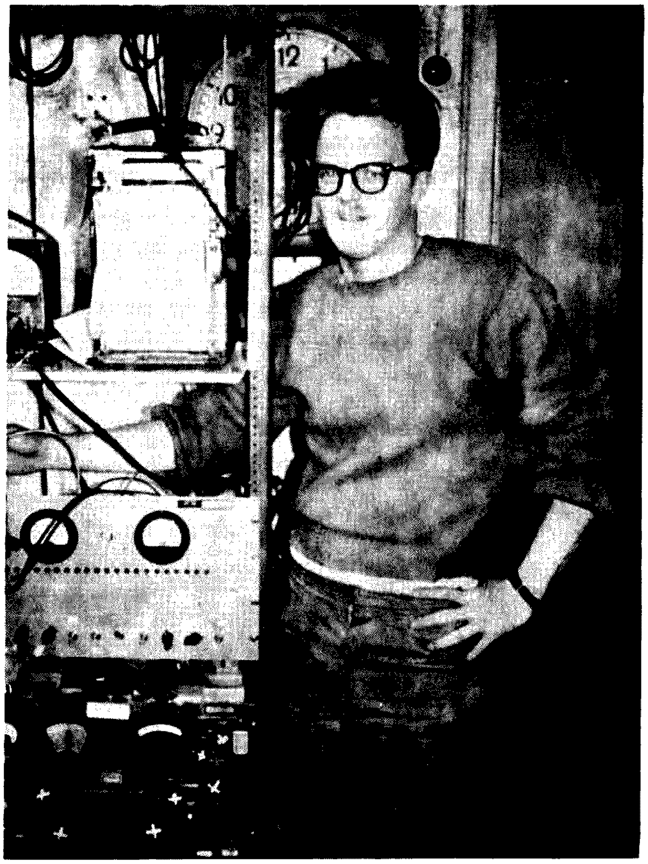


Photo F. The author is standing beside the 30-MHz and 50-MHz Riometers. Also shown are the power supplies, Esterline-Angus chart recorders, test gear, and Hammarlund SP-600 receivers.

nas for my Riometers—see Photo G—were broadband, 4-element yagis—that is, two driven elements, each over a reflector, phased so that the beamwidth would be approximately circular. These elements were of aluminum pipe approximately 3 inches in diameter, placed around very heavy fiberglass poles. Erecting this array took quite a bit of time. Because of local conditions, I eventually replaced this rather elegant design with a simple wire dipole placed over a metal roof as the reflector.

Well, I mused over my proposed 6L6 rig and wrote a letter to the FCC to be mailed to them when the Soviet ship *OB* left the Antarctic to return to Leningrad. I wondered whether or not I should operate as WØODE/KC4. I was on a continent not claimed by the US (or by the USSR, for that matter), and I was not on a US expedition.

In the meantime, I got a chance to visit the radio communications center at the base. This building had a small studio room for broadcasting to Moscow, a room for Teletype™ equipment, and a general operating room containing tape recorders and several MF, HF, and VHF receivers. I learned that the military HF receivers used at Mirnyy covered 1.5 to 25.5 MHz. The transmitters, however, were not in the communications center but were located on Radio Hill, about a half mile away. This was done in an attempt to lessen local QRM when the station was operating simultaneously on several frequencies.

Quite soon thereafter, I wandered up to the transmitter building and spent about an hour listening on 20 meters. I heard good signals from South America and also from several strong ham stations in the US. I also heard KC4USV at McMurdo Sound, Antarctica.

I was told that the transmitter building was, in fact, the location of ham station UA1KAE. (See Photo H.) KAE signified *A*ntarctic *K*ontinental *E*xpedition; the UA1 indicated that the expedition's home base was Leningrad. I was told also that I could be one of the operators of UA1KAE. The station didn't operate during the austral summer since everyone was too busy, but as soon as Antarctic autumn came around in March, I began to go up to the ham station once or twice a week, when weather conditions permitted. We had several transmitters at Mirnyy, some of 5 kW and one or two of 1-to-2k-W input. It was one of these latter transmitters, usually with dipole antennas, that was used for hamming.

UA1KAE had averaged about 1500 QSOs per year since it had been set up in 1957. The transmitter was not capable of SSB operation. I attempted to operate AM, but the rig didn't seem capable of much modulation, so my contacts were nearly all CW, at least one-way. I usually worked 20 meters, although I did get on 15 and 40 meters. I didn't operate UA1KAE as often as I might have wished due to my own work schedule and also due to our weather. It doesn't get very cold at Mirnyy. Unlike Vostok, which regularly runs at about −100° F. in winter, Mirnyy rarely gets below −40° F. On the other hand, Mirnyy has a heck of a wind-chill factor!

Mirnyy is located on the east coast of Antarctica, where the world's worst storms occur. The cold inland bases have no wind to speak of during really cold periods, but winds come down off the 10,000- to 13,000-foot plateaus of east Antarctica, meet much warmer winds off the Indian Ocean, and all hell breaks loose. One time, winds broke two ¾-inch steel cables holding down one of our IL-2 aircraft (a Russian version of the DC-3). The plane took off by itself under wind power and flew about 3 miles out over the sea ice before crashing into an iceberg! Many, many days the weather was such that we could not venture outside and go the 150 yards to the dining hall, or, if we could, we had to go in teams along rope-guided paths. Thus, the ½-mile trip to Radio Hill through drifts, in blizzard conditions, forced me to cancel a number of my hamming sessions at UA1KAE.

Photo G. The author is erecting an antenna element.

One amusing thing often happened when I operated CW. UA1KAE was celebrated throughout the USSR, and there often would be Soviet ham stations piling up to work UA1KAE. In those days I did not know the Cyrillic alphabet in code (there are several extra letters such as: ya = ·—·—; ch = ———·; sh = ————; etc.). The Soviet stations, naturally, would swing into Cyrillic. I would then come back in badly *transliterated* Russian saying, "I do not write Cyrillic; I am an American operator of UA1KAE." Invariably, the Soviet operator then cut off his transmissions. I suppose at the least he thought I was a pirate station.

I did have a few CW-SSB QSOs with American hams. These were in attempts to talk with my parents in Kansas City, Missouri, and with some of my university friends in Palo Alto, California. Other hams passed traffic for me through the ham stations at McMurdo and other US

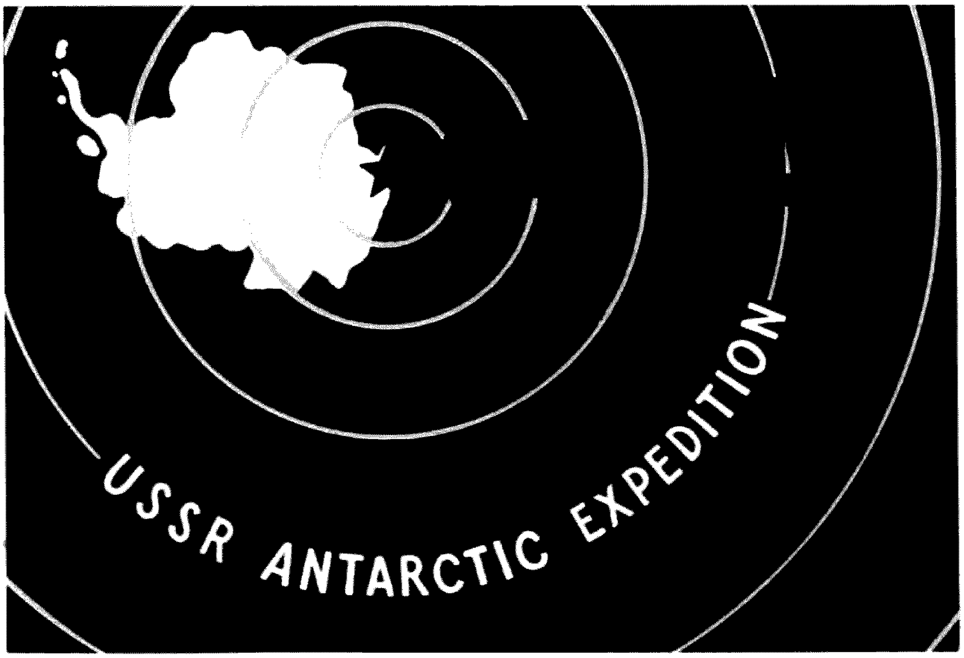


Photo H. This is the UA1KAE QSL card. The star marks Mirnyy's location.

stations; these hamgrams were then sent to me via Navy circuits from McMurdo to Mirnyy. Hams (some, regretfully, now silent keys), or calls I remember with gratitude, include Mike WØMAF, Fred W6QS, Jules K2KGJ, WØRDR, WØMM, and Lee Bergren.

I had also another quite different but amusing incident involving CW. I was asked to help get a RTTY link going between Mirnyy and McMurdo stations. We had tried for some days without success and also had had difficulty raising McMurdo on CW. I suggested that I could try McMurdo on the ham bands, and the chief radio engineer at Mirnyy agreed that it was worth the effort, so I went up to the transmitter building and listened on 20 meters sideband. Sure enough, there was KC4USV, big as life.

Now, it happened in those days (just as it does today) that ham tickets were issued at Antarctic stations to men who supposedly had qualified in the Antarctic and were given Conditional class licenses. I am pretty sure that some of those license exams were a sham. I tried to break KC4USV's stateside SSB QSO via my own CW. I tried several times, slowing my CW to well under 13 wpm. The US ham called the KC4USV op's attention to my break call, but the KC4USV op mumbled something about not being able to copy it and refused to let me break in.

A couple of days later, when communications were re-established, I sent a short comment to one of the regular Navy CW ops to the effect that at least one of the KC4USV ops had better take some of the grease out of his jaw and begin applying it to his elbow. The Navy CW op agreed with me. Little did I know that the McMurdo communications officer in charge (a) knew virtually nothing about radio, (b) was one of those individuals who had been "given" Conditional tickets, (c) was the guy at the microphone at KC4USV the day I had tried repeatedly to break in on CW, and (d) read my brief radiogram describing his performance!

That incident was almost as funny as the time a US biologist at McMurdo had a fit when I told him over the radio that the "rare" white-blooded fishes we had caught in a Mirnyy fishing contest had been eaten by us right after the event. Boy, he howled about the principles of the scientific life, the duties of the scientist and so forth, when all he really wanted was for me to haul back some fish in formaldehyde so that he could publish a paper. I told him, truthfully, that we had no formaldehyde at Mirnyy and that we had already drunk all the vodka and grain alcohol! Actually, the fish were fried up and were pretty good, tasting like perch. Penguin eggs, on the other hand, were terrible, tasting and smelling like rotten fish. (See Photo I of my friend "Little Vasily" and I trying to consume a penguin egg omelet.)

By the way, we didn't kill any birds or eat living penguin eggs at Mirnyy; the eggs we ate had been blown away from the Emperor penguin rookery in a storm and had frozen.

My Soviet friends made up in ingenuity for what they lacked in parts and supplies. While we did some rather hazardous things on aircraft flights (such as cooking lunch in flight on an open-flame burner, quite near barrels of aviation gasoline), they had a good air-safety record. Unfortunately, their fire-safety record at Mirnyy wasn't so good. Fire is a deadly enemy in the Antarctic since there is virtually no water available to fight it. Eight meteorologists were lost at Mirnyy in a fire just 4 months before I arrived.

Similarly, the Soviet communications equipment was boat anchor stuff which seemed to work pretty well. Even so, two old 1940s-vintage RCA receivers were incorporated into gear in use at Mirnyy. I assume that these were old lend-lease receivers from World War II. I had a 1960 RCA Semiconductor Handbook with me, and the electronics people were amazed and almost incredulous at the relatively large number of transistors which were then available to industry and to hams. To prove my point, I had at least the Develco VLF receiver to show for solid-state gear. NSB had already constructed solid-state Riometers, but I could not take them to Antarctica because they had not yet been through the required six months of laboratory shakedown.

Other items of great interest were my stereo music tapes, lightweight nylon clothing, Missouri corncob pipes, my Polaroid camera, and, of course, various men's picture magazines.

On my part, I found quite fascinating the Soviet's leather and fur clothing, their language, the great similarities I found between American and Soviet humor, and the way Americans and Soviets

Photo I. The author and his friend, "Little Vasily" Nikonov, a meteorologist technician, attempting to eat the terrible-tasting omelet made from Emperor penguin eggs.

Photo J. Mirnyy staff members celebrate the author's birthday, November 6, 1961.

view the world and react to numerous situations. (See Photo J.) Most of all, I found the Antarctic itself intriguing, subtle, and forbidding.

Lots of things have changed since I spent 13 months as a guest with the Soviets 18 years ago. It's much more common now to see flights in and out of Antarctica. As everywhere else, computers, microelectronics, and satellites have altered equipment, methods used, and research questions asked in the Antarctic. Mirnyy is no longer the main Soviet base, and even the Soviet ham calls have changed—being things like 4K1A instead of the old UA1KAE. But all in all, it was a great experience for me, and I recall many events fondly.

Finally, I must confess I have probably set a record or near-record for poor QSLing. In going through some old boxes last year, I found some 17-year-old QSL cards from UA1KAE for contacts I made. These had gotten mislaid in shipping my baggage out of the Antarctic in 1962. To those of you who have recently received 1961 QSO confirmation from UA1KAE postmarked 1978—sorry, fellows! ■

Note: My thanks to my wife, R. G. Gillmor, for drawing the map of Antarctica, and to A. Bothell for help with photo reproduction.

✓ Reader Service—see page 195

Protect Yourself with a GFI

—before it's too late

Make your hamming safer.

C. C. Lo WA6PEC
5414 Barrett Ave.
El Cerrito CA 94530

The ground fault interrupter (GFI) has been around for some time. Like many other safety devices, its popularity grows slowly because safety devices are not favored, as a rule. For an amateur radio operator, however, the GFI could be very valuable because a ham comes in contact with lots of line-operated equipment, and, inadvertently, some faulty equipment could turn up and shock the daylights out of him.

The GFI described here will prevent a normal person from suffering severe shocks by turning off the line power in approximately 25 ms when a fault current as low as 5 mA is detected. While 5 mA of 60 Hz current will cause some sensation, a persistent 10-20 mA could cause fibrillation of the heart and breathing to stop. The GFI can be built for 110 V or 220 V operation; load current capacity is rated at 25 Amps.

How It Works

Refer to Fig. 1. The heart of the system is a differential transformer, T1, which senses an imbalance load current on the two power lines which are wound on the toroid core in a bifilar fashion. Differential current as low as 5 mA will produce a large enough signal to change the output state of the comparator, U1, whose output triggers SCR1, which in turn activates power relay K1 and shuts down output power. The whole process takes about 25 ms in the worst case. SCR1, after being activated, remains on until the reset switch is pushed.

The test switch is used to

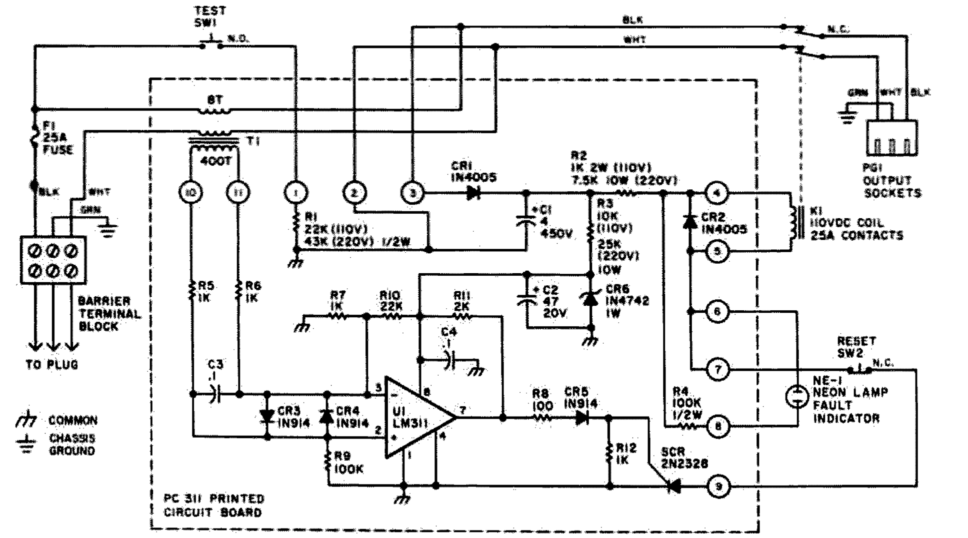


Fig. 1. Schematic diagram of portable ground fault interrupter—type 311.

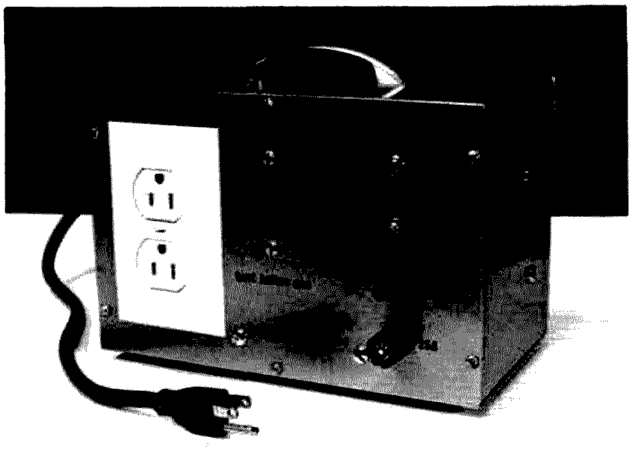


Photo A.

simulate a fault current of 5 mA for testing purpose. It is a good practice to test the system by the test switch prior to the use of the GFI. The neon light is used to indicate a fault and power-down condition.

For 220-V operation, a 220-V socket must be used for PG1; R1 must be changed from 22k to 43k; R2 must be changed from 1k (2 W) to 7.5 k (10 W), and R3 must be changed from 10k (10 W) to 25k (10 W). The GFI described was tested in close proximity to a high-power radio frequency transmitter and was found to be RFI-proof.

Construction

The complete system is housed in a 5″ × 6″ × 9″ steel box. Photo A shows the GFI and Photo B shows the component layout. A printed circuit board is used to contain all electronics components. The switches, relay, light, fuse, and socket are all mounted on the front panel, but a barrier terminal block is mounted on the inside of the side wall of the box for connection to the power line cord.

Operation Hints

If the GFI keeps shutting off with a certain load, it indicates that the load or the wiring to the load has a short which provides the fault (leakage) current to trip the GFI; such a fault must be sought out and corrected before the tool or the equipment is used. In some cases, even a very low current would do damage to certain persons; hence, by no means should a person subject himself or herself to any test shock. All common sense and carefulness must be exercised when electrical power is involved; the first mistake could also be the last. ■

Parts List

R1	22k (110 V), 43k (220 V), both ½ W
R2	1k (110 V) 2 W, 7.5k (220 V), 10 W
R3	10k (110 V), 25k (220 V), both 10 W
R4	100k ½ W
R5, 6, 7	1k ¼ W
R8	100 ¼ W
R9	100k ¼ W
R10	22k ¼ W
R11	2k ¼ W
R12	1k ¼ W
C1	4 uF 450 V electrolytic
C2	47 uF 20 V electrolytic
C3, 4	.1 uF 25 V disc
CR1, 2	1N4006
CR3, 4, 5	1N914
CR6	1N4742 12 V zener diode
SCR	2N2328
F1	Fuse holder and 25 Amp fuse
U1	LM 311 IC
SW1	SPST N.O.
SW2	SPST N.C.
NE1	Neon lamp and holder
K1	Relay 110 V coil, 25 Amp or 30 Amp contacts DPDT
T1	Differential transformer
PC311	Printed circuit board
Chassis box	5″ X 6″ X 9″steel box with handle

The following are available:

GFI kit	110 V	type 311-K	$55.95
	220 V	type 312-K	$65.95
Assembled GFI	110 V	type 311	$70.95
	220 V	type 312	$80.95

(all above plus $5.00 shipping and handling)

PC board	$10.00 ppd
Relay	$16.00 ppd
Transformer T1	$13.50 ppd

To order, send check or money order to: LOTRONICS, PO Box 975, El Cerrito CA 94530 (allow 3-4 weeks for delivery).

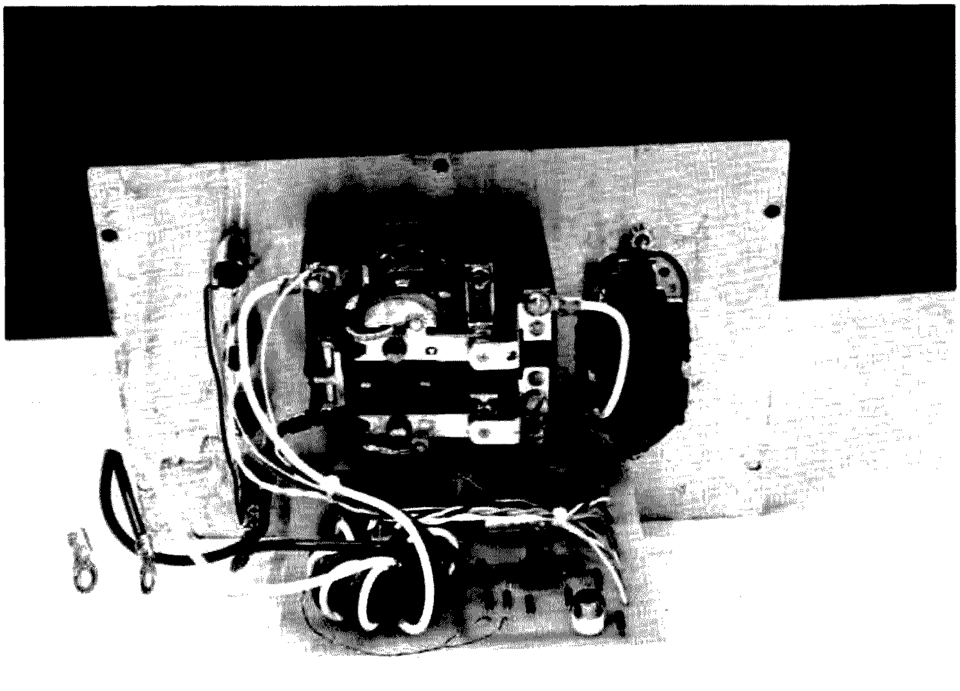


Photo B.

Poor Man's CW Memory

—works even with a straight key

Thanks, Elmer!

Eric Unruh WBØRYN
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Newton KS 67114

A dog may be a man's best friend, but for the CWer, a memory for his keyer has got to come in a close second. A memory makes everyday operating much easier and more enjoyable, and is almost indispensable during a contest. It's a worthwhile addition to any ham's station.

Why, then, do so few hams have them? "Well, my keyer is an oddball design; I don't have access to a free-running oscillator in order to synchronize it to the memory"; or, "I just use a straight key."

I had the same objections, but at the 1977 Field Day, a friend in my club, Elmer Watts KØHAO, told me that he had designed a memory that would work with any keyer—even a straight key! I was so delighted with my version of his design that I asked for permission to write it up. This is the result.

Most of the previous memories were designed to work with only one keyer or type of keyer, as the two had to be synchronized. That is, the oscillator on the keyer had to be exactly in step with the oscillator on the memory in order for a dot to be stored in one memory location and a dash in exactly three. One got perfectly-spaced CW out of such a memory, but it was tricky to build. What makes this memory unique is that you don't have to synchronize it with another oscillator.

The secret of this memory is in clocking it at a much higher rate than the keying speed. Dits are then stored in a number of memory locations, not just one, and dahs are stored in approximately three times as many locations as are the

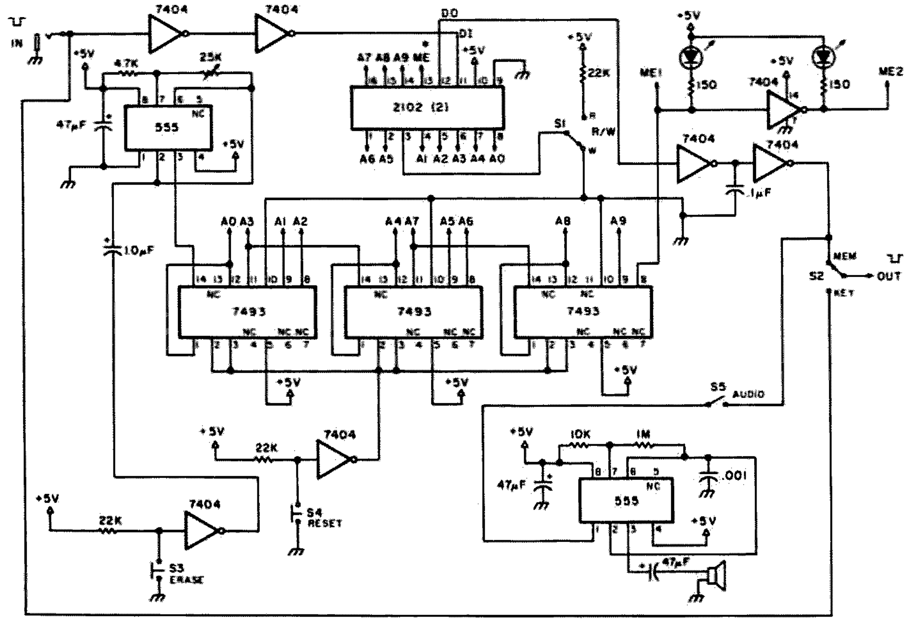

Fig. 1. The basic circuit.

dits. Running the memory in such a fashion destroys the perfect 1 to 3 ratio of a well-adjusted keyer, but the output of the memory is so close (1 to 2.9 or 3.1) that even the most critical ear can't tell the difference. The memory space certainly is not used in the most efficient way, but the advantage is that it can be used with nearly all keyers, bugs, straight keys, or sideswipers.

The basic circuit is shown in Fig. 1. It is straightforward and unbelievably simple. The heart of the circuit is two 2102 1K x 1 static RAM memory chips, for a total of 2K or 2048 bits of memory. They are wired up in parallel, pin for pin, except for pin 13, the memory-enable pin. More on this later.

A 555 timer is wired up in the astable multivibrator mode and clocks three 7493s, which are 4-bit binary counters. The speed of the clock can be varied by means of the 25k pot. The 7493s provide the ten address lines needed to address the 2102s (2^{10} = 1024 bits per chip). As we said before, the 2102s are in parallel except for the ME pins, because we want to enable only one chip at a time. (A logic 0 on the ME line enables the chip, while a logic 1 disables it.) This is accomplished by using an inverter section connected to pin 8 of the last 7493. In the starting position, where A_0 through A_9 = 0, ME1 will be low, ME2 will be high, and the first memory chip will be enabled. 1024 bits later, the first chip will have been addressed fully. Pin 8 on the 7493 will then switch high, ME1 and ME2 exchange logic levels, and the second memory chip will be enabled. In this way, both chips are used to their full capacity. The LEDs are there to give visual indication of when one memory has been cycled through and the other is starting.

Incoming data to the 2102s is fed through two inverters to pin 11 and can be keyed by any method in which key-down is represented by a logic 0. Although the two inverters look redundant, they are there for a reason. The DI pins tend to assume a low state if left floating. Since logic 0 = key-down in this circuit, this can't be tolerated; the two inverter sections are there to pull the DI pins high in the absence of an incoming signal.

Data-Out is available at pin 12. The two inverters and the capacitor following it are for shaping purposes. A switch, S2, is provided to allow the operator to choose between using the message stored in memory or using the key without going through the memory. Note, also, that the output drives a sidetone oscillator, another 555 in the astable mode. A switch, S5, is provided to shut off the audio tone when the memory is not in use. S4, the Reset switch, resets the memory to the starting point by bringing all the address lines to logic 0. S1, the Read/Write switch, controls whether or not data is written into the memory or is available at the output. The Erase switch brings one end of the 1.0-uF capacitor up from ground to a logic one when pushed, allowing the 555 clock to run at its top speed, around 200 kHz. The memory chips cycle through in just a fraction of a second, and if the Read/Write switch is in the Write position, it will clear the entire 2K of memory.

It should be noted that this diagram does not provide a way to key the transmitter, as different transmitters use different keying methods. Circuits for keying the two most popular types of transmitters (grid-block and cathode-keyed) are shown in Fig. 2.

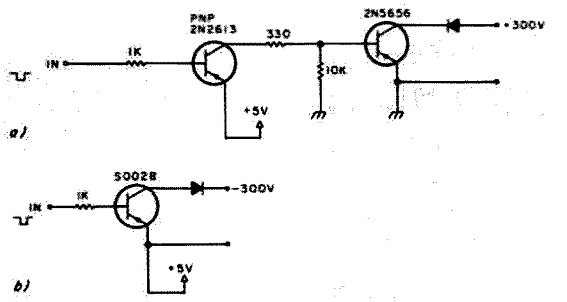

Fig. 2 (a) Cathode keying. (b) Grid block.

Construction can be as simple or as elegant as you desire. A well-regulated 5-volt supply should be used with adequate filtering. I have added 47-uF capacitors across the supply to the 555s; these should be placed as close to the 555s as is physically possible. 555s tend to generate a lot of garbage and glitches, and extra bypassing is needed to prevent these from being sent on down the line. Bypass capacitors on the order of .01 or so should be placed across the supply near all the rest of the chips, also; this is simply common sense when working with TTL and was not shown on the schematic.

As seven inverter sections are used, two 7404 chips are required. Any unused sections should have their inputs tied to ground.

The easiest way to parallel the two 2102s is simply to stack one on top of the other and solder the pins together. While it is surprising how much heat they can stand, don't overdo it; try to use a small soldering iron and solder quickly. Remember not to solder the ME pins together.

If one desires control over the pitch of the sidetone oscillator, the 1-megohm resistor on the 555 can be replaced with a trimmer pot.

Operation is simple. Turn the Memory/Key switch to the Memory position, turn the Read/Write switch to the Write position, turn the Audio switch on, reset the memories, and key in the message you want. When you're finished, switch the memory back to read and reset it. Your message should play back.

If the message is distorted, this means that the memory clock is not running high enough as compared with the keying rate. Either advance the clock rate or slow down your fist, and try again. Eventually, you will find a speed fast enough so that the message is recorded undistorted. The memory should be running as slow as possible, without distortion, in order to get a longer message into memory. Of course, once the message is in the memory, you can play it back at any speed you wish by simply varying the memory clock speed. Maybe this accounts for some of the 60 wpm plus signals we hear on the air!

Total cost for this memory is ridiculously low, with the most expensive components being the five switches. The 2102s are available nearly everywhere for under $2 each, 7493s under a buck apiece, 555s for 50 cents, and the 7404s for the whopping sum of a dime per chip. It really is a poor man's memory!

I hope you like the memory as much as I did. I'll be glad to answer any and all questions if you send me an SASE. ■

Charles E. Cohn WB9SKX
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Clarendon Hills IL 60514

Power Up for Mobile Operation

—adding an auxiliary battery

Wiring a winner.

It certainly puts a damper on the pleasures of mobile operation if you have to worry that the next push of the mike button will drain the battery to the point where the car will not start. It kind of spoils the fun of having that new super linear that draws 100 Amps from the battery on transmit, doesn't it?

What is there to do about it? You could, of course, keep the engine running while you are operating, but that wastes gas if you are not in motion. A better solution is to connect your radio equipment to an auxiliary battery—a separate battery that is charged by the alternator when the engine is running, but is disconnected and isolated from the main or starting battery when the engine is stopped. That way, you can run the auxiliary battery down even to the point of total discharge, with the main battery remaining charged and ready to start the engine.

Furthermore, there is a wide variety of electrical appliances, ranging from refrigerators to bed warmers, that can enhance the comfort of living in a van or camper. Again, you can get the most out of these conveniences only if you don't have to worry about running down the starting battery. Large motor homes and other recreational vehicles are all equipped with auxiliary batteries. They are available as optional equipment in some makes of vans and in most makes of pickup trucks. One can be added, using aftermarket components, to any vehicle that has room for an extra battery.

As a point of reference for the following discussion, Fig. 1 shows a simplified view of the normal car or truck electrical system, specifically, the part devoted to charging the battery. You can see how the alternator provides power to the vehicle circuits and charges the battery through the ammeter. The alternator field is supplied by the regulator, which receives power through the ignition switch and senses the voltage that it receives.

To install an auxiliary battery, you must first find room for it. Some vans and most pickup trucks have room under the hood. For these, battery trays are commercially available for about $10. Some cars might also accommodate an extra battery under the hood.

If there is not room under the hood, you can install the battery in the trunk of a car or under a bed or within a cabinet in a van. The space occupied by the battery should be vented to the outside to prevent accumulation of the hydrogen gas given off by the battery when it is being charged. Plastic battery boxes are available at trailer supply stores. These are useful for protecting the battery and for keeping battery acid off other things.

You must, of course, have a battery. An ordinary car battery will do nicely and is commonly supplied when an auxiliary battery is ordered with a new vehicle. However, it is not optimal for this application. An ordinary car battery is designed for so-called "floating" service, where it is kept continually at or near full charge by the alternator and only dis-

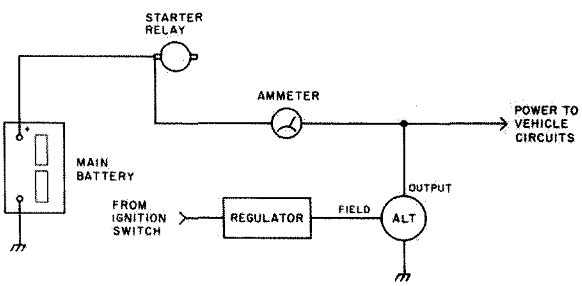


Fig. 1. Simplified circuit of automobile electrical system.

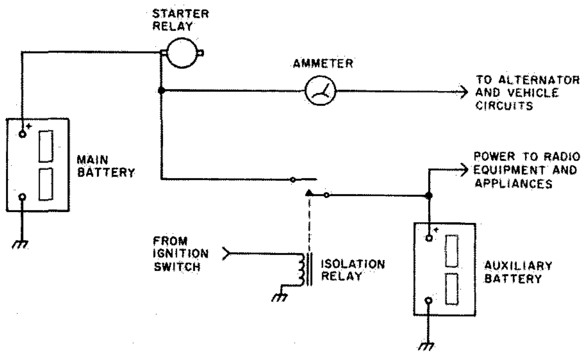


Fig. 2. Auxiliary battery with relay isolator.

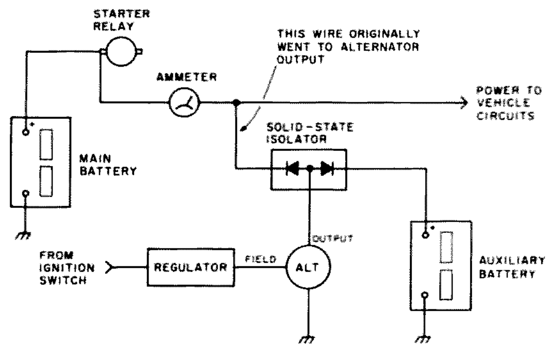


Fig. 3. Auxiliary battery with solid state isolator.

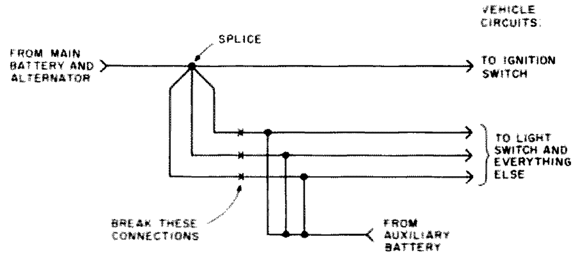


Fig. 4. Powering vehicle circuits from auxiliary battery.

charges a small fraction of its capacity by the normal engine start.

An auxiliary battery, in contrast, is subject to so-called "cycling" service, where it may discharge a large fraction (or all) of its capacity, if not completely, when electrical equipment is used with the vehicle and the engine off. (The discharge and subsequent recharge by the alternator constitute a "cycle" in battery parlance.) This sort of service is hard on a battery and hastens its deterioration by such occurrences as the shedding of active material from the plates. A battery that is designed for cycling—say, a marine battery such as the Sears Die-Hard Marine—will cost more than a car battery, but will last longer in this type of service.

The final item you will need is an isolator, whose function is to disconnect the auxiliary battery from the main battery when the engine is not running. This is available from recreational vehicle supply stores. Be sure to get an isolator with a current rating equal to or greater than the output rating of your alternator.

There are two types of isolator—relay and solid state. The relay isolator is the cheaper of the two, so (naturally) it is always used when the auxiliary battery is put on the vehicle at the factory. A diagram of the arrangement is shown in Fig. 2. It consists simply of a contactor relay (looking something like a starter relay) that connects the auxiliary battery in parallel with the main battery when the ignition is on. The auxiliary battery then receives a charge. When the ignition is off, the relay opens and the auxiliary battery is isolated.

This is a workable arrangement, but it has three disadvantages. First, if the load on the auxiliary battery while the engine is running exceeds the alternator capacity, current will be drawn from the main battery. Second, if the two batteries are at different states of charge, heavy currents will flow from the stronger one in to the weaker one when the ignition is turned on. Finally, the relay contacts are subject to deterioration.

The solid state isolator avoids these disadvantages. As purchased from a recreational vehicle supply store, it looks like a very mysterious box with cooling fins on the outside and the internal workings inaccessible. It costs about $25. However, as shown in Fig. 3, all there is to it is a pair of high-power diodes mounted on a heat sink. The anodes of the diodes are both connected to the output terminal of the alternator, while the cathodes are connected to the two batteries. Thus, current can flow from the alternator to both batteries, but not from one battery to the other. The regulator continues to sense the voltage of the main battery and thus compensates for the diode drop.

You can save a little money by making your own isolator. Simply procure two diodes with current ratings equal to or greater than your alternator output rating. The lowest voltage rating offered, commonly 50 volts, is adequate. Mount them on a heat sink (with adequate insulation of course) and hook them up.

To install the solid state isolator, find a place to mount it near the alternator. Remove the heavy wire from the alternator output terminal and connect it to one side terminal (i.e., one diode cathode) of the isolator. (This wire will carry charging current to the main battery.) Prepare a new heavy lead and connect it between the alternator output terminal and the center terminal of the isolator (i.e., the two diode anodes). Connect the remaining side terminal to the auxiliary battery.

Whenever you do any electrical installation work of this type, it should go without saying that you first disconnect the ground cables from both the main and auxiliary batteries. Otherwise, expensive fireworks will occur.

Use number 10 or heavier wire for the power connections between the alternator, isolator, and batteries. A kit of crimp-type terminals is extremely useful for this sort of job.

Once you have an auxiliary battery, you can get a lot more benefit from it by rewiring the vehicle electrical system so that the lights and other accessories are connected to the auxiliary battery, and only the items controlled by the ignition switch remain connected to the main battery. That way, you won't have to worry about running down the main battery if you leave the lights on, either inadvertently or for safety, or if you plug something into the cigar lighter socket on the dashboard.

Because of the wide variations in the details of car and truck electrical systems, I can present only general guidelines for making this change. See Fig. 4. Start by studying your vehicle's wiring diagram. Look for a splice where the main power wire from the battery, ammeter, and alternator branches out to the ignition switch, light switch, and other accessories such as the cigar lighter (possibly passing through the fuse box on the way). Cut all wires away from this splice except the ignition switch wire and the feed wire from the battery. Connect the wires you have cut loose to the auxiliary battery.

Normally, vehicles with auxiliary batteries have not been wired in this way. (My van is probably the only one until this article appears.) Making the change will, in all likelihood, involve you in working with the tangle of wires under the dashboard, but the results are well worth it.■

Project Update

—doubled capacity for K2OAW's repeater IDer

Just add three ICs.

Peter A. Stark K2OAW
PO Box 209
Mt. Kisco NY 10549

Quite a few repeaters around the country are using the K2OAW repeater control and CW identifier published in *73 Magazine*, February and March, 1973.

The identifier used a simple diode matrix for memorizing a call consisting of up to 32 dits, dahs, and spaces. That was sufficient even for long repeater calls such as WR2XXX. But the FCC

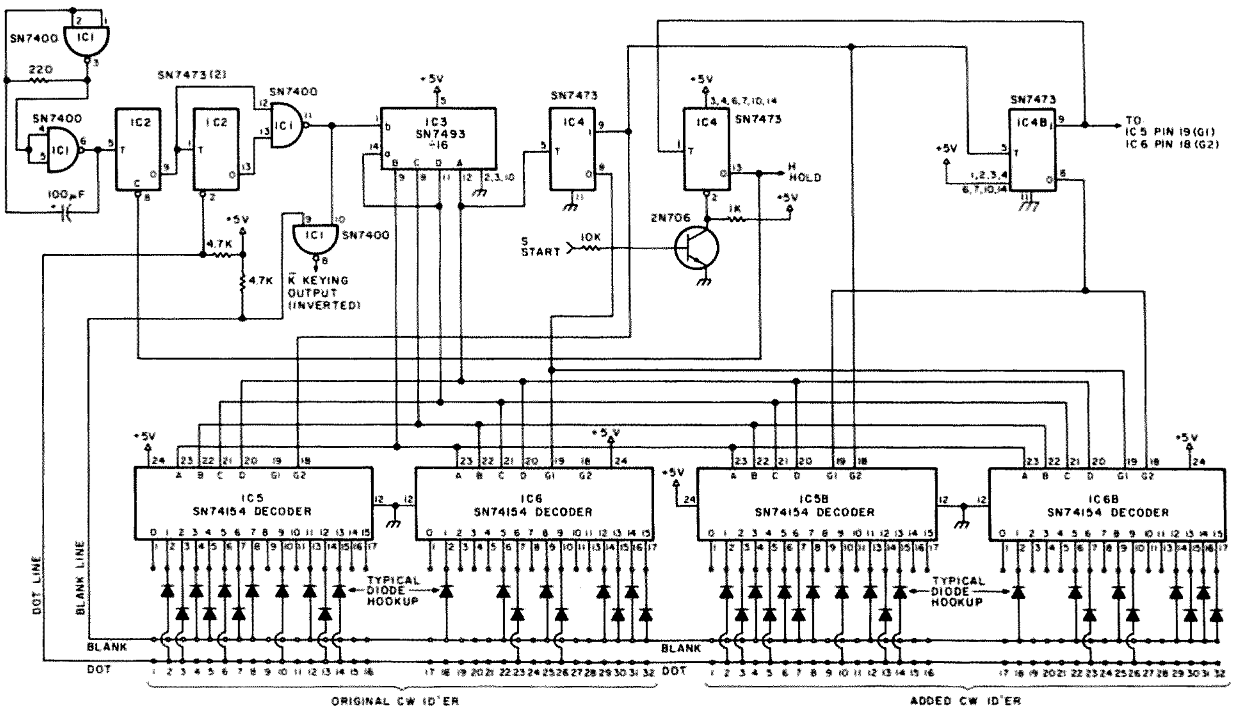


Fig. 1. CW identifier as modified for 64 diode positions.

recently changed the rules—no new WR calls will be issued and individual calls followed by /RPT are to be used. Now, even a simple call such as K2EEE/RPT is too long to fit into the 32-bit limitation.

Snort of designing a completely new identifier, the easiest solution for repeaters which must change to the new call system is to simply add three new TTL integrated circuits as shown in Fig. 1.

The three new ICs are IC4B, IC5B, and IC6B. IC5B and IC6B are connected exactly the same as IC5 and IC6 on the original board and extend the diode matrix to 64 bits. Diode matrix wiring is exactly the same as before, with diodes scanned from left to right.

IC4B is a new flip-flop which is connected between the two halves of the old IC4 to extend the counter from 5 bits (which would access 32 diodes) to 6 bits (to access 64 diodes). The wiring to the G1 (pin 19) and G2 (pin 18) inputs to all four 74154 decoders is now different.

The new ICs and diodes can be installed on a perforated board which connects to the original printed circuit board with 11 wires, counting +5-volt power and ground. I also have several of the original identifier boards, which I will be happy to sell ($7 each) to anyone who would like to mount the new board piggyback above the old one.

So, if you have to change your repeater's call, go ahead and make this modification. It's a lot easier to modify the present identifier than to start all over. ■

Microcomputer Interfacing

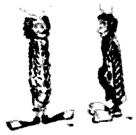
from page 14

programs back into memory. In any case, when errors are found, you will probably want to reedit and reassemble the software to produce a complete, error-free, documented listing.

Since most programs will contain errors, it may be a good idea to have the debug program as a permanent part of your computer. The storage of a debug-type program in read-only memory (ROM or PROM) is wise since "runaway" programs being tested might alter the debug software, causing you to have to load it again. There are many debug or *monitor* programs available, with Intel Corporation's Insite software library listing at least four. The editor/assembler programs may also be resident in PROM, and the low cost of both read/write memory and PROM chips suggests that many users will keep standard system programs such as editors, assemblers, and debug resident in their systems. The alternative is a paper tape, cassette, or disk-based software package which must be read into memory before each use.

There are also cross-assemblers which will generate an assembled program, but for some other computer. For example, a PDP-11 might be able to cross-assemble 8080 microcomputer programs. Cross-assemblers can be powerful programs, since some incorporate simulation programs to test the program, too.

The program we use for testing programs is DBUG written by Dr. Chris Titus,* and the assembler output shown in our program examples is that produced by the Tychon Editor/Assembler (TEA). Both are resident in our 8080 system on PROM chips.



*"DBUG, An 8080 Interpretive Debugger," Titus, C.A., E & L Instruments, Inc., Derby CT 06418, 1977.

Contests

from page 18

band at the same time.

EXCHANGE:

OM stations send RS(T) plus 2 digits denoting the operator's age; YL stations send RS(T) plus 00.

SCORING:

For non-Asian stations: Score 1 point per Asian QSO; multiplier is the number of different Asian prefixes worked on each band according to WPX rules. Asian stations score 1 point per non-Asian QSO; multiplier is the number of different countries in the world worked on each band according to the DXCC countries list.

Note: JD1 stations on Ogasawara (Bonin and Volcano) Islands belong to Asia. JD1 stations on Minamitori Shima (Marcus) Island belong to Oceania. Contacts among Asian stations and among non-Asian stations will not count for QSO points or multipliers. Contacts with KA stations are not eligible! They are considered not amateur, but military!

ENTRIES AND AWARDS:

Please use official contest log and summary sheets or other similar forms. Please keep all times in GMT and fill up the blanks of "multiplier" by the countries or prefixes only the first time on each band. A number of awards will be issued depending on the number of entries from each country in each class. Disqualification may result for violation of the contest rules, false statement in the report, or taking points for duplicate contacts on the same band in excess of 2% by the total. The log and summary sheet must arrive together at JARL, PO Box 377, Tokyo Central, Japan, on or before the following dates: phone—September 30th; CW—November 30th. You may have contest results by enclosing one IRC and SAE with your log.

WEST VIRGINIA QSO PARTY
Starts: 2300 June 16
Ends: 2300 June 17

All amateur radio operators are invited to participate in this year's party sponsored by the West Virginia State Amateur Radio Council. The same station may be worked on different bands for additional points. Only one contact with each station per band may be counted for scoring. West Virginia stations may work each other.

EXCHANGE:

QSO number, RS(T), and WVA county or state/country.

SCORING:

Out-of-state stations multiply the number of eligible QSOs with WVA stations by the number of different WVA counties worked. This total is then multiplied by the power multiplier indicated below. WVA stations multiply the number of eligible QSOs by the sum of the different WVA counties, states, and countries worked. This total is then multiplied by the power multiplier: dc input of 200 Watts or less, multiply by 1.5; dc input of 201 Watts to legal limit, multiply by 1.0.

ENTRIES & AWARDS:

To be eligible for an award, a station may have only one unassisted operator and logs must contain a minimum of 50 valid contacts (20 for Novices). Logs must be received no later than July 15th and logs will not be returned. Logs must indicate the date, time, QSO number, callsign, their QSO number, signal report, and county/state/country or station worked, mode, and band. Awards will be issued as follows: highest-scoring WVA resident, 1st runner-up WVA resident, 2nd runner-up WVA resident, highest-scoring Novice WVA resident, highest-scoring station from each state, highest-scoring station from each country, and highest-scoring Novice from each state. Decision of the Contest Committee of the WVA State ARC will be final. Logs should be sent to: West Virginia QSO Party, PO Box 36, Seneca Rocks WV 26884. Suggested operating frequencies are 35 kHz inside each CW band and 10 kHz inside the general portion of each phone band.

7-LAND QSO PARTY
Starts: 1200 GMT June 30
Ends: 2400 GMT July 1

This is the second annual QSO Party sponsored by the NAS Whidbey Island ARC. The 7-land area includes the 8 US call district states, the VE7 call area of Canada, and the KL7 area of Alaska.

Operating time is limited to 30 of the 36 contest hours. The same station may be worked on each band, and contacts between 7-land stations are permitted for multiplier and QSO credit.

EXCHANGE:

All stations: RS(T)/contact no. /state, province, or country. 7-land stations include county.

SCORING:

One point per QSO for 7-land stations. Five points for each 7-land contact for all other stations.

Multiplier: 7-land—one multiplier for each of the 50 US states and 13 Canadian provinces on each band. All others—one for each state or province worked in the 7-land area, maximum 13 on each band.

Power Multiplier: 5 Watts or less—x5.00; 5 to 100 Watts input—x2; 100 to 299 Watts input—x1.5; 300 to 499 Watts input—x1.25; over 500 Watts input—x1.

Final score is QSO point total x sum of band multipliers x power multiplier.

AWARDS:

Certificate to each top-scoring single op in each state, province, and DX country.

Certificate to each top-scoring multi-op, single transmitter in each W/VE call district.

There will be no multi-multi category.

All stations operating outside the call district indicated by their call must sign portable.

LOGS:

Logs must show band, mode, date and time in GMT, station worked, exchange sent and received, points.

Use a separate sheet for each band and include a dupe sheet if your entry includes over 100 contacts.

Make your own log and dupe sheets. However, a summary sheet can be obtained from WB7NVM if an SASE accompanies the request.

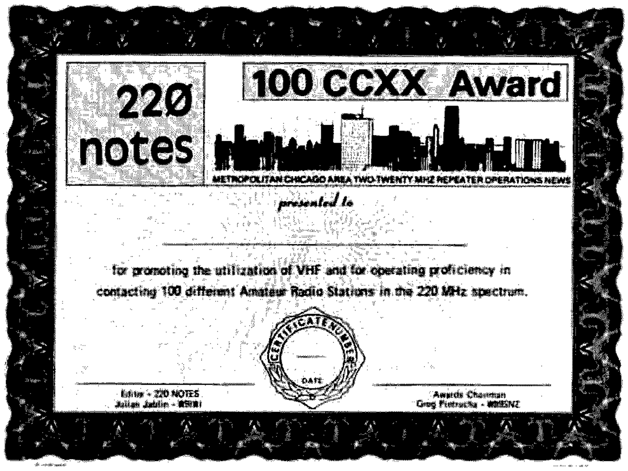
Include an SASE with the entry. Mailing deadline is August 1, 1979. Mail entries to: NAS Whidbey Island ARC, c/o Lloyd Vancil, 3541 Appian Way, Oak Harbor WA 98277.

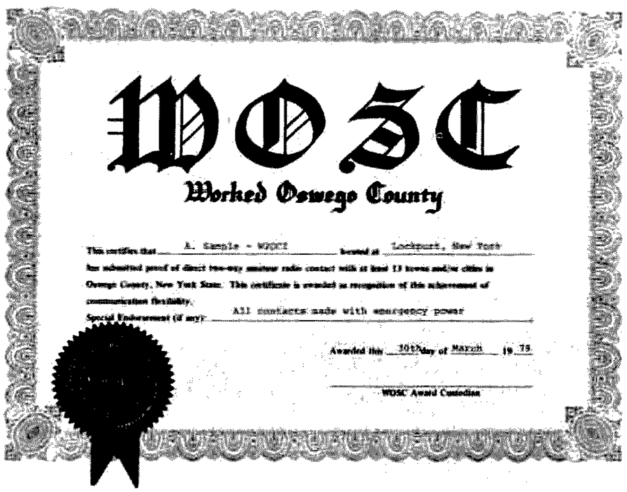
220 NOTES—100 CCXX AWARD

An attractive certificate is awarded to amateur radio operators who contact 100 separate stations anywhere in the 220-MHz band *after* receipt of the official logsheets. Contacts may be made through any repeater or via simplex. Please keep a dupe sheet to avoid disqualification caused by duplicate entries. Logs may be obtained from WB9SNZ; include an SASE. Completed logs should be mailed with $1.00 to *220 Notes*, to: Greg Pietrucha WB9SNZ, 2216 N. Kildare Avenue, Chicago IL 60639.

THE WORKED OSWEGO COUNTY AWARD

The Worked Oswego County Award (WOSC) is available to any amateur radio operator who works amateur radio stations in at least 13 of Oswego County's 24 towns and cities. A gold-seal endorsement is available to those who work all 24 cities and towns.





All direct two-way contacts (made without the aid of a repeater) made after January 1, 1978, count toward the award. All contacts must be made from the same station at the same fixed location, or, if mobile, from within five miles from the licensed location. Contacts with all fixed or mobile stations count on any amateur band. Multiple contacts with the same station portable or mobile in a number of town or city locations is permitted for the purpose of making additional town or city contacts.

A special endorsement is available if contacts with all cities or towns are made using emergency or battery power.

Applicants should list the time, date, frequency, mode, and power used, along with station contacted and location (town name or city). This is the usual information that would be filled in on the standard ARRL log. The list of 13 or 24 contacts should be mailed to the Award Custodian along with a self-addressed, stamped return envelope. QSL cards are not required, but the spot log check requests to the stations listed may be made by the Award Custodian.

There is no charge for this award. The award is sponsored by radio station WOSC to encourage contact with all areas of Oswego County and test station capabilities. The rules and qualification specifications may be changed from time to time by the Award Custodian. In the case of questions and disputes, the decision of the WOSC Award Custodian is final. The Fulton Amateur Radio Club will act as custodian for the award. Its mailing address is: PO Box 246, Fulton NY 13069.

Official WOSC List of Oswego County Towns and Cities

Oswego Town	Richland
Hannibal	Sandy Creek
Granby	Boylston
Minetto	Orwell
Scriba	Albion
Volney	Parish
Schroeppel	West Monroe
Palermo	Constantia
New Haven	Amboy
Hastings	Williamstown
Mexico	Redfield
City of Oswego	City of Fulton

Looking West

from page 6

operator assigned the callsign indicated hereunder. I actively operate in the presently-allocated 220-MHz amateur band, using my own equipment and through repeaters representing substantial investments of cash and technological effort.

In a portion of Docket 20271 (Par. 103 and 124) concerning its position to WARC on frequency allocations, the Commission proposed that the present 220-225-MHz amateur radio frequencies be allocated primarily to a new use by the maritime radiotelephone service.

I am not aware of any Notice previously issued regarding this proposed allocation. This portion of the Report and Order clearly affects my rights and the rights of other licensed amateur radio operators to the 220-MHz band. A formal opportunity for amateur radio response would demonstrate that the 220-MHz band is in active use throughout the United States, presenting an attractive alternative to the crowded 2-meter band.

Growth of "220" had previously been restricted by the threatened allocation of the frequencies to Citizens Band use. However, since the Commission denied that proposal, amateur use of the band has flourished.

I join with the 220-MHz Spectrum Management Association of Southern California in its petition to withdraw the affected parts of Docket 20271, and to set that matter for comments and hearings in an appropriate framework as required by law.

Respectfully submitted,

/s/

Date:
Name/Call:
Address:
City/State:

Thanks to *220 Notes*, here is an easy way for you to join in the fight to save 220. Lee Knirko W9MOL and Julian Jablin W9IWI, who prepared the special "Action" bulletin, suggest that you do one of the following with the letter:

1) Make one copy and 14 photocopies, and send all 15 to the Secretary of the FCC in Washington; or

2) Send just one copy to the FCC (which will at least put you on record as opposing the US 220 WARC proposal, although it will not be considered an official reply by the Commission); or

3) Look over the points made and draft a letter in your own words to the same effect. This is the best method, although it takes the most time. Then go out and again make 14 photocopies and send all 15 to the Commission as your official reply; or

4) If you do draft your own letter but do not have the time to copy it, at least send it to the FCC as fast as possible.

The idea here is for the amateur community to show its support for the one lone Petition for Reconsideration on this matter which was filed on time. Without such support, the 220-SMA has little chance of accomplishing much. With your support, the FCC will be forced to take notice.

Lee and Julian also suggest that you send copies to your senators and representatives, as well as to Dave Sumner at ARRL HQ. I might also suggest that copies be sent to the 220-SMA of Southern California, to the Westlink Amateur Radio News Service, and to myself.

THE CB BANDITS DEPARTMENT

Abuses of CB operation were given a good look on the morning of April 5th on the National Broadcasting Company's "Today" program. In a segment entitled "CB Bandits," produced at NBC's Burbank facilities by Scott Goldstein, NBC correspondent Jack Perkins explained to the public the myriad of problems now prevalent on the 11-meter Citizens Band by visually documenting many of the more common abuses in the CB service.

Shown were such regulatory violations as the use of excessive power, DXing, and even the playing of music on 11 meters. In the case of the latter, a female CB operator in the midwest was shown running an on-the-air CB music program from taped cartridges through her CB set and linear amplifier. Other scenes depicted how "CB bandits" who run excessive power make life miserable for both the legal CB operator (who wishes to use 11 meters for its intended purpose) and his neighbors, in the form of excessive TVI and BCI. The FCC was given its say on this problem through Los Angeles Engineer-in-Charge Larry Guy, who stated that such operations were indeed illegal and noted that if all CB operators obeyed the regula-

tions, there would be no need for amplifiers and the like. The report showed the FCC's enforcement operation here in southern California, but explained that although the FCC attempted to keep control over CB, it was hampered in this due to a lack of staff. It gave a figure of 400 FCC employees nationwide who were trying to police more than 15 million CB operators.

Perhaps the most vivid portion of this 5-minute, 30-second segment was mini-cam coverage of a business in Costa Mesa, California, known as Pacific Coast Communications, which the report alleges to be a supplier of illegal power amplifiers and similar equipment. To radio amateurs, this particular piece has important significance in that it visually gives credence to what many amateurs have said for a long time—that the FCC's linear amplifier ban on such devices operating in the spectrum from 24 through 36 MHz is nothing but a bureaucratic farce which punishes the law-abiding amateur for the sins of another radio service. The ban has accomplished only one thing: It has created a rather healthy black market for such equipment. I suspect that operations such as PCC are more the rule than the exception. Maybe the contents of the "Today" report will get through to the Commissioners the fact that their "easy way out" was not the right road to follow after all. The inability of the FCC to cope with the CB problem won't be easily forgotten.

Whether they realize it or not, the "Today" program producers have performed a service for amateur radio. They did not lump amateur and CB operations together (as is often done by the broadcast media), and they graphically pointed out the real world of CB and the problems it faces today. Moreover, they may have given amateurs the kind of ammunition needed to shoot down the unconstitutional, unwarranted, and illegal ban on 10-meter amplifiers.

COMMENTARY

The NBC report neglected to mention one important item—that the problems depicted were big-city ones not often found in the outlying areas. Los Angeles CB operation is a mess. It's virtually impossible to hold a QSO of any consequence because of the many CB bandits like those depicted on "Today." This holds true for most cities of any size. However, once you get away from the big cities, things are quite different; the CB bandit is definitely a minority figure in such locations.

One other point missed by the NBC presentation was the difference between AM and SSB operation. Only unstructured AM was shown, which in big-city CB is a no-man's-land. Not mentioned were some of the structured and voluntarily-policed SSB operations. However, it is hard to really criticize this report on either of these points, since the obvious aim was to enlighten the public about the current problems of 11-meter CB. Considering the constraints imposed by the exact timing that TV broadcasting requires, I must say that NBC has done a rather outstanding job.

* * *

In a late-breaking development, the FCC acted the week of April 1st to deny the 220-SMA Petition for Reconsideration of Docket 20271. The FCC based its denial of this and eight similar petitions on the grounds that over four years had been spent on the preparation of the WARC proposal and that, during that time, all interested parties had been given ample time to comment. However, it must be noted that during this four-year period, not once was there a mention of reallocating 216 through 225 MHz to the maritime service and, therefore, there was no way in which concerned amateurs could comment on the matter. Many 220-MHz amateurs feel that both the maritime service and the FCC have directly violated the federal government's Administrative Procedures Act and stand ready to take whatever legal action is necessary to prevent the implementation of the WARC proposal.

RTTY Loop

from page 20

tions with special data, these characters can be used as software switches to accomplish special functions. The special codes detailed above, for example, translate to:

$00—The null is stored for control codes which have no function in Baudot, e.g., $01, $02, $1F, but not those with a function, as the BELL ($07).

$FF—A DEL is stored for certain "special" printable characters not found on the Baudot keyboard.

$FE—Stored at the first location of the table, $FE will be sent as LTRS when a NULL is input from the keyboard.

After the table value is retrieved, it is tested for $FF, and, if present, a branch to SPLCHR is executed. This routine handles those printable characters, like *, %, and @, that are not represented in Baudot. Another test for $00 directs a branch back to the input if present. Thus, control codes do not even start the outputting routine.

If there is no "special case," then the Baudot output sequence is initiated. The MSB of the data retrieved from the table encodes LETTERS or FIGURES case. The routine diagrammed in Fig. 3 shows how the shift is read, compared with the current case, stored, and changed if necessary. It should be noted that SPACE, CARRIAGE RETURN, and LINE FEED are all sent as lowercase (LTRS) characters. Thus, downshift when spacing or when sending a new line is ensured.

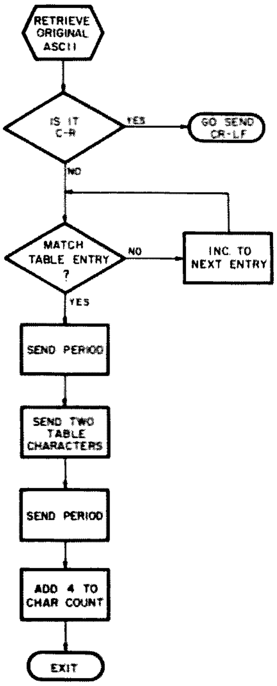


Fig. 5. SPLCHR routine.

Having established the shift, the actual character is output, using the routine shown in Fig. 4. This routine loads the carry bit with the five remaining data bits in the accumulator, keeping track of the bit number with a counter. If the carry bit is a "1", a MARK is sent; a "0" sends a SPACE. START (22 ms SPACE) and STOP (31 ms MARK) bits are also appended, thus creating true TTY format.

Should you have encountered one of those "special" characters we mentioned above, a branch to SPLCHR would have brought you to a routine diagrammed in Fig. 5. Here, the original ASCII character input is retrieved from the table pointer where it was stored. If it is a carriage return, a branch to a routine called CRLFOT will send the string CR-CR-LF-LTRS-LTRS, a "standard" way of initiating a new line in Baudot, and echo a CR-LF on the terminal. Otherwise, a period (.) followed by two letters and another period fill in for the missing character. Fig. 6 shows the codes used for the ASCII characters encoded.

The flowcharts shown this month comprise an overview of a practical means of Baudot transmission with a computer.

ASCII	Symbol	Baudot
$23	#	.NR.
$25	%	.PC.
$2A	*	.AS.
$2B	+	.PL.
$3C	<	.LT.
$3D	=	.EQ.
$3E	>	.GT.
$40	@	.AT.
$5B	[	.((.
$5C	\	.BS.
$5D	]	.)).
$5E	↑	.UP.
$5F	—	.UL.

Fig. 6. SPLCHR conversions.

Next month, I will go into a program to implement this scheme on an SWTPC 6800 computer. Input shall be through the control interface. An MP-S ACIA-type input is preferred, although the MP-C PIA-type board will suffice. Output shall be through one bit of a PIA board (MP-L) on port #7.

Regards this month to Melvon G. Hart W0RV in St. Louis MO. Melvon is using Teletype™ gear now, but we hope with the program now developing, and others, he will soon be able to get that SWTPC system on RTTY! He also lets us know that an active two meter RTTY net is on in St. Louis, on 146.70 MHz, AFSK. Thanks for the info, Mel.

Ham Help

I have a niece in Corpus Christi TX who is interested in becoming a ham. She is 8 years old but sharper than I in some ways. Is there a group in Corpus Christi who could help out with this project? Thanks.

Jim Falkner
Box 850
Port Saint Joe FL 32456

OSCAR Orbits

Courtesy of AMSAT

The listed data tells you the time and place that OSCAR 7 and OSCAR 8 cross the equator in an ascending orbit for the first time each day. To calculate successive OSCAR 7 orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the day's first ascending (northbound) equatorial crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world from you, it will descend over you. To find the equatorial descending longitude, subtract 166° from the ascending longitude. To find the time OSCAR 7 passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR 7 when it is within 45 degrees of you. The easiest way to determine if OSCAR is above the horizon (and thus within range) at your location is to take a globe and draw a circle with a radius of 2450 miles (4000 kilometers) from your QTH. If OSCAR passes above that circle, you should be able to hear it. If it passes right overhead, you should hear it for about 24 minutes total. OSCAR 7 will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15° east or west of you, add another minute; at 30°, three minutes; at 45°, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

OSCAR 8 calculations are similar to those for OSCAR 7, with some important exceptions. Instead of making 13 orbits each day, OSCAR 8 makes 14 orbits during each 24-hour period. The orbital period of OSCAR 8 is therefore somewhat shorter: 103 minutes.

To calculate successive OSCAR 8 orbits, make a list of the first orbit number (from the OSCAR 8 chart) and the next thirteen orbits for that day. List the time of the first orbit. Each successive orbit is then 103 minutes later. The chart gives the longitude of the day's first ascending equatorial crossing. Add 26° for each succeeding orbit. To find the time OSCAR 8 passes the North Pole, add 26 minutes to the time it crosses the equator. OSCAR 8 will cross the imaginary San Francisco-to-Norfolk line about 11 minutes after crossing the equator. Mode A: 145.85-.95 MHz uplink, 29.4-29.50 MHz downlink, beacon at 29.40 MHz. Mode J: 145.90-146.00 MHz uplink, 435.20-435.10 MHz downlink, beacon on 435.090 MHz.

OSCAR 8 Orbital Information

Orbit	Date (June)	Time (GMT)	Longitude of Eq. Crossing °W
6310Abn	1	0136:46	68.6
6324Jbn	2	0141:57	69.9
6337Jbn	3	0003:54	45.4
6351Abn	4	0009:05	46.7
6365Abn	5	0014:15	48.1
6379X	6	0019:26	49.4
6393Abn	7	0024:37	50.7
6407Abn	8	0029:47	52.0
6421Jbn	9	0034:58	53.3
6435Jbn	10	0040:09	54.6
6449Abn	11	0045:19	55.9
6463Abn	12	0050:30	57.2
6477X	13	0055:40	58.5
6491Abn	14	0100:51	59.8
6505Abn	15	0106:02	61.2
6519Jbn	16	0111:12	62.5
6533Jbn	17	0116:23	63.8
6547Abn	18	0121:33	65.1
6561Abn	19	0126:44	66.4
6575X	20	0131:54	67.7
6589Abn	21	0137:05	69.0
6603Abn	22	0142:15	70.3
6616Jbn	23	0004:12	45.8
6630Jfd	24	0009:23	47.1
6644Abn	25	0014:33	48.4
6658Abn	26	0019:43	49.8
6672X	27	0024:54	51.1
6686Abn	28	0030:04	52.4
6700Abn	29	0035:15	53.7
6714Jbn	30	0040:25	55.0

OSCAR 7 Orbital Information

Orbit	Date (June)	Time (GMT)	Longitude of Eq. Crossing °W
20775	1	0002:24	64.0
20788	2	0056:41	77.6
20801	3	0150:58	91.1
20813qrp	4	0050:18	76.0
20826	5	0144:35	89.6
20838X	6	0043:55	74.4
20851	7	0138:12	88.0
20863	8	0037:32	72.9
20876	9	0131:49	86.5
20888	10	0031:10	71.3
20901qrp	11	0125:27	84.9
20913	12	0024:47	69.8
20926X	13	0119:04	83.3
20938	14	0018:24	68.2
20951	15	0112:41	81.8
20963	16	0012:01	66.6
20976	17	0106:18	80.2
20988qrp	18	0005:39	65.1
21001	19	0059:55	78.7
21014X	20	0154:12	92.3
21026	21	0053:33	77.1
21039	22	0147:50	90.7
21051	23	0047:10	75.6
21064fd	24	0141:27	89.1
21076qrp	25	0040:47	74.0
21089	26	0135:04	87.6
21101X	27	0034:24	72.4
21114	28	0128:41	86.0
21126	29	0028:02	70.9
21139	30	0122:19	84.5

Corrections

This is to express thanks to all CW music fans for corrections and suggestions for improvements for the keyboard described in the February issue of *73* ("This Station Plays Beautiful CW").

A note from KA1ADF (Speedy) arrived one day before I received my copy of *73* and pointed out: (1) The 10k resistors of Fig. 1 are not shorted out as the print indicates; (2) The callout for Fig. 2 should show 4071 for U7; and (3) U10 is a 4049. WA0KZL points out that the diodes are 1N4148, not as indicated in the callout for Fig. 1. Actually, about any diode will work. Even the cheap 1N4001 will do fine. Along with thanks to Tex goes my apology to Susan Philbrick of the *73* staff. She questioned this and I gave her a wrong answer.

W1ZB reports that he has built 20 keyboards over the years and is now going back to the diode matrix after trying many other methods. His next keyboard will use CW music logic but will replace the 40105 FIFO with the Fairchild 3341 to give a 64-letter buffer. For those who want a larger buffer, this is a good way to go.

DA1WD wants a memory for canned messages. An RCA CPD1823SD RAM interfaced between the 40105 FIFOs and the shift register ought to work. I have not made one like this, but it looks good on paper and will give 128 letters. If 256 letters are desired, a pair of CD1822SDs would do the job.

WB5RVH is on the air with an all-plastic case, using a converted UNIVAC surplus terminal and a rechargeable nicad power pack. He reports RFI problems when using the charger plugged into the ac supply. No problem without the charger. Suggest adding 0.01 uF bypass capacitors on all in/out lines. Electrolytics do a good job of filtering but are poor for rf bypass.

The worst problem of all is availability of the 40105 FIFO. This chip is made by RCA and Motorola and is available from the big houses such as Cramer, Hamilton, and Semiconductor Specialists. Unfortunately, all of these distributors have a hard-nosed $25 minimum order policy. On top of that, they often do not stock all other required chips. I was about to believe that it would be necessary to go to Japan for service when I decided to check the *73* advertisers—see Daytapro on page 183 of the February issue. Send Neil K9WRL an SASE for a quote on a chip package. He promises he will supply the 40105. By the way, if your hobby time is hard to come by, use the top line of chips. Specify RCA buffered "B" line, or equal. A typical number is CD 4071BE. After you have one keyboard working, you can test "bargain" chips easily.

Several others have written for diagrams on keying circuits and sidetone oscillators. Sorry, but I did not make drawings. I just hooked up the components per typical sketches, such as shown by VE3CW4 on page 107 in the February issue.

As hams notify me that they are on the air, I will send them a "CW Music" number. Who is going to be #3? Let's hear more CW music. Even if you don't care for a keyboard, good code makes operation a pleasure and can be sent by all methods of keying.

Russell C. W. Crom WB9WRE
904 Barberry Street
Mt. Prospect IL 60056

We would like to point out that one of our articles ("Universal Alarm Circuit," March, 1979) is very similar to one which appeared in the December 11, 1975, issue of *Electronics* ("Multiplexed detectors isolate water leaks"). F. E. Hinkle, Jr. K5PA (Austin TX) holds US patent number 4,090,193 on this device.

John C. Burnett
Managing Editor

Ham Help

I need a schematic diagram for an Electronic Counters, Inc. (ECI), Pulse Generator, Model 5101. If someone has a copy to share, I will pay for reproduction and mailing. Thank you.

Russell Steele
838 Gayle Street
Papillion NE 68046

I need a manual for a Conar Model 80 solid-state television kit. I also need any kind of information on a 1928 Model 3 Eveready ac receiver and a possible matching transmitter. Any help with these items will be deeply appreciated. Thanks.

Peter H. Oesterle VE3HOH/W3
RD #1
Orwigsburg PA 17961

I am attempting to make a list of optometrists who are amateur radio operators. Presently, I know of about 15, and I am sure there are more out there. Perhaps an informal net could be started. All QSLs will be appreciated. Thank you.

Dr. Thomas W. Byers WB9YTG
7221 W. Lake St.
River Forest IL 60305

I would appreciate any information on a 4-inch Western Electric 0-1-0 milliammeter. It has 6 terminals on the back, labeled AC1, AC2, DC +, DC −, DC ±, and R.

Neil Johnson W2OLU
30 Harwich Road
South Orleans MA 02662

LETTERS

from page 13

several additional pieces of gear to the station. Not only are the products at the top of the line in features, design, and reliability, but also I have called them on two occasions for advice in application of some of the equipment and have universally been treated respectfully and promptly. On each occasion, I was referred to the amateur radio department and have found the information readily available, helpfully given and interpreted, and additional recommendations made.

The attitude and cooperation are truly exemplary. The speed and completeness of the service department is outstanding, and the basic design and presentation of the products are unbelievable. I would not hesitate to recommend this company and their personnel to anyone wishing a complete package of up-to-date equipment backed by all the technical and service expertise that could ever be needed, and all presented in a speedy, courteous, and comprehensive way.

Dr. E. Daniel Kay, Jr. K4HTY
Portsmouth VA

TURKEYS

Never in my wildest dreams would I have ever thought I'd be subscribing to *73 Magazine*. Until now, I have considered it just a cut above *Popular Electronics* as far as contents. Things like how to build a moisture detector or fuse testing made simple simply did not appeal.

Your February issue, however, has caused me to rethink my position. The article on the 8080 control system makes me feel that you may be getting around to some serious amateur projects. I did read the article, "The 2 Meter ECM Caper," and I am appalled at the fact that you could publish something tantamount to sanctioning the jamming of another amateur station. Granted, the amateur in question may have used improper or illegal methods to obtain a license, but at that time, he was still a licensed amateur.

I realize that you have to sell magazines in order to provide livings for you and your staff, but I personally feel that articles providing the "turkeys" with new ideas are not in the best interest of anyone associated with amateur radio. Lord knows, we have enough problems without causing new ones.

R. G. Wilde K6EGM
Van Nuys CA

DX

from page 22

OK3TAB/D2A is in Angola and will be there for one year. He has a beam up and is a very good operator in handling the pileups. QSL to OK3ALE.

The Northern California DX Foundation shipped a new linear amplifier to Easter Island to help boost the signal of Father Dave CE0AE. You should be hearing the results by now.

Beginning in July, EL stations in Liberia will be signing 5L for the remainder of the year.

KH3AA is a civilian on Johnston Island and is available for skeds. Write to John at Box 69, APO San Francisco 96305.

In case you have been looking for San Marino, there are eight licensed true-blue stations. These are M1B, M1BS, M1C, M1D, M1H, M1I, M1Y, and M1W. Good luck.

Liechtenstein and San Marino are often believed to be the smallest sovereign states in the world, but a mansion on the Via Condotti in Rome is probably the smallest of them all. This is the independent territory of the Sovereign Military Order of Malta. It represents an order founded during the Crusades and the order held the island of Rhodes for over 200 years. The order still issues its own passports and maintains its own diplomatic corps.

For some reason, the ARRL has refused to recognize the Sovereign Military Order of Malta as a separate country, but remember, it took the League 30 years to admit that there were two Germanys.

Here is the entire group that hoped to put VU4ARC on from the Laccadives last March. The DXpedition was well planned down to the last detail, even including medical personnel among the group, but was halted at the last minute due to tight security surrounding a visit to the Laccadives by the Prime Minister.

A new amateur in the American Embassy in Bangui has reportedly been issued the call TL8JAM. At this writing, he had no gear on hand but was awaiting shipment of some from the States. You should be hearing him anytime now.

Brother Ed HV3SJ has been sent to Colombia, thereby shutting down any regular activity from the Vatican.

QSLing for rare DX stations can sometimes be a bigger chore than ever imagined. Over 3,000 QSLs from 4U1UN went out to deserving DXers during February alone. W2MZV is now handling 4U1UN QSLs, so you can QSL direct to Herman if you desire. If you haven't snagged this one yet, look for them from Wednesdays 1900Z to 0100Z Thursdays in the 21355 kHz and 14240 kHz areas, plus or minus.

Pradhan A51PN reports that he is now handling his own QSLing. Look for him on 14005 kHz between 1200Z and 1230Z and on 14225 kHz between 1230Z and 1300Z. QSL turnaround is generally four to six weeks. Pradhan's activity has increased noticeably since the Southeastern DX Club shipped him an outboard vfo.

W1GNC reports sending back all the W0DX/Desecheo QSL requests because he never received any logs. This should not cause any problems since KP4AM/D is the only one being accepted for DXCC credit.

A station has been showing on twenty meters signing 3X1IX and saying to QSL to Box 477 there in Conakry. Some have wondered if this might be Slim. Back in 1963 there was a station signing 7X1IX, also saying to QSL to Box 477 in Conakry and also giving his name as Vlad. This station was legitimate and was operated by OK3UI, so there appears a very good possibility that 3X1IX is for real.

The Arabic Net meets each Saturday at 1900Z on 14250 kHz. Stations checking into this net include A7, A9, ST2, ST0, YK, YI, JY, and SU among others. If you need any of these for a new one, it might pay to take a listen.

LX1AG has been showing regularly twice a week on 14240 kHz at 2330Z. He says he plans to follow this pattern for some time and hopes to give a new country contact and QSL to everyone needing LX.

The ARRL has withdrawn all Sable Island credit for the operation last fall of VE1MTA, saying the station was not authorized.

K8NW wants us to let everyone know that he is not, repeat not, QSL manager for VR0M and should not be sent any more cards.

Due to a recent callsign shuffle, stations on Crete can be identified by their new SV9 prefix.

There has been a chain letter going around aimed at amateurs. All you have to do to claim untold riches, claims the letter, is mail one dollar to the proper address, then prepare twenty copies of the letter inserting your name in the proper spot, and mail them out to twenty ham friends. This chain letter is illegal because it asks for money. I wonder how it would work if, instead of money, the letter asked for blank DX QSL cards. Just think, you send one QSL to the name at the bottom of the list and a few weeks later you receive 8,000 DX QSLs ready for you to fill in your callsign. Instant Honor Roll. Actually, that kind of thing has been going on in CB circles for years.

DJ9ZB has out the latest edition of his up-to-the-minute QSL

Manager's Directory. This 6" x 8" softcover book runs to about 80 pages and is available direct from DJ9ZB for $5.00.

WB9OQU takes a list for those needing 4S7EA each Wednesday evening about 2310Z. 4S7EA shows up at 2330Z and usually stays around for about an hour. QSL to WB9OQU.

Herb Schoenbohm KV4FZ/NØVA has not backed off on his attempt to have Water Island declared a separate DXCC country. He prepared eight pages of strong support and fired it off to the DXCC desk there in Newington. Water Island remains a live issue with Herb.

FR7BP has requested that no IRCs, stamps, or dollars be sent for return postage since his mail is usually opened before he receives it and such items removed. Just send your card and he will reply via the bureau. It is usually best not to develop a habit of putting call letters on the outside of envelopes destined for overseas addresses. In some areas, this just brings unwanted attention.

D4CBS reports that plans for any S9 operation have been shelved for the immediate future. Angelo says that the possibility still exists but that the probability is just about zero.

Speaking of D4CBS, he is one of the first, along with AA6AA and W1NG, to reach the first plateau of 100 zones in the chase to earn 5BWAZ award #1.

A new DX club is being formed in the Baton Rouge, Louisiana, area. Drop a note to Jack Whitaker, 2327 Daggett Avenue, for more details.

That recent K1CO/PJ7 operation ran up 14,074 contacts in scoring some 12.3 million points. Not satisfied, they will add three more operators and try again in the CQ WW contest this fall. This will be a multi-multi operation from PJ7 and a multi-single operation from FS7. QSL K1CO/PJ7 to K3RLY.

OE6EEG along with DJ9ZB, F6BDS, and J28AZ are planning a possible upcoming effort from the Red Sea area including Abu Ail. They are exploring the possibilities of several areas and you should be hearing more on this soon.

North and South Yemen, 4W and 7O, long-time enemies, have decided it might be best for all concerned if they combined the two countries under one government. This would, of course, mean the deletion from the DXCC list of 4W and 7O and the addition of the emerging single nation. Being the opportunists they are, several DXers are already planning for the great event.

EP2LI reports that his next duty station will be in Qatar, A7, and that he plans to make every effort to reduce this one's standing on the needed lists. Mike had to abandon everything in Iran including rig, household goods, clothing, and the family bus. QSL to WA4PYF, who also has logs for A7XAH.

The Swiss Amateur Radio Magazine, *Old Man*, reported that HB9APN is at the Swiss Embassy in Peking and has been on SSB on 21155 kHz signing HB9APN/BY.

There is a feeling, going into WARC 79, by the FCC in Washington that the amateurs are lax in reporting unauthorized interference in the amateur bands. Citing the well-known Russian "woodpecker" as an example, they note that complaints to the FCC on this violation of ITU frequency allocations have dwindled to a trickle and it may be quite possible to have an assertion made at WARC 79 that the interference is nil because the amateurs themselves have stopped complaining. If you are one who has not complained because you felt the ARRL was there to protect us all and was taking care of things, then maybe you should write the League and inquire why this intrusion into the amateur bands is still going strong after more than two years. The "woodpecker" is not the only violator. The Afrikaner Net has at times been forced to shift frequency because of commercial interference. There are times when you must take matters into your own hands and quit waiting for the other fellow. The following is a full list of FCC monitoring stations and their telephone numbers. The next time you hear an intruder on the amateur bands, pick up your telephone and report it to the nearest monitoring station. Not just once, but every time.

Allegan, Michigan	(616)-673-2063
Anchorage, Alaska	(907)-344-1011
Belfast, Maine	(207)-338-4088
Douglas, Arizona	(602)-364-2133
Ferndale, Washington	(206)-354-4892
Fort Lauderdale, Florida	(305)-472-5511
Grand Island, Nebraska	(308)-382-4296
Kingsville, Texas	(512)-592-2531
Laurel, Maryland	(301)-725-3474
Livermore, California	(415)-447-3614
Powder Springs, Georgia	(404)-943-4794
Sabana Seca, Puerto Rico	(809)-784-3772
Washington, DC	(202)-632-6975
Waipahu, Hawaii	(808)-677-3954

Just because your neighbor called doesn't mean you need not call. The more reports the better.

ZS6BEE will shortly be heading out to Marion Island, ZS2MI, to relieve the present operator there. Plans call for some much needed activity after his arrival.

The FCC has extended the grace period for renewal of amateur radio licenses to five years. This means that you may regain your operator's privileges up to five years after letting your license expire without having to retake the exam. See the May *QST* for details.

A6XP, the last active station in the UAE, went QRT on February 11th and this appeared to have ended any amateur activity for the present time. The gear was confiscated and it seems the present authorities have no use for amateur radio in their country. K1DRN has been handling the QSL chores for A6XB since 1971 and has all the logs up to 0300Z on February 8th.

This may be a little after the fact, but a group of UA-types received permission to put Franz Joseph Land on the air using the call R1FJ. The operation was originally to start in mid-April, but this has been pushed back somewhat. Anyway, if you heard or worked R1FJ, you know it was FJL. If it hasn't been heard yet, then it should be at any time.

Amateur license totals at the end of January stood at 357,900 with 63,000 Novices, 68,000 Technicians, 119,000 Generals, 83,000 Advanceds, and 22,000 Extras. Amateur growth rate during 1978 was 8.4%.

RM-3317 requests that a hobby license be established adjacent to the 29-MHz band. The ARRL plans to file an opposition.

Recent check-ins to the 14225-kHz net include FB8XV, STØRK, CR9AJ, BV2B, and KA1NC. If any of these excite your blood, try 14225 kHz from 1500Z daily. The Afrikaner Net has been drawing not only from Africa, but South America, Europe, Asia, and the Pacific areas as well. This one meets at 21355 kHz from 1830Z.

The Comoro authorities have done a sudden about-face and shut down all amateur activity. Robin D68AD has dismantled his station, taken down his antenna, and is awaiting reassignment. It appears that Comoro will be joining the United Arab Republic in a steady march to the uppermost regions of the most-needed list.

K3ZJ wrote in to point out an error in the April QSL listing. HS1ABD's QSL manager is K3EST, not W1YRC as listed. We knew that all along, guys. We just wanted to see if you were paying attention.

Carl and Martha Henson, WB4ZNH and WN4FVU, reported great conditions in making some 5,200 QSOs from the Maldive Islands, mostly on twenty with some on fifteen, but precious few on 10/40 meters. They give much of the credit to 4S7EA and his friends at Ceylon Tours as well as to 4S7JD and his wife for their generous hospitality and the fact that they were there if anything was needed. QSL to Carl Henson, 8280 Chestnut Dr., Jonesboro GA 30236. Carl notes that cards for AQ7 and HQ7 will be answered okay, but cards with incorrect date and/or time will receive biting criticism in addition to QSL. (Apparently, some stations mistook 8Q7 for AQ7 or HQ7.)

That's about all for this month. I hope some of the preceding information helps you work a few new ones. If any of you take a DXpedition-type vacation this summer, shoot a few extra pictures of your exotic surroundings and send them along, either black-and-white or color.

Thanks for much of the preceding information to the *West Coast DX Bulletin*, the Long Island DX Association *Newsletter*, and *WorldRadio News*.

NOVICE CORNER

We have been asked to remind everyone to please not send cards destined to stateside QSL managers via the ARRL Outgoing QSL Bureau. These cards wind up in that manager's envelope at the bureau and then he must pay postage on it to get his own cards from the bureau. If a QSL isn't worth the 30¢ two-way postage to the one requesting it, it sure isn't worth anything to the manager. Remember to always use GMT, also called UCT or Zulu time, on QSLs sent to managers and always include a self-addressed stamped envelope (SASE) or a self-addressed envelope and IRCs (SAE) for the manager to use in sending the DX station's QSL back.

AMATEUR RADIO IN JAPAN

The following information comes from an interview between Jan Shillington N9YL and Jun Okamura JA2BJW which appeared in the Wheaton Community Radio Amateurs, Inc., bulletin which is edited by N9YL. It should greatly increase your knowledge of conditions in Japan.

Q. How many hams are there in Japan?

A. There are 355,757 stations (CB—367,633) as of December, 1977.

Q. How many classes are there in Japan?

A. Four classes—First Class, Second Class, Novice-CW, and Novice-Phone.

Q. How many DX countries has Japan?

A. Four countries—JA, JD1 (Ogasawara Island), JD1 (Minami-Torishima Island), and JD1 (Okino Torishima).

Q. What is the Japanese zone number?

A. 25 (WW contest, etc.) and 45 (ITU).

Q. How many kinds of month-

From left to right: Ernest 4S7EA, Carl WB4ZNH/8Q7AF, Martha WN4FVU/8Q7AG, and Jay 4S7JD during Carl and Martha's recent successful operation from the Maldive Islands in the Indian Ocean.

ly ham magazines are published in Japan?

A. Three kinds—JARL News, CQ Ham Radio, *and* Mobile Ham.

Q. Can you tell me the Japanese prefixes in licensed order?

A. JA, JH, JR, JE, JF, JG, JI, JJ, JK, and JL (except JD, 8J1).

Q. What is the call area of the largest number of hams in Japan?

A. JA1 has about 41% of all.

Q. What is the call area of the smallest number of hams in Japan?

A. JA9 has about 4% of all.

Q. How much is a Drake TR-7 in Japan?

A. $1,338 ($1 equals ¥195). Prices for other rigs: Mosley TA-33—$307; Yaesu FT-101—$903; Collins KWM-2A—$4666; Hy-Gain TH6DXX—$508; Trio TS-820S—$1180.

Q. Can an American operate in Japan?

A. Yes, he can, but as a member of a club station only.

Q. Can you tell me the structure of a callsign for a Japanese club station?

A. Three-letter suffix, of which the first letter is Y or Z, such as JA1YAA, JH2ZAB.

Q. Is KA in Japan a ham station?

A. No. The Japanese government does not recognize KA as a ham. JA is forbidden to QSO with KA.

Q. What are the most wanted three states of USA from JA?

A. Delaware, Wyoming, and North Dakota.

Q. In which direction does W's sig come up to JA on short path?

A. Around 40° NE.

If you are planning a trip to Japan and would like to operate under their "club" system, contact the TIARA (club?) at: TIARA, Tomigaya Grand-301, 19-5 Tomigaya 2-chome, Sibuya, Tokyo 151, Japan, or telephone in Tokyo 485-1971.—N9YL.

OSCAR DXPEDITION ANNOUNCEMENT

WB6GFJ will return to Tahiti later this summer to operate on OSCAR. The Post and Telecommunications Office in Papeete has just notified Ross that his callsign has been authorized and is awaiting his arrival in Tahiti. His callsign will be FO0FB. QSL via WB6GFJ or the AMSAT-OSCAR QSL Bureau. This year, Ross will have Modes A, B, and J (CW and SSB), but will concentrate on Mode A QSOs from Tahiti. Plans are to operate on all currently-operating satellites with Mode A capabilities. As plans firm up, we will publish exact dates, times, frequencies, and exact orbits to look for Ross on the air on OSCAR.

Part of his time will be spent helping FO8 stations get started and operating on OSCAR. Anyone with unused 2 meter converters or small CW transmitters that could be left with FO8 stations for them to use on OSCAR would be appreciated. Also, anybody that can translate OSCAR information from English into French would be most appreciated—contact Ross as soon as possible.

Presently, the plans are to be in Tahiti sometime in August or September of this year.

W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

from page 4

committees suppose. When someone like me can double the attendance, that's important to know.

All during the St. Louis hamfest, people introduced themselves to me and said they had driven hours to get there and hear what I had to say. It works. Committees should look over the ham world for people who will have things to say which hams want to hear . . . and one way or another get these speakers in. All too many of the speakers are excruciatingly dull, so it isn't easy to find the hot ones.

The 2,000 chairs in the hall were almost fully occupied, with over 1,500 estimated in the audience as I talked about amateur radio past, present, and future. That's not bad for a first hamfest in St. Louis, I'd say. I didn't see any League officials at the hamfest at all . . . and the League didn't even bother to have a booth!

The hamfest committee is to be congratulated on putting on a first-rate show, having an in-

Hams drove in from over 200 miles around to enjoy this day in St. Louis—ARCH MARCH—ARCH for the famous St. Louis arch and MARCH for Midwest Amateur Radio Computer Hobbyists. This is the 73 Magazine *booth (also* Kilobaud MICROCOMPUTING*) and Sherry handling subscriptions.*

In case any ARRLers who said that no hamfest could succeed without the support of the League have any lingering doubts, here is a picture of one part of the exhibits . . . and the whole place was packed like this. The ARRL, though invited, did not even bother to run a booth at the show and the local director refused to come. No one here was interested in politics, neither pro-ARRL nor con; it was a hamfest and a joyous one. It is a pity that the ARRL has to see every amateur function as a political threat.

teresting program (other than me), getting an exhibition hall full of exhibitors, and in doing all this in just a few weeks. The ARRL said there was no way to put on a good hamfest without starting a year ahead. Balderdash.

DALLAS AND ATLANTA

So far, my commitments for talking at hamfests for the rest of this year include a barrage at Dallas in early June and at Atlanta in mid-June. I'll be giving two talks at both hamfests . . . one on amateur radio and what can be done to get it going again, and the other on how to take advantage of the incredible opportunities for making money with microcomputers. I personally intend to increase my own net worth substantially during the next year or so, *and* thousands of others can get on the bandwagon . . . once they know the secret of how to go about it.

In September, I'll be giving a talk at the Hartford ARRL Convention. I'll bet they'll hate that! Right in their home town!

NOTHING CAN GO WRONG . . . GO WRONG . . . GO WRONG . . .

Joke number 1254C, wherein the captain of the plane gets on the intercom and says, "This is flight 73X, now leaving Boston and flying nonstop to Seattle. This is the first fully-automated transcontinental flight run entirely by microcomputer. The system has been thoroughly tested and it is so dependable that it is no longer necessary for a flight crew to featherbed on these flights. Be assured that every contingency has been considered and nothing whatever can possibly go wrong . . . go wrong . . . go wrong . . . go wrong . . ."

Which brings us to the ridiculous situation we've had with trying to keep up with subscriptions. If you get many magazines, you realize that we are not alone in trying to cope with the monumental screwups which computers can aggravate. Yes, I know all about computers not making mistakes, but I also know that programmers, computer salesmen, computer manufacturers, and data-input people are capable of incredible botching and/or deceptions.

Bill Blair, of the *Country Journal*, recently devoted a full-page editorial to apologizing for subscription aggravations to readers, citing Fawcett Publications as the cause of their miseries. Our problems stemmed from Data Input Service Corp. (DISC), down near Boston . . . with a big assist from Prime Computer, Inc.

A few years ago, we handled all of the subscriptions for *73* by cutting a small mimeograph-type of stencil for each subscriber. This paper stencil was then filed in a rack by zip code and it took maybe a day or two to handle a subscription, complete with sending any desired back issues. When there was any problem, all we had to do was go to the file, pull out the stencil, and see what had gone wrong. It took maybe a couple of minutes. One girl was able to handle everything.

Obviously, such an archaic system had to be improved. We called IBM and signed on the dotted line for what they recommended. It was an IBM 403 with keypunch and card sorter. It was so big and heavy that we had to have a special support in the basement to keep the floor from caving in.

The 403 was no blessing. It took as long to punch a card for each subscriber as it had to cut a stencil . . . and longer to file the cards, which still had to be hand-filed. The 403 printer was not as fast at making labels as the Elliott paper stencil printer. Such was progress.

After evaluating the net result of the new system, which cost about twice as much as the old one to use . . . and was slower, I started looking for an outside computer service to handle subscriptions. I found one which was recommended highly by one of our advertisers (Waters Manufacturing . . . it was also a subsidiary of Waters, so perhaps their enthusiasm was not without bias), and moved our subscription list there. Within three months we were in deep trouble.

It took us several months to go back over past subscriber lists and find the well over 2,000 subscribers who had been dropped seemingly at random by the computer. This outfit, which eventually became DISC, mumbled about dirt in the tape-read heads, or something.

As the number of subscriptions and the number of problems escalated, with our response time on looking up answers for angry readers going from the one or two days when we were doing everything ourselves to two and three months with the computer service, I got antsy to get things back on home ground. That was when I started calling computer firms to see what I needed, and it was then I found that computer folk had a language all their own which I couldn't understand.

It was my attempt to cope with this language barrier which resulted in my starting *Byte*, if you remember that magazine. I eventually gave up trying to learn enough to outwit the computer salesmen and software houses and hired my own "expert" to sort out the claims and promises of the computer firms.

My expert checked out everything available and recommended the Prime 300 computer as being the best for our application. I talked with the Prime salesmen and was assured that their system would be able to handle the subscriptions for *73*, for *Kilobaud MICROCOMPUTING*, our accounting, Reader Service, prospective subscriber lists, industry lists, advertising lists and data, repeater lists, article lists, daily orders, inventory, and a few other chores . . . no problem.

By mortgaging everything right down to the paper clips, we were able to buy a Prime 300. Our expert hired two full-time programmers to write programs for handling our subscriptions. One year later, we were ready to give it a try. We were desperate to use it because things had been going from bad to worse with the outside service.

Once we had the subscriptions on our own system, the problems went from worse to total disaster. One 13-megabyte disk was not enough, said Prime, no matter what their salesmen had said. So, we bought a second drive. In no time at all, that one had bogged and clogged, and a third drive was needed immediately. I think they ran about $15,000 each, heading us for the poorhouse. When things still grunted to a halt, the diagnosis was a need for 64K additional internal memory . . . another $15,000.

The subscriptions kept the computer from being usable for anything else at all. Reader Service had to go back to being done by hand, the accounting had to be sent out to a service agency, the payroll was sent to another agency, and so it went. I finally made enough of a fuss that Prime sent a technician to see what was wrong. It was then that they discovered that the Prime operating system had no provision for reusing disk space which had been left free by expired or moved subscribers. We were heading toward a need for hundreds of megabytes at this clip. Prime eventually came up with a mod for the operating system which allowed material to be deleted from a disk rather than just be ignored.

Added to the system programming problems were troubles with keeping the equipment running. The disks were going down every few days, we had memory problems, the power supply went out every now and then, and so it went. We finally gave up trying to cope with it and went back to DISC with the subscriotions.

Today, three years into owning the Prime 300, we are able to use it for handling the daily orders, Reader Service, and a few shorter lists . . . and that's about all. Beyond that, it bogs down and little comes out. I'd estimate that the system is able to do about 20% of what the Prime people promised—tops. I've been trying to get help from Prime on this, but they are so busy building new plants and selling larger systems that they seem unable to remember their sale of three years ago.

I am no fan of IBM . . . indeed, when I had IBM come in to recommend a new computer system for us, they suggested a System 32, with floppy disks and no application programming available. I think *that* probably would have been even worse than the Prime. But there is much to be said for buying a more-popular computer system and keeping away from smaller outfits such as Prime. It is almost impossible to find programmers or data-processing people with experience on the Prime. This means you have to hire people with little or no training and send them to Prime school at your own expense. Then you have to put them to work for a year or so on a system for which you are paying (they are not cheap) and give them time to get experienced.

The computer has been much more dependable since we fired all of the data-processing people who smoked. They swore up and down that the filters on the system would keep the smoke from hurting the disks, but disk failure now is rare with no smokers around.

For a while it appeared that DISC was going to be able to cope with the subscriptions, but eventually the problems got worse and worse. Three-year subscribers were entered for one year, address changes brought duplicate, triplicate, or no copies. Requests for help went unanswered. It was a disaster. As the complaints grew, I got more and more frustrated. My circulation people daily assured me that everything was being taken care of. All letters were being answered. All missing issues were being sent. Then I found that one of our customer-service people had merely been putting problems into a box and working on the top ones. There were about three-thousand unanswered complaints built up.

I raised hell. It took about twelve full-time people to work out the problems over a period of months, but it was like building a sand castle with the tide coming in. As fast as a thousand problems were solved, the data-input people at the service bureau would create two thousand more.

We shopped around for a long time, looking for a sub-

scription service (called fulfillment). We checked each one out with several of their customers because many magazines are having serious problems with this, as reported by Bill Blair. The magazine publishing magazine, *Folio*, often has grim stories of magazine fulfillment service problems, so they are a sad fact of modern publishing life.

All this is of little consolation to the innocent subscriber who gets caught in the middle of this mess. Since I subscribe to over 200 publications per month, I frequently run into these frustrations myself. I haven't found any magazines yet which are out to screw anyone . . . the screwing is there, but not intentional. I have found the circulation departments of most magazines to be as dedicated to helping the subscriber as ours, and just as frustrated as the subscribers over the problems.

Those readers of *73* who have not been loused up by our copelessness are asked to check around to see if they have any friends who have been victimized. Tell them that we really think we have things in hand at last. Our new agency, FAI, in New York, seems to be getting good marks from the other magazines they handle and have been getting our problems squared away quite satisfactorily for the last two months.

If you have written about a subscription problem and have not heard from us yet, you will receive a customer service report form in the next two to three weeks . . . this will speed up the handling of all problems and questions. Everyone here wants to have every subscriber happy and fulfilled. Please pass the word around at your club and over the air and let's make sure that everyone is made happy.

DEALING WITH THE FCC

The recent screwing of the hams by the FCC came as no surprise to those who are familiar with the way this government agency works. The real responsibility for the utter failure of the amateur community to come out of the situation with reasonable rules has to lie with both the ARRL and the ham industry.

The League, by convincing most amateurs that amateur radio is well represented by the ARRL, has discouraged any initiative by either individuals or clubs. Indeed, the ARRL has done all it can to discourage any individual approach to the FCC by amateurs and clubs. The net result of this is that when the ARRL fails to provide representation, there is none by anyone, so the FCC goes right ahead without any guidance and terrible things go wrong.

The FCC has been dealt with once in the last few years with great success. I hate to make a big deal out of this, but the results of this effort were so outstanding that it should not be swept under the table. I don't recall ever seeing even the slightest mention in *QST* of the ham/FCC meeting which brought about the complete turn of events with the FCC and the remarkable changes in repeater regulations, deregulation of amateurs, and a great many other changes.

Here's what happened. Amateurs in general were happy with the lack of restrictions on the use of repeaters and had adapted to the problems this lack of restrictions had caused by getting together and working out unofficial rules. We set up coordinating groups, repeater councils, got a national coordination plan working, etc., all without any help from either the FCC or the ARRL.

A few amateurs insisted that we *must* have FCC regulations for repeaters. Years later, the FCC suddenly acted by announcing brutally-restrictive rules and forcing the generation of incredible amounts of paperwork . . . to no one's benefit. The ARRL refused to do anything about the situation, partly because they had very little contact with repeaters and partly because they didn't want to anger anyone at the FCC.

Amateurs responded to the new rules by filing hundreds of petitions for reconsideration of the rules. Prose Walker, the chap in charge at the time, responded by throwing the whole lot in his wastebasket. I could see that we were going to get nowhere this way, so I decided it was time to do something about it.

Having been strongly instrumental in the nationalization of repeater frequency pairs via my *Repeater Bulletin* (monthly newsletter to repeater groups) and FM symposiums around the country which *73* sponsored, I contacted repeater groups and got them to send representatives to Washington to testify before the FCC. I set up the hearing and got the seven FCC Commissioners and the repeater group representatives into a hearing room and orchestrated a convincing discussion of the need for deregulating amateur radio. The ARRL, by the way, was asked to help with this and flatly refused. Right after the hearing, the League counsel took some of the visitors out to lunch and explained patronizingly that this sort of approach would not work . . . a waste of time.

It did work. The FCC Commissioners listened and were impressed. Wiley became chairman of the FCC and implemented the deregulation of amateur radio which we requested. The hearing was in January, 1974, and soon after that the restrictive repeater regulations began to be changed. Prose was "retired" and amateur rules improved enormously.

So what went wrong recently?

When the amateur industry gathered to testify before the Commissioners regarding ten meter linears, there was none of the cooperation which I had been able to bring to the 1974 hearing. I had gotten my group together the day before the hearing and we had gone through just what we wanted to get across, how best to do it, who should discuss what and answer questions on it, etc. We had our act together.

This time there was no act at all. ARMA, the manufacturer's association, got people from industry in to testify, but the ARRL's council was there and refused to cooperate with ARMA. Several of the manufacturers refused to cooperate with ARMA. The result was that the ARRL testimony, which went on interminably, took the wind out of the sails of the ARMA representative. The whole presentation was fumbling and lacked direction. Worse, no one had any concrete suggestions for anything to replace the FCC plan. The FCC didn't want to know what was wrong with their plan, they just wanted to do something. Without any alternative to offer, hams lost the battle completely.

I sat in on the discussions before the testimony and tried my best to get the manufacturers to provide a clear and coherent approach to the situation, complete with an easy out for the Commission. I got nowhere with this. I have tapes of these meetings and the FCC testimony if any historian wishes to review the sorry event at some later date.

After the fumbling and often emotional testimony by the ARRL and the industry, offering little constructive to the FCC, in came the EIA (Electronic Industries Association) representative. He had his act together. He got up, spoke for about five minutes, telling the FCC they were right, just exactly what they wanted to hear, and sat down. He won the day hands down. The score: CB—1, hams —0.

Sad to say, I see not even the slightest hint that either the ARRL or the ham industry has learned anything from this incredible debacle. ARMA is talking about paying a professional lobbyist in Washington, someone who not only is not a ham, but who also doesn't even know anything about amateur radio! I agree that we desperately need some strong representation in Washington—that's where the action is. But I disagree on grasping at straws. We need an experienced ham, possibly retired, who can spend the time to keep the FCC acquainted with what amateurs need in the way of changed rules. He could also keep in contact with key congressmen and senators to help put pressure where it is needed, when it is needed.

We also need to get our act together and organize hearings before the FCC when we need them. These hearings should be carefully planned and run. The Commissioners have a lot bigger pots to stir than amateur radio, so the more of their work we can do for them, the more cooperation we will get. We should try to remember that.

You can bet that if anything does get going in the way of an International Amateur Radio Lobby, a great deal of the push will be in Washington, where the power is. There is no reason why amateur radio should permit itself to be pushed around. We can't depend on the ARRL for these things, as we have seen all too clearly. If the League ever does decide to do something affirmative, then we can support them . . . but why support a vacuum?

SEEK FAME AND FORTUNE

Well, fame anyway. Getting published in *73* does often seem to pay off in wondrous ways. I'm talking about a lot more than just the recognition you get at the club or in contacts over the air—which can be heady enough. Many authors have written to tell me about doors that an article has opened for them . . . interesting jobs, consulting, etc.

Getting published still has the effect of making you an "expert" on a subject. It then follows that some firm somewhere has a need for such an expert and you find yourself in demand.

In addition to reflecting in the prominence a published article brings, there is the satisfaction of knowing that you've provided both education and entertainment to tens of thousands of people. How many times in your life can you reach out and touch that many people?

If all that doesn't move you to a typewriter, then let's get crass about it and point out that *73* pays hard cash for articles, and a lot more than any other ham magazine. Heck, one magazine seems to pay only if you get a lawyer to sue them for the pittance they promise. *QST* not only doesn't pay one cent for the articles they publish, but also you don't even get word on when your article will appear or any chance to even see it before publication! No wonder they

have so little of any significance.

With *73*, you get paid upon acceptance, not upon publication. This means you get paid right up front. Then, when your article is set in type and set up for publication, you will get a page proof of it to check over for any errors. You get to see it about the way it is going to appear in the magazine. And when it comes out, your call will be right there on the cover of the magazine.

One other thing . . . *QST* has a practice of rewriting just about every article. This means that your golden prose will be put through the meat grinder by some hack and the resultant mush will be attributed 100% to you, even though you haven't been given a chance to defend yourself. There are an awful lot of furious ex-*QST* authors. Have you noticed how few regular contributors there are in *QST* other than their poorly-paid staff? How many paid-staff articles do you find we have to use to pad out *73* to a reasonable size? And we publish about three times as many pages of articles as *QST* per month.

Another magazine strategem you want to watch out for is the small down payment, with the rest upon publication. This is a gem. It saves the magazine a bundle, obviously. It unfairly ties up the author, but without anything significant in pay. I understand that both *Byte* and *Interface Age* use this author-screwing system. And suppose they decide not to ever publish the article at all? You're helpless. So, for a few bucks, a magazine can keep articles which they have no intention of ever using from being submitted to competitor magazines.

It does take a substantial investment in articles to keep up a magazine inventory. For instance, at around $50 a page for *73*, this means that the hundred pages of articles in an issue will tie up about $5,000. We carry an inventory of perhaps six months in articles normally . . . about $30,000 or so.

What kind of articles are needed? Of course, the most-read articles are generally those about small construction projects. We're open for anything at all . . . antennas, gadgets, complete receivers, transceivers, test equipment, shack accessories, repeaters, microcomputers with a ham accent, autocall systems, anything on DXing, DXpeditions, humor which will make *me* laugh, good cartoons (no amateurs at this, please . . . except radio amateurs), club activities, club projects, stories of transmitter hunts, interviews with famous hams, reviews of new equipment . . . it is endless.

How many antenna articles can we publish? Hundreds . . . anything new and interesting will get a thousand hams heading for their roofs. Perhaps you've hooked a computer up for some CW processing. Antenna aiming? Digital circuits of almost any kind are read with great interest by most readers. I look through the ads and wish we could get good interesting articles on every piece of new equipment I see. Sure, I wish I could be the one to use the gear and write it up myself, but I'm already spread much too thin, so as a practical matter, I'd like to see reader evaluations. Why not help pay for your equipment that way?

Before you get a lot of ideas about conning manufacturers for free gear to be written up . . . no way. I flatly refuse to give anyone any prior agreement to publish anything. I want people who have spent their hard-earned money to cash in on this, not some sharpy on the con. Manufacturers, please go with me on this: Unless you hear from me personally about someone going to test something, do not get suckered into someone saying they are going to write an article on the equipment and therefore should get it free or for a discount. if I hear about it, no deal.

RTTY . . . I want a lot more material on RTTY. I want it on OSCAR and equipment for using OSCAR. I want updates on new stuff for SSTV. Let's keep it going. How about more info on TV satellite reception? How about weather satellite information? There are so many things going on that I don't understand the chap who calls up and says he would like to write an article but doesn't know what to write about.

FEBRUARY WINNER

For the second time in four months (he was also our November winner), Dr. Ralph E. Taggart WB8DQT has walked away with our $100 "Most Popular Article" check. Our readers used their Reader Service card ballots to select "Attention, Satellite Watchers!" as their favorite article in the February issue.

FCC

Reprinted from the Federal Register.

Amendment of Rules Concerning the Amateur Radio Service to Permit the Acceptance by Any Commission Office of Code Credit Certificates

AGENCY: Federal Communications Commission.

ACTION: Order (rule amendment).

SUMMARY: The Commission amends § 97.25 of its rules regulating the amateur radio service to permit the acceptance by any Commission office of Code Credit Certificates. Certificates are issued to applicants for amateur radio operator licenses who have completed the telegraphy elements of their examinations but fail the written elements. This action is taken to lessen the burden on those applicants who wish to complete the examination at an office other than the one at which the telegraphy portion was taken.

EFFECTIVE DATE: April 20, 1979.

ADDRESS: Federal Communications Commission, Washington, D.C. 20554.

FOR FURTHER INFORMATION CONTACT: Mr. J. B. Johnston, Private Radio Bureau, (202) 254-6884.

SUPPLEMENTARY INFORMATION:

In the matter of amendment of §§ 97.3 and 97.25(b) of the Commission's Rules; Order.

Adopted: February 22, 1979.

Released: April 6, 1979.

By the Commission.

1. By an Order released on June 7, 1978, effective June 16, 1978, the Commission amended §§ 0.314, 1.922 and 97.25 of its Rules to provide for the issuance of Amateur Code Credit Certificates by the Engineer in Charge at each of its field offices. Certificates are issued to applicants for amateur radio operator licenses who successfully complete the telegraphy element of their examinations but fail the required written element. Section 97.25(b) currently provides that upon presentation of the Certificate to the Commission within one year of the date of its issuance, the applicant will be given credit for the telegraphy element at the speed listed. The purpose of the Certificate is to allow an applicant to receive his/her amateur license upon successful completion of the remaining examination element(s) without having to retake the telegraphy test.

2. Section 97.25(b) currently provides that an Amateur Code Credit Certificate will be honored only at the Commission office which issued it. This restriction was intended to allow Commission personnel to validate the authenticity of certificates presented for credit. However, it has also imposed a hardship on some applicants who wish to complete their examinations at an office other than the one at which they took their telegraphy test. Thus far, there has been no problem with attempts to falsify Certificates. Interim Amateur Permits and Temporary Radio Operator Authorizations may also be presented to gain examination credit toward higher classes of radio operator licenses. These documents are accepted at any Commission office and their authentication at offices other than the issuing one has not been difficult. As it appears that the more restrictive acceptance of Code Credit Certificates is unwarranted, the Commission is herewith amending § 97.25(b) to delete this restriction. Further, in order to formalize and clarify the criteria utilized for the issuance of the Certificate, the Commission now amends § 97.3 to include a definition of "Amateur Code Credit Certificate," and § 97.25(b) to specify the conditions under which such Certificates are issued.

3. As these amendments serve to clarify Commission procedures and to eliminate an unnecessary restriction, the Commission, pursuant to Section 553(b) of the Administrative Procedure Act, finds that prior public notice and the receipt of comments are unnecessary. Additionally, in order to expeditiously eliminate any confusion and inconvenience now caused to those taking amateur radio operatpr examinations, the Commission, pursuant to § 553(b)(3) of the Administrative Procedure Act, finds that it is desirable that these amendments be made effective with less than 30 days notice.

4. Accordingly, IT IS ORDERED, effective April 20, 1979, that Part 97 of the Commission's Rules and Regulations IS AMENDED as shown below. The authority for this action is found in Sections 4(i) and 303 of the Communications Act of 1934, as amended. For further information on these Rule changes contact Mr. J. B. Johnston, Personal Radio Branch, FCC, 1919 M Street, NW, Washington, DC 20554, Tele: (202) 254-6884.

(Secs. 4, 303, 48 Stat., as amended, 1066, 1082; 47 U.S.C. 154, 303)

Federal Communications Commission.

William J. Tricarico,
Secretary.

Part 97 of Chapter I of Title 47 of the Code of Federal Regulations is amended as follows:

In § 97.3, a new paragraph (aa) is added as follows:

§ 97.3 Definitions.

* * * * *

(aa) *Amateur Code Credit Certificate.* A certificate issued to applicants for an amateur operator license evidencing successful completion of a telegraphy examination element.

In § 97.25 paragraph (b) is amended to read as follows:

§ 97.25 Examination credit.

* * * * *

(b) Amateur Code Credit Certificates (FCC Form 845) will be issued by the engineers in Charge of FCC offices to applicants for amateur operator licenses who successfully complete telegraphy examination elements 1(A), 1(B) or 1(C), but who fail the associated written examination element(s). Upon presentation of a properly completed Amateur Code Credit Certificate, the FCC shall give the applicant for an amateur radio operator license examination credit for the code speed listed on the Amateur Code Credit Certificate. An Amateur Code Credit Certificate is valid for a period of one year from the date of its issuance.

Ham Help

I have a basin with four ultrasonic transducers affixed to the underside. I would like to get in touch with someone who has a circuit diagram and instructions to build an ultrasonic cleaner with a basin such as mine. I would also like to know how to determine the resonant frequency of these transducers and whether they must all be driven in phase.

Paul Leduc VE2DFL
76 17th Avenue
Roxboro, Quebec
Canada H8Y 3A4

Social Events

from page 26

will be June 10, 1979. For information, contact Henry Wener WB2ALW, 53 Sherrard St., East Hills NY 11577, or phone (516)-829-5880 days or (516)-484-4323 nights.

CHELSEA MI
JUN 3

The Chelsea Swap 'n Shop will be held on Sunday, June 3, 1979, at the Chelsea Fairgrounds, Chelsea, Michigan. Gates will open for sellers at 5:00 am and for the public from 8:00 am until 3:00 pm. Admission is $1.50 in advance or $2.00 at the gate. Children under twelve and non-ham spouses are admitted free. Talk-in on 146.52 and 146.37/.97. Proceeds will benefit the Dexter High School Radio Club and the Chelsea Communications Club.

STEVENS POINT WI
JUN 3

The Central Wisconsin Radio Amateurs, Ltd., will hold its swapfest picnic on Sunday, June 3, 1979, starting at 10:00 am at Bukolt Park, Stevens Point, Wisconsin. There will be a picnic area, refreshments, equipment sales, and prizes. For information, write to Frank L. Guth W9BCC, Secretary-Treasurer, Central Wisconsin Radio Amateurs, Ltd., 1632 Ellis Street, Stevens Point WI 54481.

WEST HUNTINGTON WV
JUN 3

The Tri-State ARA will hold its 17th annual hamfest and family picnic on June 3, 1979, starting at 10:00 am, at the Camden Amusement Park, West Huntington, West Virginia. There will be a planned program for the XYL and kids, or you can enjoy the amusement park if you prefer. There is a possibility the FCC will administer amateur exams. There will be major prizes, a large flea market, exhibitors, and displays. Dealers are always welcome to space in the covered pavilion. Talk-in on 34/94 or 16/76. For more information, write TARA, PO Box 1295, Huntington WV 25715.

MANASSAS VA
JUN 3

The Ole Virginia Hams Amateur Radio Club, Inc., will hold its annual hamfest on June 3, 1979, at the Prince William County Fairgrounds, located ½ mile south of Manassas, Virginia, on Rte. 234. Gates will open at 8:00 am but tailgaters may enter at 7:00 am. General admission is $3.00 per person, with children under 12 admitted free. Tailgating is $2.00 per vehicle, with over 300 spaces available. Prizes include a 5-band SSB transceiver, a synthesized 2 meter transceiver, and a Bird 43 wattmeter, plus many more. Breakfast and lunch are available on the premises. Featured will be an FM clinic, a YL program, a children's program, CW proficiency, and QSL bureau programs. Indoor exhibit space for dealers and manufacturers is available. For information, write to Sam Lebowich WB4HAV, OVHARC, PO Box 1255, Manassas VA 22110.

ALLENWOOD PA
JUN 3

The 8th annual Milton Amateur Radio Club Hamfest will be held on June 3, 1979, rain or shine, at the Allenwood Firemen's Fairgrounds, located on US Rte. 15, 4 miles north of Interstate 80, Allenwood, Pennsylvania. Hours are from 8:00 am to 5:00 pm. Registration for sellers is $2.50 advance or $3.00 at the gate. XYLs and children are free. Featured will be a flea market, an auction, a contest, cash door prizes, a free portable and mobile FM clinic, and supervised children's activities. There will be an indoor area available, plus food and beverages. Talk-in on .37/.97, .34/.94, and .52. For further details, call or write Kenneth Hering WA3IJU, RD #1, Box 381, Allenwood PA 17810, or phone (717)-538-9168.

PRINCETON IL
JUN 3

The Starved Rock Radio Club will hold its annual hamfest on Sunday, June 3, 1979, at the Bureau County Fairgrounds, Princeton, Illinois. The fairgrounds are centrally located and easily reached via routes 80-6-34-89-26. Watch for the large yellow "Hamfest" signs. There will be lots of room for the free swappers' area and park-

ing. New equipment dealers, manufacturers, and their representatives are invited to request details on reserving space in our inside display area. There will be food and refreshments available during the day. Camper, van, and trailer spaces are available for a nominal fee and should be reserved in advance. Please include an SASE for map, motel information, and advance reservations at $1.50, if postmarked before May 20 ($2.00 at the gate). For more information, write W9MKS/WR9AFG, Starved Rock Radio Club, RFD #1, Box 171, Oglesby IL 61348, or phone (815)-667-4614.

GUELPH ONT CAN
JUN 9

The Central Ontario Amateur Radio Flea Market will be held on Saturday, June 9, 1979, from 8:00 am until 4:00 pm at Centennial Arena, College Ave. W., Guelph, Ontario, Canada. Commercial displays will open at 10:00 am. Admission is 75¢ per person with children 12 years and under admitted free. Admission for vendors is an additional $2.00. There will be a large indoor and outdoor flea market, commercial exhibits, free balloons, free handouts, and operating ham stations. Talk-in on .52/.52, .37/.97 VE3KSR, and .96/.36 VE3ZMG.

MEADVILLE PA
JUN 9

The Crawford Amateur Radio Society will hold its fifth annual hamfest on Saturday, June 9, 1979, at Crawford County Fairgrounds, Meadville, Pennsylvania. Admission is $2.00. Gates will open at 8:00 am. Bring your own tables. The cost to display is $2.00 for an inside area and $1.00 for an outside area. There will be door prizes, refreshments, and commercial displays. Talk-in on .04/.64, .81/.21, .63/.03. For details, write CARS, Hamfest Committee, PO Box 653, Meadville PA 16335.

BEMIDJI MN
JUN 9

A hamfest will be held on June 9-10, 1979, at Bemidji Fairgrounds, on the west side of town on Highway 2, Bemidji, Minnesota. There will be a complete program for hams, nonhams, and kids. Camping will be available on Saturday night. Tables are available at no charge. Tickets are $1.50. Talk-in on 146.34/.94 and 3935. For more information, write Jerry Pottratz WBØMSH, Rte. 2, Box 239B, Bemidji MN 56601.

SENATOBIA MS
JUN 9-10

The fourth annual Tri-State Hamfest will be held on June 9-10, 1979, in the coliseum of Northwest Junior College, Senatobia, Mississippi. Indoor air-conditioned space will be available for manufacturers, dealers, and distributors. For information, contact Joel P. Walker, 1979 Hamfest Chairman, PO Box 276, Hernando MS 38632; (601)-368-5277.

POMONA NJ
JUN 10

The Short Points Amateur Radio Club will hold its 2nd annual Atlantic City Area Hamfest and Electronic Fleamarket on Sunday, June 10, 1979, from 8:00 am to 4:00 pm, rain or shine, at Stockton State College Campus, Pomona, New Jersey. There will be free parking spaces, climate-controlled indoor sales area, clean restrooms, good food at realistic prices, paved and shaded tailgate area, free ac power at the indoor tables, and two chairs provided with each table rental. Featured will be door prizes, commercial exhibitors, free technical seminars, group meetings, and contests. Registration is $2.00 per person, with children under 12 free. Tailgating is $2.00 per car space, while the indoor sales area is $5.00 at the gate; bring your own table. The indoor sales area has an advance registration of only $5.00, which includes a table and two chairs. SPARC will give a free table and two chairs for each space rented to the first 80 persons to pre-register. Deadline for this special is June 1st. For information, write Monte Tremont WB2EYF, PO Box 142, Absecon NJ 08201, or phone (609)-266-2678.

MONROE MI
JUN 10

The Monroe County Radio Communication Association

will hold its annual hamfest Swap and Shop on June 10, 1979, from 8:00 am to 4:00 pm at the Monroe County Community College on Raisinville Rd. off M-50, Monroe, Michigan. Donation is $1.00 at the gate. There will be plenty of free parking, free trunk sales and indoor table space. Features will include a contest, an auction, commercial displays, and UHF, VHF, and HF technical sessions and demonstrations. Talk-in on 146.13/.73 or .52. For reservations and information, contact Fred Lux WD8ITZ, PO Box 982, Monroe MI 48161.

AKRON OH
JUN 10

The Goodyear Amateur Radio Club will hold its 12th annual hamfest picnic and flea market on Sunday, June 10, 1979, from 10:00 am to 5:00 pm at Goodyear Wingfoot Lake Park, near Rtes. 224 and 43, east of Akron, Ohio. There will be five main prizes, including a Yaesu FT-101ZD, a Midland 13-510, a Wilson Mark II, a Drake MN-4C, and a Bird wattmeter. Featured will be a large flea market, auction, and picnic area. Tickets are $3.00 each or two for $5.00. Talk-in on 146.04/.64. For more information, contact D. W. Rogers WA8SXJ, 161 South Hawkins Ave., Akron OH 44313.

OAK RIDGE TN
JUN 14-15

The Oak Ridge Amateur Radio Club will hold the Oak Ridge Amateur Radio Convention and Hamfest '79 on July 14-15, 1979, at the Oak Ridge Civic Center, Oak Ridge, Tennessee. Admission is $1.00. There will be commercial and flea market exhibitors. FCC exams will be given on Saturday at 8:00 am. Features for the ladies and kids include movies, a tour of the Museum of Science and Energy, or the pool, picnic, and playgrounds at the Civic Center. Camping facilities, motels, and restaurants are conveniently located. The week of July 9-16 will be proclaimed Amateur Radio Week in Oak Ridge by the Mayor. Talk-in on 146.88, 147.72, and 146.82. Local talk-in on 146.52. Anyone interested should contact Charles Byrge WB4OBE, PO Box 291, Oak Ridge TN 37830.

DUNELLEN NJ
JUN 16

The Raritan Valley Radio Club will hold its eighth annual hamfest on Saturday, June 16, 1979, from 8:00 am to 4:30 pm at Columbia Park, Dunellen, New Jersey. For details, write Raritan Valley Radio Club, RD 3, Box 317, Somerset NJ 08873, or phone WB2MNE at (201)-356-8435.

MIDLAND MI
JUN 16

The Central Michigan Amateur Repeater Association, Inc., will hold its fifth annual Midland Hamfest on Saturday, June 16, 1979, from 8:00 am until 3:00 pm at the Midland County Fairgrounds, Midland, Michigan. There will be door prizes with a drawing at 2:30 pm. Tickets are a $2.50 donation at the door, with XYL and junior op free on the OM's ticket. There will also be several computer displays. Tables will be available. An auction will be held at 1:00 pm for gear that isn't sold. Talk-in on .13/.73 and .52.

JACKSONVILLE IL
JUN 17

The Jacksonville Area Amateur Radio Club will hold its 14th annual hamfest and flea market on June 17, 1979, at the Morgan County Fairgrounds, Jacksonville, Illinois. Tickets are $1.50 each or 4 for $5.00. There will be indoor facilities, a camping area with a minimum fee, and food available on the grounds. Coffee and donuts will be served from 8:00-9:00 am. Talk-in on .52/.52.

TORRINGTON CT
JUN 17

The CQ Radio Club will hold its flea market and hamfest, rain or shine, on June 17, 1979, from 9:00 am to 5:00 pm at the Torrington Fish and Game Association grounds, located at Weed Rd., just off Rte. #4, between Torrington and Goshen, Connecticut. Admission is $1.00 per person including your vehicle. Children and ladies are free. Food and refreshments will be available at reasonable prices. There will also be prizes, plenty of parking, table space, and activities for the children.

Reader Service—see page 195

Talk-in on .52 and 147.84/.24. For more details, contact Ed Josefow W1JSU at (203)-482-1837.

CROWN POINT IN
JUN 17

The Lake County Amateur Radio Club will hold its 16th annual Dad's Day Hamfest on June 17, 1979, from 8:00 am until 5:00 pm at the Lake County Fairgrounds, Crown Point, Indiana. The event is all indoors. Donation is $1.50 in advance and $2.00 at the door. Table space is available on a first-come, first-served basis. There will be refreshments, a picnic area, ample parking, and a zoo and playground area for the children. Talk-in on 147.84/.24. For information and advanced tickets, write LCARC, PO Box 1909, Gary IN 46409.

BARNESVILLE PA
JUN 17

The Schuylkill Amateur Repeater Association will hold its 2nd annual hamfest on Sunday, June 17, 1979, at Lakewood Park, Barnesville, Pennsylvania, along Rte. 54, 3 miles east of Exit 37E on Interstate 81. Gates open at 9:00 am, rain or shine. Registration is $2.00, with XYL and children free and tailgaters $1.00 additional. Indoor tables are available at $2.00 per table. There will be large indoor and outdoor display areas, prizes, plenty of parking space, amusement rides, picnic tables, and refreshments. Talk-in on 147.78/.18 and 146.52. For more information, write SARA Hamfest, PO Box 901, Pottsville PA 17901.

LOUISVILLE KY
JUN 29-JUL 1

The Louisville Area Computer Club will hold its 4th annual Computerfest™ 1979 from June 29 through July 1, 1979, at the Bluegrass Convention Center, Louisville, Kentucky. Activities include a flea market, seminars, and exposition, as well as activities for the entire family. Seminar and exposition admission is $4.00. Pre-registered Ramada Inn guests ($29.00, single; $34.00, double) receive free admission. For advance mail information, write Computerfest '79, Louisville Area Computer Club, PO Box 70355, Louisville KY 40270, or phone Tom Eubank, Chairman, at (502)-895-1230.

BELLEFONTAINE OH
JUL 1

The Champaign Logan Amateur Radio Club, Inc., will hold its annual hamfest on Sunday, July 1, 1979, at the Logan County Fairgrounds, South Main Street and Lake Avenue, Bellefontaine, Ohio. There will be free admission and door prizes. Trunk and table sales are $1.00, and there will also be a bid table. Talk-in on 146.52. For more information, contact John L. Wentz W8HFK, Box 102, West Liberty OH 43357, or Frank Knull W8JS, 402 Lafayette Ave., Urbana OH 43078.

DUNKIRK NY
JUL 1

The Northwestern New York Repeater Association and the Northern Chautauqua Amateur Radio Club will hold their Lake Erie International Hamfest on Sunday, July 1, 1979, at the fairgrounds in Dunkirk, New York. A large flea market area and plenty of free parking will be provided. Tickets are $4.00 at the gate or $3.00 in advance. RV hookups are available. For information on advance sales or for a map showing easy directions from I-90, write to Dick Brinkerhoff WB2HEF, 123 5th St., Dunkirk NY 14048.

HARRISBURG PA
JUL 4

The Harrisburg RAC will hold its annual Firecracker Hamfest on Wednesday, July 4, 1979, at the Shellsville VFW picnic grounds, I-81 north, Exit #27 or #28, Racetrack Exit, Harrisburg, Pennsylvania. Look for the large balloon. Admission is $3.00, with no charge for tailgating. Tables will be available in the pavilion. Talk-in on .52/.52.

WELLINGTON OH
JUL 7

The Northern Ohio Amateur Radio Society will hold its second annual NOARSFEST on Saturday, July 7, 1979, at the Lorain County Fairgrounds, one mile west of Rte. 58 on Rte. 18, Wellington, Ohio. Admission tickets are $1.50 in advance and $2.00 at the gate and are good for all prize drawings. Children under 12 are admitted free. Gates open for the sellers and dealers at 6:00 am and to the public from 7:00 am to 5:00 pm. Indoor dealer tables are $4.00 each by advance registration. Drawing-only tickets are available by mail or at the gate for $1.00 each. Flea market spaces are $1.00 each. There will be over 100 prizes, including a DenTron HF-200 transceiver, a Ten-Tec 509, a DenTron GLA-1000, a Wilson Mark II, and an Optoelectronics counter. There will be plenty of food and free parking. Featured will be a large indoor exhibit hall for dealers and a huge blacktopped midway for flea market and trunk sales. There will be free camping outside the gates on Friday night, but no hookups. For advance registration, information, or tickets, write NOARSFEST, PO Box 354, Lorain OH 44052.

INDIANAPOLIS IN
JUL 8

The Indianapolis Amateur Radio Association will sponsor the Indianapolis Hamfest on Sunday, July 8, 1979, at the Marion County Fairgrounds, on the southeast corner of Indianapolis at the intersection of Interstates 74 and 465, Indianapolis, Indiana. There will be commercial exhibitors and dealer displays for a fee of $30.00 per booth. The commercial building will be open from 12:00 noon until 9:00 pm on Saturday and will reopen at 7:00 am on Sunday. Camper hookup facilities are available on the fairgrounds for overnight parking if you arrive on Saturday. A food and drink vendor will have a setup outside, while a professional caterer will have facilities inside. For more information, write to the Indianapolis Hamfest, PO Box 1002, Indianapolis IN 46206.

OAK CREEK WI
JUL 14

The South Milwaukee Amateur Radio Club will hold its annual Swapfest '79 on Saturday, July 14, 1979, at American Legion Post #434, 9327 S. Shepard Avenue, Oak Creek, Wisconsin. Admission is $2.00 and includes a happy hour with free beverages. Prizes include a $100 first prize, a $50 second prize, and a variety of other prizes. Activities will begin at 7:00 am and continue until 5:00 pm. Parking, a picnic area, hot and cold sandwiches, and liquid refreshments will be available on the grounds. Overnight

camping is also available. Talk-in on 146.94. More details, including a map, may be obtained from the South Milwaukee Amateur Radio Club, Inc., Robert Kastelic WB9TIK, Secretary, PO Box 102, South Milwaukee WI 53172.

TERRE HAUTE IN
JUL 15

The 33rd annual WVARA Hamfest will be held on July 15, 1979, at the Vigo County Fairgrounds, one mile south of I-70 on US 41, Terre Haute, Indiana. Overnight camping will be available. There will be a free flea market, a covered flea market at $2.00 for a 12' x 12' space with some tables and ac available, XYL bingo, food, refreshments, and valuable prizes. Advance ticket sales are $1.50 or 4 for $5.00. Tickets at the gate are $2.00 or 3 for $5.00, with children under 12 free. Talk-in on .25/.85 and .52. For tickets and information, send an SASE to WVARA Hamfest, PO Box 81, Terre Haute IN 47808.

ALLENTOWN PA
JUL 15

The Delaware-Lehigh ARC, Inc., the BGYE, Inc., and the Lehigh Valley ARC, Inc., will hold their Tri-Club Hamfest on July 15, 1979, from 8:00 am to 4:00 pm at the Allentown Police Academy pistol range on Lehigh Parkway South at Allentown, Pennsylvania. Admission is $2.00 for lookers and $4.00 for sellers. Talk-in on .34/.94 and .52.

WILKES-BARRE PA
JUL 15

The Broadcasters Amateur Radio Club will hold its 2nd annual hamfest on July 15, 1979, from 9:00 am to 4:00 pm at Pocono Downs Racetrack, Rte. 315, four miles north of Wilkes-Barre, Pennsylvania. Setup begins at 8:00 am. Admission is $2.50, with no additional fee for sellers. XYLs and children are free. The event is all indoors. Talk-in on 147.66/.06 or 146.52. For more information, write John Soha W3KU, 62 S. Franklin Street, Wilkes-Barre PA 18707, or phone (717)-823-3101.

CANTON OH
JUL 15

The fifth annual Hall of Fame Hamfest will be held on Sunday, July 15, 1979, at Stark County Fairgrounds, Canton, Ohio. Tickets are $2.50 in advance and $3.00 at the gate. Mobile check-in on .19/.79 or .52/.52. For information, contact Max Lebold WA8SHP, 10877 Hazelview Ave., Alliance OH 44601.

GUANAJUATO MEX
JUL 19-21

The first annual ARARM-LMRE will be held in Guanajuato, Mexico, from July 19-21, 1979. Guanajuato is located 230 miles north of Mexico City. Registration will be US $13.00. A package will be available for US $40.00 and will include 2 banquets, 1 dinner dance, sight-seeing, theater, and gifts. Drawings will be held, with a grand prize being an SSTV setup. A total of 500 prizes will be given away. The US $40.00 includes registration. Hotels are available with prices ranging from US $10.00 and up for a double room. English-speaking guides are available from the University of Guanajuato. Talk-in on 147.63/.03, 146.10/.70, and 149.22/.82. HF/SSB frequencies will also be operating, and we hope to arrange special licenses for visiting hams who may wish to operate from XE1-land during their stay. There will be a flea market and demonstrations at the convention hall. For more information, contact the Radio Club Leon, PO Box 12A, Leon, Guanajuato, Mexico.

EUGENE OR
JUL 21-22

The 4th annual Lane County Ham Fair will be held on July 21-22, 1979, at the Oregon National Guard Armory, 2515 Centennial Blvd., Eugene, Oregon. Registration is $3.00, and an extra drawing ticket is given with advance registration. There will be displays, lectures, contests, swapshop, transmitter hunt, and entertainment. The facilities provide plenty of free parking for motor homes and trailers.

For information and advance reservations, phone or write Wanda or Earl Hemenway, 2366 Madison, Eugene OR 97405 at (503)-485-5575.

ESSEX MT
JUL 21-22

The International Glacier-Waterton Hamfest will be held on July 21-22, 1979, at the Three Forks Campground, ten miles east of Essex, Montana, on US Highway 2. Registration is at 9:00 am. Talk-in on .52 and .34/.94. For more information, write Glacier-Waterton Hamfest, PO Box 2225, Missoula MT 59806.

PITTSFIELD MA
JUL 21-22

The NoBARC Hamfest will be held on July 21-22, 1979, at Cummington Fairgrounds, Pittsfield, Massachusetts. There will be tech talks, demonstrations, and dealers. Flea market admission is $1.00. Advance registration is $3.00 single and $5.00 with spouse, and $4.00/$6.00 at the gate. Gates open at 5:00 pm on Friday for free camping. Talk-in on 146.31/.91. For reservations, contact Tom Hamilton WA1VPX, 206 California Ave., Pittsfield MA 01201.

GOLDEN CO
JUL 22

The Rocky Mountain Radio League, Inc., will hold its Field Demonstration Day and Swapfest on July 22, 1979, at the home of Karl Ramstetter WA0HJZ, which is located on Highway 93, Golden Gate Canyon Road. This is accessible by going one mile north of the city limits of Golden, turning westward off Highway 93 onto Golden Gate Canyon Road, proceeding for approximately 7½ miles, and making a right turn across the cattle guards. Signs will be posted for further directions. There will be demonstrations, including slow-scan TV and computers, door prizes, and a potluck lunch, with soft drinks and ice supplied by the League. It would be appreciated if everyone would make his contribution to the potluck lunch by bringing his favorite dish and helping out the League with any spare blankets and chairs. There will be camping facilities available for campers, trailers, mobile homes, etc., on Saturday afternoon before the Fest. No dogs, guns, or motorbikes, please.

MARSHALL MO
JUL 22

The Indian Foothills Amateur Radio Club will hold its 4th annual hamfest on July 22, 1979, at the Saline County Fairgrounds, Marshall, Missouri. Tickets are $2.00 each or 3 for $5.00 in advance; $2.50 at the door. Registration is at 8:00 am, with lunch at 11:30 pm (all you can eat) and the drawing at 2:30 pm. Prizes include a Tempo S1, a Dentron Jr. Monitor™ tuner, and many more. There will be flea markets for the OM and XYL. There is no charge for flea market tables this year, but reservations are requested. There will also be old and new equipment displays, a 10-X booth, and other activities for the XYLs. Talk-in on .52, .28/.88, and 147.84/.24. For information and tickets, write Norman Gibbins WB0SZI, 692 North Ted, Marshall MO 65340.

MACKS INN ID
JUL 27-29

WIMU (Wyoming, Idaho, Montana, and Utah) will hold its 47th annual hamfest on July 27-29, 1979, at Macks Inn, Idaho. Festivities include 2-meter hunts, OSCAR demonstrations, ladies' crafts, and a repeater display. The pre-registration prize will be a Wilson Mark II handie-talkie complete with touchtone™, battery pack, and charger. The grand prize is your choice of an Icom IC-211 or a Kenwood TS-520. Saturday night special events include kids' movies and an adult dance. For further information, contact Dave Hunting WB7FGV, Box 662, Kemmerer WY 83101, or call (307)-877-9440.

OKLAHOMA CITY OK
JUL 27-29

The Central Oklahoma Radio Amateurs will sponsor the Oklahoma State ARRL Convention and "Ham Holiday" on July 27-29, 1979, at Lincoln Plaza, 4445 Lincoln Blvd., Oklahoma City, Oklahoma. The program will include an ARRL forum and technical talks on 1-GHz techniques, fast-scan TV for radio amateurs, NBVM, and other subjects of current interest. In addition, a full program is scheduled for the ladies. Pre-registration will be $4.00 if received before July 20. After that date, it will be $5.00. A synthesized 800-channel VHF transceiver will be awarded to encourage pre-registration. The main award will be a TS-120V with power supply. Adequate rooms are available for commercial exhibitors and swappers. Mail your registration to CORA, PO Box 14424, Oklahoma City OK 73113.

Unlimited parking space is also available.

MOOSE JAW SASKATCHEWAN CAN
JUL 27-29

The Moose Jaw Amateur Radio Club will hold its 1979 Hamfest (Particifest 79) on July 27-29, 1979, at the Saskatchewan Technical Institute, 600 Saskatchewan St. W., Moose Jaw, Saskatchewan, Canada. Registration will be held on Friday evening with a full day of activities on Saturday culminating in a banquet and dance. Most of the meetings and workshops will be held on Sunday. There will also be a busy schedule for the XYLs.

OLIVER BC CAN
JUL 28-29

The Okanagan International Hamfest will be held on July 28-29, 1979, at Gallagher Lake KOA Kampsite, 8 miles north of Oliver, B.C., Canada. Registration starts at 9:00 am Saturday. Activities start at 1:00 pm Saturday and continue until 2:00 pm Sunday. Ladies may bring their hobbies and items for a white-elephant sale. Featured will be prizes, a flea market, bunny hunts, entertainment, a home-brew contest, and more. A potluck lunch will be served Sunday at noon. Call-in on 3800, .34/.94, and .76 simplex. For information, write

Continued on page 188

Social Events

from page 168

John Juul-Andersen VE7DTX, 8802 Lakeview Dr., Vernon, B.C., Canada V1B 1W3, or Lota Harvey VE7DKL, 584 Heather Rd., Penticton, B.C., Canada V2A 1W8.

BOWLING GREEN OH JUL 29

The Wood County Amateur Radio Club will hold its 15th annual Wood County Ham-a-Rama on July 29, 1979, at the Bowling Green Fairgrounds, Bowling Green, Ohio. Gates will open at 10:00 am, with free admission and parking. Dealer tables and space are available. Trunk sale space and food will also be available. Tickets are $1.50 in advance and $2.00 at the door. Prizes will be awarded. Talk-in on .52 K8TIH. For information, write Wood County ARC, c/o Eric Willman, 14118 Bishop Road, Bowling Green OH 43402.

FLAGSTAFF AZ AUG 3-5

The Amateur Radio Council of Arizona will hold its annual Ft. Tuthill Hamfest on August 3-5, 1979, at Flagstaff, Arizona. Prizes include TS-520 transceivers, a microwave oven, a Wilson Mark II HT, a Wilson System III triband antenna, and more. Featured will be a western barbecue, tech sessions, and exhibits. Camping facilities are also available. For further details or information, write Ft. Tuthill Hamfest, c/o 8520 E. Edwards Ave., Scottsdale AZ 85253.

LITTLE ROCK AR AUG 4-5

The Central Arkansas Radio Emergency Net (CAREN) Amateur Radio Club will hold its second annual Ham-a-Rama on Saturday and Sunday, August 4-5, 1979, at the Arkansas State Fairgrounds, Little Rock, Arkansas. There will be two main prizes given, as well as door prizes. Featured will be forums, dealers' exhibits, a Saturday night party, and a large flea market. Talk-in on 146.34/.94. For details, send an SASE to Morris Middleton AD5M, 19 Elmherst Drive, Little Rock AR 72209.

JACKSONVILLE FL AUG 4-5

The Jacksonville Hamfest Association is pleased to announce the 1979 Jacksonville Hamfest and ARRL North Florida Section Convention to be held on August 4-5, 1979, at the Jacksonville Beach Municipal Auditorium, Jacksonville, Florida. The location is just one block from the beach, where U.S. 90 meets the sea.

Advanced registrations are available at $3.00 per person from R. J. Cutting W2KGI/4, 303 10th St., Atlantic Beach, Florida 32233. Price at the door will be $3.50.

A large indoor swap area will be featured, with advance table reservations available for $5.00 per table per day from Robbie Roberts KH6FMD/W4, 10557 Atlantic Blvd., #31, Jacksonville, Florida 32211. Information on exhibitors' booths and space are available from the same address.

Other features and programs include statewide organization meetings on such topics as traffic nets and MARS, a microprocessor seminar, a solar power demonstration, a DX "pileup" contest, a hidden transmitter hunt, an OSCAR forum, ARRL forums, emergency preparedness programs, DX and contest presentations, antenna and technical seminars, and much more.

More general information may be obtained from JHA, 911 Rio St. Johns Dr., Jacksonville FL 32211.

MT SINAI LI NY AUG 5

The Radio Central Amateur Radio Club will hold its "Ham-Central" on Sunday, August 5, 1979 (rain date is August 12, 1979), at the Mt. Sinai Elementary School, Rte. 25A, Mt. Sinai, Long Island, New York. Admission for sellers is $3.00 per tailgate space and $1.50 for buyers, with XYL and children under 12 free. Monies are to be used for Radio Central and the St. Charles Hospital Repeater. Doors will open at 7:00 am for sellers and 9:00 for others. They will close at 4:00 pm. Featured will be antenna advice with Art and Madeline Greenberg, a Novice table, great food, a CW contest, an ARRL table, a special event of a fly-in by the Suffolk County Police Dept. helicopter, and a Radio Central Club table. Talk-in on 146.52 WA2UEC and 144.71/145.31 K2VL. For information, call Joan Longtin at (516)-924-8438 or Robin Goodman at (516)-744-6260, or write Radio Central, "Ham-Central," PO Box 680, Miller Place NY 11764.

SALEM OH AUG 5

The second annual Salem Area Hamfest will be held on August 5, 1979, from 9:00 am to 3:00 pm at the Kent State Salem campus, Salem, Ohio. Tickets are $1.50 in advance and $2.00 at the door. Inside tables are $5.00 with space for your own table at $2.00. Flea market space is $1.00. There will be air-conditioning, a wheelchair ramp, free parking, refreshments, and prizes, consisting of an Atlas RX-110, TX-110, and a PS-110. Talk-in on 146.52. For details, write Harry Milhoan WA8FBS, 1128 West State, Salem OH 44460.

LEVELLAND TX AUG 5

The Hockley County Amateur Radio Club and the Northwest Texas Emergency Net will sponsor their 14th annual picnic and swapfest on Sunday, August 5, 1979, at the City Park, Levelland, Texas. A $2.00 registration is requested but not required. Registration begins at 8:00 am and lunch will begin at 12:30 pm with a bring-your-own-picnic-basket lunch. There will be swapping all day with tables provided. Talk-in on 146.28/.88.

GLENN MI AUG 5

The Black River Amateur Radio Club will sponsor its 26th annual VHF Picnic and Swap 'n Shop on Sunday, August 5, 1979, at the Allegan County Park, Glenn, Michigan. Take Interstate 196 north of South Haven, Michigan, to the Glenn Exit. Door prizes will be awarded. Bring the family and a picnic basket (no lunch will be provided on the grounds) to enjoy the beach and playground. Talk-in on 147.90/.30 and 146.52. For information, contact Ed Alderman WB8BNN, RR#2, Box 98AA, Bangor MI 49013, or phone (616)-427-8830.

ANGOLA IN AUG 5

The Steuben County Radio Amateurs will hold their annual F.M. Picnic and Hamfest on Sunday, August 5, 1979, at Crooked Lake, Angola, Indiana. There will be prizes, picnic-style barbecued chicken, inside tables for exhibitors and vendors, and overnight camping (fee charged by county park). Talk-in on 146.52 and 147.81/.21. Admission is $2.00.

MUNCIE IN AUG 11

The Delaware Amateur Radio Association will hold its 2nd annual hamfest on Saturday, August 11, 1979, starting at 7:00 am, at Springwater Park, County Roads 300 E. and 100 N., Muncie, Indiana. Tickets are $1.50 in advance and $2.00 at the gate. Reserved table space is $1.00 per table with no extra charge for outside space. There will be hourly drawings from 9:00 am until 3:00 pm, with the grand prize of a Tempo SYNCOM S1 being drawn at 3:00 pm. Second prize will be a HAM III rotor. Talk-in on 146.25/.85 and 146.52/.52. For information or tickets, send money and an SASE to DARA, PO Box 3021, Muncie IN 47302.

LEXINGTON KY AUG 12

The Bluegrass Amateur Radio Club will hold its annual Central Kentucky Hamfest on August 12, 1979, at the Fasig-Tipton Sales Paddock, Newton Pike, Lexington, Kentucky. The program will include grand prizes, hourly door prizes, manufacturers' exhibits, an indoor/outdoor flea market, guest speakers, and forums. For information, contact the Bluegrass Amateur Radio Club, Inc., PO Box 4411, Lexington KY 40504.

PETOSKEY MI AUG 18-19

The Straits Area Radio Club will hold its Swap 'n Shop and hamfest on August 18-19, 1979, at Petoskey Middle School, State and Howard Streets, across from the Catholic church and post office, Petoskey, Michigan. There will be a donation of $2.00 at the door. Table space is also $2.00. Refreshments will be available. There will be a swap and shop on Saturday from 9:00 am to 4:00 pm and on Sunday from 9:00 am to 12:00 pm. Prizes, a ladies' program, and seminars at 11:00 am and 2:00 pm on Saturday will be featured. A banquet at the Holiday Inn on Saturday at 7:00 pm will have Mellish Reef DXpeditioner Bob Walsh WA8MOA as guest speaker. Banquet tickets are $7.50 and are limited to 200, sold in advance only. For full information and lodging, send an SASE to Bill Moss WA8AXF, 715 Harvey Street, Petoskey MI 49770, or phone (616)-347-4734.

ST. CHARLES IL AUG 26

The Fox River Radio League will hold its hamfest on Sunday, August 26, 1979, at the Kane Co. Fairgrounds Exhibition Hall, St. Charles, Illinois. Tickets are $1.50 in advance and $2.00 at the gate. For information, contact Martin Schwamberger WB9TNQ, 1051 Northfield Drive, Aurora IL 60505.

BEREA OH SEP 23

The fourth annual Cleveland Hamfest will be held on Sunday, September 23, 1979, at the Cuyahoga County Fairgrounds, Berea, Ohio. The hamfest will be an all-indoor operation. There will be 10-foot booths available with an 8-foot table and two chairs for $30.00.

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7A	14	14	14	14
ARGENTINA	21	21	14	14	7	7	14	21	21	21A	21A	21A
AUSTRALIA	21	21	14	7A	7	7	7	7	7	7	14	14
CANAL ZONE	21	14A	14	14	7	7	7A	14	14	21	21A	21A
ENGLAND	14	14	7A	7	7	7A	14	14A	14A	14A	14	14
HAWAII	21	21	14	14	7	7	7A	14	14	14	14A	21
INDIA	14	14	14	7B	7B	7B	14	14	14	14	14	14
JAPAN	14A	14	14	7A	7	7	7	14	14	14	14	14A
MEXICO	21	21	14	7A	7	7	7	14	14	14	21	21
PHILIPPINES	14	14	14	14	7B	7B	7B	14	14	14	14	14
PUERTO RICO	14	14	7A	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7B	7B	7	7	7B	14	21	21	21A	21	14	14B
U. S. S. R.	14	14	7A	7	7	7A	14	14	14	14	14	14
WEST COAST	14A	14	14	14	7	7	7A	14	14	14	14A	14A

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	14	7	7	7	7	14	14	14	14
ARGENTINA	21A	21	14	14	7	7	14	14	21	21	21A	21A
AUSTRALIA	21	21A	21	14	7A	7	7	7	7	7	14	21
CANAL ZONE	21	21	14	7A	7	7	7A	14	14	21	21A	21A
ENGLAND	14	14	7A	7	7	7	7	14	14A	14A	14A	14
HAWAII	21	21A	21	14	7	7	7	7A	14	14	14	14A
INDIA	14	14	14	14B	7B	7B	7B	14	14	14	14	14
JAPAN	14A	14A	14	14	7	7	7	14	14	14	14	14
MEXICO	14	14	7	7	7	7	7	7A	14	14	14	14
PHILIPPINES	14	14	14	14	7B	7B	7B	14	14	14	14	14
PUERTO RICO	21	14	14	7	7	7	14	14	14	14	21	21
SOUTH AFRICA	7B	7B	7	7	7B	7B	14	14	21	21	14	14B
U. S. S. R.	14	14	7A	7	7	7	7A	14	14	14	14	14

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	14	7	7	7	7	14	14	14	14
ARGENTINA	21A	21	14A	14	7	7	7A	14	21	21	21A	21A
AUSTRALIA	21A	21A	21	21	14	14	7	7	7	7	14	21
CANAL ZONE	21A	21	14	14	7	7	7	14	14	14	21	21A
ENGLAND	14	14	7A	7	7	7	7	14	14A	14A	14	14
HAWAII	21	21A	21A	21	14	14	7	7	14	21	21	21
INDIA	14	14	14	14B	7B	7B	7B	14	14	14	14	14
JAPAN	14A	14A	21	14	14	14	7	7	14	14	14	14
MEXICO	21	21	14	7A	7	7	7	14	14	14	14	21
PHILIPPINES	14	14A	14A	14	14	7B	7B	14	14	14	14	14
PUERTO RICO	21	14A	14	14	7	7	7	14	14	14	21	21
SOUTH AFRICA	7B	7B	7	7	7B	7B	7B	14	14	14	14	14B
U. S. S. R.	14	7A	7	7	7	7	7A	14	14	14	14	14
EAST COAST	14A	14	14	14	7	7	7A	14	14	14	14A	14A

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor
SF = Chance of solar flares

june

sun	mon	tue	wed	thu	fri	sat
					1 G	2 G
3 G	4 F	5 P/SF	6 P	7 G	8 G	9 G
10 P/SF	11 G	12 G	13 G	14 G	15 G	16 G
17 F	18 F	19 F	20 F	21 F	22 G	23 G
24 G	25 G	26 G	27 G	28 G	29 G	30 G

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W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

DAYTON

Despite the rapid growth of the Atlanta Hamfestival, Dayton pulls 'em in in greater numbers every time. It's gotten so big that it is difficult to see everyone there. No, it's impossible. Whether they have 15,000 or 20,000 in attendance is irrelevant—it's too much to handle.

I had not really intended to get to Dayton this time, feeling that I would do better to spend the four days involved working on Instant Software and a new publishing project. But I began to waver just a bit when they called up and wanted to know where they could reach Jean Shepherd K2ORS in order to get him to entertain at the banquet. Then they asked if I would be available to speak on the microcomputer forum . . . and I gave in.

Shep was outstanding, as usual. I think they had well over 1,500 at the banquet, and he had them in stitches. The banquet was nice . . . grilled hockey pucks, I think. I wasn't sure. The potato was good, which is more than I can say for a lot of restaurants . . . and the company was fine. Most of the entertainment was a bore . . . some local group singing and dancing . . . unfortunately none of them were singers or dancers. That went on incredibly long. The MC was excellent . . . he introduced the two hundred or so people at the head table in a minute and a half, making some very entertaining comments as he went along.

The Dayton crew has been at it for years and they are certainly professional about it. There are few glitches in the Hamvention.

The crowds seemed to be down a bit this year—no one knows why. I heard rumors that they clocked in 14,000, compared to 19,000 last year. The aisles were easier to traverse. Other later reports put attendance at 17,000. Big deal . . . that's numbers. I talked with exhibitors, and sales were the best ever, no matter how many were there. Some dealers went home with over $50,000 in sales for the three days.

Despite long-term delivery delays promised by Drake, I understand that dealers were really loaded up with Drake gear for the show . . . which brought prices down to perhaps $5 or $10 over cost on the big gear. While this is hard on the dealers, it is a bonanza for the rest of us. All HTs were selling well, too. I don't think a single dealer went home with an HT in his truck. The showing of the first prototype of the new Yaesu programmable HT helped convince dealers that long-term stocks of the more traditional HTs would not be prudent. It's getting time to liquidate HT crystal stocks.

Swan showed their new line of transceivers and wowed everyone. Their microprocessor-controlled units will be in short supply for a long time. The Japanese are going to have to work a little harder to keep their large share of the US market.

But long after the new ham gear and the acres upon acres of flea market fade into fuzzy memory, the Jean Shepherd entertainment at the banquet will live on in memory. Long after the old rig we bought off a flea market truck that chilly Saturday has been auctioned off at a local hamfest, we'll remember Shep and his problems with the Texas kilowatt on 7182 kHz back in the '30s. "Doesn't that sonofagun ever sleep?"

ARMA

The most recent meeting of the Amateur Radio Manufacturer's Association came the night before the Dayton Hamvention and was sparsely attended, considering that almost 250 firms run ads in any one month in the ham magazines.

A representative from the Electronic Industries Association was there to try to convince the ham industry that they might do better to join the EIA rather than fritter around with ARMA. It was noted that only one ham manufacturer is presently a member of EIA, and that one admitted discovering the membership with some surprise, a sort of bonus for their CB affiliation.

I don't think I helped that project as much as I might have when I reminded everyone that we had heard this same story ten years ago when Bob Waters lured the ham industry away from a ham manufacturer's association and into the EIA. The ham industry was in the same division as the CB industry, and thus when it came to any conflicts between the two (and there were beauts, like 220 MHz), money talked and the ham industry seemed to get a deaf ear.

The costs of joining the EIA are not insignificant. It would cost *73* about $2,000 per year to belong, with few (if any) benefits which I could pin down. And then, if any special projects for lobbying came up, the cost of them would be on top of the two thou. Someday, I'd like to have a general idea of how much Hy-Gain and Johnson put into the pot to get more CB channels on eleven meters and the 220 MHz band for CB. Both of those projects were bummers, incidentally. The eleven meter expansion project resulted in the serious wounding of CB and cost the industry billions. It sank Hy-Gain.

It was noted that ARMA had not been able to decide on anything and follow it through with success. The effort to stave off FCC actions on linear amplifiers was an abject failure. I feel that this total defeat was primarily due to the lack of support of ARMA by some of the larger firms in the ham industry, the back-stabbing (to put it politely) by the ARRL, and the lack of strong leadership in ARMA to put together a program with which to fight the

INFO.

Manuscripts

Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a stamped, self-addressed envelope with each submission. Payment for the use of any unsolicited material will be made upon acceptance. All contributions should be directed to the 73 editorial offices. "How to Write for 73" guidelines are available upon request.

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FCC and win.

One of the more serious problems facing any industry association is the seeming preference for the death of amateur radio over accommodation between the US manufacturers and importers of Japanese (called "foreign") equipment. I can understand the emotions involved, particularly when you consider that somewhere around 70% of the ham gear being sold is being imported from Japan. I've heard repeated claims that the Japanese are selling this ham gear at a loss here in order to destroy the US manufacturers. I'd sure like to see some proof of this contention.

On the surface of it, the high sales of Japanese equipment seems to be the result of a lot of advertising, excellent design, good marketing, and factors such as this. The Japanese have some unfair advantages, I'll admit, in that they have about 400,000 hams in Japan as a market that is virtually closed to our manufacturers. With about double the market for ham gear, they can afford to spend more on design and run larger production runs . . . which means lower costs.

Then there is the matter of Japanese productivity vs. that of the US. A recent article in *Fortune* pointed out that the US has been down toward the bottom of the list in worker productivity improvements. The Japanese have been building new and more automated plants, while our unions and government have been making it almost impossible for us to do the same, thus forcing dealers to sell imported equipment which has more features and costs less.

There have been some strong moves to turn this around. Swan has stopped importing their equipment and is now making everything here in the US. Their new line of transceivers is going to have a strong effect on the market, for they are taking advantage of microcomputer technology. But other US manufacturers have been complacent, telling dealers that they are so busy with other things that ham gear will be six months or more back-ordered. And one major firm which has been making a big deal out of hams buying American has some very clearly indentifiable Japanese parts in its new rig.

Some of the US problems undoubtedly could be cured if we could get the government out of the act. I talked with one manufacturer recently who had had his plant closed down by OSHA because they found a fire escape support column which was painted. It seems that they could not inspect the column for any possible cracks . . . so everyone had to be sent home until the paint could be removed from the fire escape column.

OSHA seems to be the cause of the recent semiconductor plant shutdown which caused incredible consternation in the entire electronics industry. The early estimates are that much over $10 billion was lost as a result of this unnecessary action. Some 20¢ chips were being bid up to $5.00 and more by contractors frantic to finish contracts on time or by manufacturers being pressured by customers for delivery.

I doubt if they are having nearly as much government harassment in Japan . . . and this means that they can be more competitive with us. If you read much about Japan, you know that workers take their jobs very seriously and are dedicated to their employers. The excesses of many industrialists of a hundred years ago spawned a strong union movement in the US, and some of the ramifications of that have not been helpful in making us competitive with other countries. The strong union positions in England have been a powerful factor in keeping that country from being seriously competitive with much of the world.

In the microcomputer field, no other country has been able to provide any serious competition for the US. You can bet that the Japanese microcomputer makers have been over here, sizing up the market, but they haven't been able to do much about it. Between our technological advances and the dollar/yen situation, US firms are getting into better positions to give the Japanese a run for their money. Where we are not being held back by union restrictions on modernization and excessive government regulation, we can raise hell with imports.

Well, getting back to ARMA, the suggestion was made that instead of trying to represent the industry, getting involved with battles with the FCC, or trying to help our WARC position, it be made more of a social club . . . perhaps with an industry friendship dinner during the more important hamfests and conventions. If the group is afraid to tackle anything more meaningful than that, then let's have dinner meetings and eat. That's better than protracted meetings hassling over bylaws, dues, and elections, which are just an enormous waste of time and of little interest.

There is one point of history that I would like to clarify since it seems to already be in the process of being rewritten. It was mentioned at the ARMA meeting that the opinion about trying to do something to help the amateur radio position at WARC was about evenly split. I might remind ARMA that the motion to tackle this project was made by Tom Gentry of Icom—it was carried with one and only one negative vote.

I recognize that the eventual scuttling of the project, which I attribute to *Ham Radio* magazine, calls for a distribution of

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CB TO 10

Many readers have written or called to ask about obtaining back issues which contain articles in our "CB to 10" series. For everyone's information, the issues which have thus far featured "CB to 10" articles are listed below.

1977—May—Part I—"Bandplan and Crystal Information"
1977—Jul—Part II—"Conversion Data"
Part III—"Converting the TRC-47"
Part IV—"Johnson 123A Mod"
Part V—"Converting the Hy-Gain 670B"
1977—Dec—Part VI—"Antenna Suggestions"
Part VII—"Convert a TRC-11"
1978—Feb—Part VIII—"The Publicom I"
1978—Jul—"How About SSB CB Conversions?"
1978—Aug—Part IX—"A Pair of Radio Shack Rigs"
1978—Sep—Part X—"Realistic's Mini 23"
Part XI—"Hy-Gain's PLL Rigs"
1978—Oct—Part XII—"Convert a Kraco PLL Rig"
1978—Nov—Part XIII—"The Lafayette Telsat SSB-75"
Part XIV—"A Realistic PLL Rig"
Part XV—"A Realistic HT"
1979—Jan—Part XVI—"A CW Conversion"
Part XVII—"SBE and Pace Rigs"
1979—May—Part XVIII—"Several PLL Rigs"
1979—Jun—Part XIX—"Lafayette SSB Rigs"

These issues may be purchased at $8.50 for 5 of your choice (order #STO500), $14 for 10 of your choice (# ST1000), or $25 for 25 of your choice (#ST2501). Include $1 for postage and handling, and send your order to 73 Radio Bookshop, Peterborough NH 03458.

LETTERS

MEMORIES

I was reading my March issue of *73* and noticed your story of the trip we took to Europe in October, 1963. I always felt that the idea of the Institute of Amateur Radio was a very good one and that hams getting to know hams through group tours to other countries was an excellent way of promoting amateur radio.

I am a holder of a lifetime subscription to *73* (yes, I was one of the lucky ones who subscribed in Miami back in '61 or '62), and I have followed you through your editorials. Many times I started to write and tell you how much Anna and I enjoyed the trip, but somehow I never got around to it.

Do you remember your miniature greyhound jumping off the bed and breaking its leg? Or Annora Todd yelling that she wanted to get off at "Arts and Meters" underground station in Paris? Wasn't the cannelloni good at the restaurant in Rome where we went with you one evening and ate in the open-air section? Do you remember when one of the single guys had to double up in the room with the gal in the red coat and her husband? I can't remember her name, but in a crowd we would all say, "Follow the gal in the red coat."

Well, I've finally gotten around to telling you (after all these years) how good I think your idea was and how great the trip was. I have gone many places since then, but never had one-tenth the fun we all did on that momentous trip to Europe by *73* hams. If that trip could ever be duplicated and it leaked out how much fun it was and how interesting it was to meet hams from other countries, you would have to form a full-time travel agency.

I have recently retired from practicing dentistry, and Anna and I moved here to the mountains of western North Carolina from Miami, Florida. Good luck, Wayne, and keep up the good work.

Lamon L. Whiddon K4MHY
Boone NC

It was January, 1961, and you were Life Subscriber #1. I remember it well! The Italian greyhound was named Petite Chienne because that's what everyone called her when we got to Paris. The Rome restaurant was the Tres Scalini and it is still there and superb. I often look at the slides and relive that fantastic trip.—Wayne.

Somehow I was propelled to open the March copy of *73* and I read Never Say Die.

My husband has been dead a year and I had not opened any of his ham magazines until today. As one of the XYLs on that 1963 trip to Europe, I want to thank you for renewing all those wonderful memories.

It would be wonderful to be in contact with the travel group again.

Annora Todd
222 W. Hawthorne St.
Aurora MO 65605

SCHOLARSHIPS

High-school graduates who plan to enter college this fall and who are licensed amateurs may be eligible for one of the $250 scholarships offered by the Atlanta Radio Club. If you qualify, write to the ARC Scholarship Fund, PO Box 77171, Atlanta GA 30357.

Philip J. Latta W4GTS
Marietta GA

ABSURDITY

I feel that the idea of each ITU country having one vote each at WARC is absurd.

Although some people have expressed discontent at the very idea of one country having more say than another, citing it undemocratic, I see it as just the opposite. I see it undemocratic when a handful of radio users have the same vote as millions. This is totally unreasonable for the millions of radio users, since the more operators there are, the more air space is required.

The only truly fair way on which to base votes is on radio population. Because it is not going to change, I feel the US should drop out of the ITU. Many countries play the ITU game during conferences and then disregard the decisions made afterwards, anyway.

William D. Matteo WB2IVI
Toms River NJ

WPIX

From time to time, you mention your television career. With this in mind, I thought you might be interested in the accompanying picture which shows a young (1948) Wayne Green, hair and all, behind a WPIX RCA-TK 10 camera.

I believe the man at the piano is Sigmund Spaeth, who had a program called "The Tune Detective."

I am sure your loss to TV was a gain for amateurs.

Otis Freeman
WPIX, Inc.
New York City NY

Thanks, Otis! Sure, I remember Dr. Spaeth and his program . . . and little things like the night I did the Woody Woodpecker call for him on camera. I remember the Gloria Swanson show, too, with Zasu Pitts and a lot of other old-time stars. Those were fantastic times. The hair? Heck, my father has more hair than I do . . . so did his father, right up until he died . . . but then they didn't have the aggravation of my first wife.—Wayne.

SURPLUS

I just read an article in one of the back issues of *73*. The issue, Feb., '78, had an article by James C. Chapel W9HDA, entitled "Surplus Adventures—pound foolish!" He didn't feel he could trust a company to ship a signal generator to him from a government surplus outlet. Well, this definitely points out a need of hams.

I want to become a ham but suffer from a pecuniary deficiency. Since I work at the Ogden depot, which is a major electronics surplus outlet in Utah, I think I can benefit all those out there who wish to purchase this equipment and who do not wish to suffer expensewise in the process! In short, I offer, for a reasonable fee, to ship what they wish from Ogden to wherever they may desire.

My background consists of thirteen years in electronics, the last 6 months of which have been as a quality control inspector in the same field. I could, most likely, even inspect the item they wish to bid on, given enough lead time. Not only will all the hams out there benefit, but maybe I'll finally be able to join the fraternity.

If I should thrive at this, I shall definitely make it a business and we'll all benefit because then I'll be able to afford to advertise in your superb magazine. Until then, I shall have to rely on your largess to print this in your next Letters column. If anyone out there is interested, please have them include an SASE.

Thomas W. Newbery
610 North Liberty St.
Ogden UT 84404

HOT CHIHUAHUA

I am returning to the frontiers of Texas again, this time backpacking in the arid wilderness mountains of the Chihuahuan Desert. Please publish the particulars of the expedition so that more experimental NBVM stations may participate. One of the following mountain ranges will be selected for a base camp above the desert floor where temperatures will be more tolerable while operating: Chisos, Davis, Glass, Guadalupe, Christmas, Solitario, or Caballo Muerta.

We will carry in all water, radios, a solar array, food, and shelter. We will be operating Sunday, July 1, through Saturday, July 7, with a two-Watt output transceiver in NBVM, SSB, and CW modes on all HF bands. In addition, we will carry a Tempo S1 2-meter FM hand-held (1.5 Watts). There are a few VHF

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Looking West

Bill Pasternak WA6ITF
24854-C Newhall Ave.
Newhall CA 91321

Mike Davis WD6FFV of Torrance, California, is a real live 13-year-old hero. On the evening of April 24th, Mike's parents gave him permission to stay up late in order to indulge in a bit of his favorite pastime: operating his station and hunting DX. Everyone else in the house was asleep as Mike searched the band looking for the western Caroline Islands. At about 1:00 am on the morning of April 25th, Mike happened across a QSO between someone on a fishing boat off the coast of Jamaica and someone in New Zealand. Conditions between the craft (later identified as the fishing vessel *Carmen*) and ZL-land were poor at best, and the information exchanged showed that an emergency existed. When those aboard the *Carmen*, identified as the boat's owner Leonard Hutchinson and crew members David Dalquist and Sergio Perez, again sent out a "Mayday" call, Mike responded, obtained their latitude and longitude, and phoned this information to the Long Beach Coast Guard station, which in turn relayed same to Miami. The situation was this: The *Carmen* was some 60 miles off the coast of Jamaica. It had been severely battered by high winds and rough seas and was taking on water. Those aboard knew that the craft would sink; they needed immediate rescue. Mike spent the next 45 minutes relaying information between the Coast Guard and the stricken *Carmen* until the signal from the vessel disappeared due to changes in propagation. It was at that time that a W5 in New Mexico acquired the *Carmen*'s signal and continued the relay between the Miami Coast Guard and the *Carmen*.

As a result of Mike's quick thinking, the Coast Guard dispatched a rescue plane which dropped a pump, rescue raft, and marine Coast Guard radio. Later, the cutter *Sherman* took the stricken 75' *Carmen* in tow and brought it back to Montego Bay, Jamaica. A spokesman for the Coast Guard credited the success of the rescue to Mike's quick thinking and positive action. Because he maintained his cool, three men who might have drowned are alive today. They have a 13-year-old amateur radio operator in Torrance, California, to thank for this.

THE "HAIL-TO-THE-QUEEN" DEPARTMENT

Nate Brightman K6OSC is another amateur we can all take pride in. He is a ham who had a dream and persevered for twelve years to see it come true. Thanks to Nate, amateur radio is now operational in full view of the general public on a day-to-day basis aboard one of southern California's most renowned tourist attractions: the *Queen Mary* ocean liner now permanently docked in Long Beach harbor.

Nate is a member of the Associated Radio Amateurs of Long Beach, California. Twelve years ago, when the *Queen Mary* made her last sea voyage from England to her final home in Long Beach, Nate and his club thought that it would be fitting to have an operational amateur station on the trip. Nate spearheaded the drive and succeeded. It was at that time that the idea of a permanent station came to him. Having an idea and making it come true are not always one and the same. In this case it took years. During its transition from an ocean liner to a tourist attraction and hotel, the original wireless room had been dismantled. Nate's idea was to restore this room to as close to its original state as possible and then add a permanent amateur station.

On April 22, 1979, Nate's dream came true. On that evening, Sharon and I attended a special invitational press preview of what had been accomplished by Nate and the Associated Radio Amateurs of Long Beach. On the top deck of the illustrious *Queen*, the wireless room had indeed been restored. Amid the relics of times gone by was nestled neatly, in a special panel arrangement, some of today's most sophisticated amateur equipment on indefinite loan from such well-known firms as Yaesu, Trio-Kenwood, Swan, DenTron, and others. What about antennas? Neatly built into one of the *Queen's* stacks and rising above it stands a triband beam and a two-meter Ringo from Cushcraft. The array is rotated by an Alliance rotor. Shortly, two dipoles (one for 75/80 and another for 40 meters) will give the ship's station 80- through 2-meter capability (six meters excluded).

Something very apropos happened the evening that the station opened. After the initial ceremony was concluded, it was time to place the station on the air. One of those present was famed DXer Don Wallace W6AM. When his turn came, Don contacted a station in New Zealand. As the QSO progressed, it was learned that the ZL had been one of the wireless operators who served on the *Queen Mary* during World War II. I remember the ZL saying, "Don, if you are where I think you are, then I preceded you some 30 years ago and had my feet in the same spot that yours are now." All of us gathered around the TS-820's speaker beamed with delight. If the QSO had been planned—and it was not—nothing could have been

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A very happy Nate Brightman K6OSC (center) chats with Roy Neal K6DUE (left) and WA6ITF during a break in the filming of "The World of Amateur Radio" aboard the Queen Mary. *(Photo by KH6IAF)*

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OSCAR Orbits

Courtesy of AMSAT

The listed data tells you the time and place that OSCAR 7 and OSCAR 8 cross the equator in an ascending orbit for the first time each day. To calculate successive OSCAR 7 orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the day's first ascending (northbound) equatorial crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world from you, it will descend over you. To find the equatorial descending longitude, subtract 166° from the ascending longitude. To find the time OSCAR 7 passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR 7 when it is within 45 degrees of you. The easiest way to determine if OSCAR is above the horizon (and thus within range) at your location is to take a globe and draw a circle with a radius of 2450 miles (4000 kilometers) from your QTH. If OSCAR passes above that circle, you should be able to hear it. If it passes right overhead, you should hear it for about 24 minutes total. OSCAR 7 will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15° east or west of you, add another minute; at 30°, three minutes; at 45°, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

OSCAR 8 calculations are similar to those for OSCAR 7, with some important exceptions. Instead of making 13 orbits each day, OSCAR 8 makes 14 orbits during each 24-hour period. The orbital period of OSCAR 8 is therefore somewhat shorter: 103 minutes.

To calculate successive OSCAR 8 orbits, make a list of the first orbit number (from the OSCAR 8 chart) and the next thirteen orbits for that day. List the time of the first orbit. Each successive orbit is then 103 minutes later. The chart gives the longitude of the day's first ascending equatorial crossing. Add 26° for each succeeding orbit. To find the time OSCAR 8 passes the North Pole, add 26 minutes to the time it crosses the equator. OSCAR 8 will cross the imaginary San Francisco-to-Norfolk line about 11 minutes after crossing the equator. Mode A: 145.85-.95 MHz uplink, 29.4-29.50 MHz downlink, beacon at 29.40 MHz. Mode J: 145.90-146.00 MHz uplink, 435.20-435.10 MHz downlink, beacon on 435.090 MHz.

OSCAR 7 Orbital Information				OSCAR 8 Orbital Information			
Orbit	Date (July)	Time (GMT)	Longitude of Eq. Crossing °W	Orbit	Date (July)	Time (GMT)	Longitude of Eq. Crossing °W
21151	1	0021:39	69.3	6728Jbn	1	0045:35	56.3
21164qrp	2	0115:56	82.9	6742Abn	2	0050:46	57.6
21176	3	0015:16	67.8	6756Abn	3	0055:56	58.9
21189X	4	0109:33	81.3	6770X	4	0101:06	60.2
21201	5	0008:53	66.2	6784Abn	5	0106:17	61.5
21214	6	0103:10	79.8	6798Abn	6	0111:27	62.9
21226	7	0002:31	64.6	6812Jbn	7	0116:37	64.2
21239	8	0056:48	78.2	6826Jbn	8	0121:48	65.5
21252qrp	9	0151:04	91.8	6840Abn	9	0126:58	66.8
21264	10	0050:25	76.7	6854Abn	10	0132:08	68.1
21277X	11	0144:42	90.3	6868X	11	0137:18	69.4
21289	12	0044:02	75.1	6882Abn	12	0142:29	70.7
21302	13	0138:19	88.7	6895Abn	13	0004:25	46.2
21314	14	0037:39	73.6	6909Jbn	14	0009:35	47.5
21327	15	0131:56	87.1	6923Jbn	15	0014:46	48.8
21339qrp	16	0031:16	72.0	6937Abn	16	0019:56	50.1
21352	17	0125:33	85.6	6951Abn	17	0025:06	51.4
21364X	18	0024:54	70.4	6965X	18	0030:16	52.7
21377	19	0119:11	84.0	6979Abn	19	0035:26	54.1
21389	20	0018:31	68.9	6993Abn	20	0040:36	55.4
21402	21	0112:48	82.5	7007Jbn	21	0045:46	56.7
21414	22	0012:08	67.3	7021Jbn	22	0050:56	58.0
21427qrp	23	0106:25	80.9	7035Abn	23	0056:07	59.3
21439	24	0005:45	65.8	7049Abn	24	0101:17	60.6
21452X	25	0100:02	79.4	7063X	25	0106:27	61.9
21465	26	0154:19	92.9	7077Abn	26	0111:37	63.2
21477	27	0053:40	77.8	7091Abn	27	0116:47	64.5
21490	28	0147:56	91.4	7105Jbn	28	0121:57	65.8
21502	29	0047:17	76.2	7119Jbn	29	0127:07	67.1
21515qrp	30	0141:34	89.8	7133Abn	30	0132:17	68.4
21527	31	0040:54	74.7	7147Abn	31	0137:27	69.8

RTTY Loop

Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

Oh, heavy sigh and deja vu, didn't we have a computer program in last July's RTTY Loop? Of course we did, but, as promised last month, this is the other half: the transmitting program for the 6800. Let's plunge right into the program, shown in Program 1. If you have the flowcharts from last month handy, use them along side.

The first 96 memory locations ($20 to $7F) are reserved for the table used to convert ASCII to Baudot. The ASCII value is used as an index to retrieve the data, representing the Baudot representation of that ASCII code. The encoding used represents the Baudot case as the Most Significant Bit (MSB), "1" for Letters and "0" for Figures, and the next five bits the character itself. Thus, ASCII "R", which has a value of $52, is found at memory location $72 [$20 (start of table) + $52 (R value) = $72]. The data at that location is $A8, which, in binary, is 10101000. This interprets to 1 - 01010 - 00, or LTRS - Baudot code 01010 (R). The last two bits are not used in this scheme. Note that, for example, a "4", which is ASCII $34 and found at location $54 in the table, would be represented by $28. This is binary 0 - 01010 - 00. That is, FIGS - Baudot code 01010 (R), since "4" is the uppercase Baudot "R".

Continued on page 166

Program 1.

```
                        NAM     RTTYXMIT
                        OPT     O,NOG
               *
               * RTTY TRANSMIT PROGRAM
               * VER 0.6 - 06 MAY 79
               * MARC I. LEAVEY, M.D.
               *
               * EXTERNAL REFERENCES
               *
          801C PIADA    EQU     $801C
          801D PIACA    EQU     $801D
          E07E PDATA    EQU     $E07E
          E1AC INEEE    EQU     $E1AC
          A048 PGCTR    EQU     $A048
               *
     0020               ORG     $20
     0020 FE   TABLE    FCB     $FE          LETTERS
     0021 00            FCB     0,0,0
     0024 00            FCB     0,0,0
     0027 50            FCB     $50          BELL
     0028 00            FCB     0,0
     002A A0            FCB     $A0          LINE FEED
     002B 00            FCB     0,0
     002D FF            FCB     $FF          CARRIAGE
     002E 00            FCB     0,0,0         RETURN
     0031 00            FCB     0,0,0
     0034 00            FCB     0,0,0
     0037 00            FCB     0,0,0
     003A 00            FCB     0,0,0
     003D 00            FCB     0,0,0
     0040 90            FCB     $90          SPACE
     0041 58            FCB     $58          !
     0042 44            FCB     $44          "
     0043 FF            FCB     $FF          #
     0044 48            FCB     $48          $
     0045 FF            FCB     $FF          %
     0046 2C            FCB     $2C          &
     0047 68            FCB     $68          '
     0048 78            FCB     $78          (
     0049 24            FCB     $24          )
     004A FF            FCB     $FF          *
     004B FF            FCB     $FF          +
     004C 18            FCB     $18          ,
     004D 60            FCB     $60          -
     004E 1C            FCB     $1C          .
     004F 5C            FCB     $5C          /
     0050 34            FCB     $34          0
     0051 74            FCB     $74          1
     0052 64            FCB     $64          2
     0053 40            FCB     $40          3
     0054 28            FCB     $28          4
     0055 04            FCB     $04          5
     0056 54            FCB     $54          6
     0057 70            FCB     $70          7
     0058 30            FCB     $30          8
     0059 0C            FCB     $0C          9
     005A 38            FCB     $38          :
     005B 3C            FCB     $3C          ;
     005C FF            FCB     $FF          <
     005D FF            FCB     $FF          =
     005E FF            FCB     $FF          >
     005F 4C            FCB     $4C          ?
     0060 FF            FCB     $FF          @
     0061 E0            FCB     $E0          A
     0062 CC            FCB     $CC          B
     0063 B8            FCB     $B8          C
     0064 C8            FCB     $C8          D
     0065 C0            FCB     $C0          E
     0066 D8            FCB     $D8          F
     0067 AC            FCB     $AC          G
     0068 94            FCB     $94          H
     0069 B0            FCB     $B0          I
     006A E8            FCB     $E8          J
     006B F8            FCB     $F8          K
     006C A4            FCB     $A4          L
     006D 9C            FCB     $9C          M
     006E 98            FCB     $98          N
     006F 8C            FCB     $8C          O
     0070 B4            FCB     $B4          P
     0071 F4            FCB     $F4          Q
     0072 A8            FCB     $A8          R
     0073 D0            FCB     $D0          S
     0074 84            FCB     $84          T
     0075 F0            FCB     $F0          U
     0076 BC            FCB     $BC          V
     0077 E4            FCB     $E4          W
     0078 DC            FCB     $DC          X
     0079 D4            FCB     $D4          Y
     007A C4            FCB     $C4          Z
     007B FF            FCB     $FF          [
     007C FF            FCB     $FF          \
     007D FF            FCB     $FF          ]
     007E FF            FCB     $FF          ^
     007F FF            FCB     $FF          -
     0080 23   SPTABL   FCB     $23,$98,$A8  #=NR
     0083 25            FCB     $25,$B4,$B8  %=PC
     0086 2A            FCB     $2A,$E0,$D0  *=AS
     0089 2B            FCB     $2B,$B4,$A4  +=PL
     008C 3C            FCB     $3C,$A4,$84  <=LT
     008F 3D            FCB     $3D,$C0,$F4  ==EQ
     0092 3E            FCB     $3E,$AC,$84  >=GT
     0095 40            FCB     $40,$E0,$84  @=AT
     0098 5B            FCB     $5B,$78,$78  [=((
```

Continued on page 166

Contests

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

COLOMBIAN INDEPENDENCE DAY CONTEST
Starts: 0001 GMT Saturday, July 14
Ends: 2359 GMT Sunday, July 15

The purpose of this contest is to commemorate the Colombian 169th independence anniversary and to promote and increase DX activity of HK radio amateurs. Entry classifications include: single operator/single band, single operator/multiband, multi-operator/multiband/one rig. Use all amateur bands 80 through 10 meters on phone, SSB, or CW. Only one contact per band with the same station will be permitted. No crossband or crossmode contacts. Club stations can only take part as multi-operator/multiband/single transmitter. A minimum of 50 QSOs must be shown in logs when applying for any award.

EXCHANGE:

RS(T) and QSO number from 001.

SCORING:

Each QSO with an HK station scores 5 points, each station in another continent counts 3 points, a station in a DX country counts 2 points, and stations in the same country count 1 point. The multiplier is the total number of different countries worked on each band. The total score will be the sum of QSO points on each band multiplied by the sum of different countries worked on each band.

ENTRIES AND AWARDS:

Logs must show all times in GMT; keep separate logs for each band and enter the country only the first time it is contacted. Each entry must be accompanied by a summary sheet listing all scoring info. The logs not summarized according to the abovementioned instructions will be used only as check logs. Awards include a silver plate for the world winner, certificates for continental winners, and winners in each classification. Violation of the regulations of amateur radio in the country of the contestant or the rules of the contest, taking credit for incorrect QSOs or multipliers, or duplicate contacts in excess of 2% of the total made will be deemed sufficient cause for disqualification. The LCRA Contest Awards Committee decisions shall be final. All logs must be mailed to: LCRA—Concurso Independencia, c/o Contest Committee Manager, Apartado Postal 584, Bogota, Colombia, SA. All entries must be postmarked no later than September 30.

CW COUNTY HUNTERS CONTEST
Starts: 0000 GMT July 28
Ends: 0200 GMT July 30

The CW County Hunters Net invites all amateurs to participate in the 1979 contest. All mobile and portable operation in less active counties is welcome and encouraged. General call is "CQ CH." Stations may be worked once on each band and again if the station has changed counties. Portable or mobile stations changing counties during the contest may repeat contacts for QSO points. Stations on county lines give and receive only one number per QSO, but each county is valid for a multiplier. Suggested frequencies are 3575, 7055, 21070, and 28070. It is requested that only portable or mobile category stations call CQ or QRZ on 40 meters below 7055 and on 20 meters below 14070 with all stations spreading out above those frequencies.

EXCHANGE:

QSO number, category (portable = P, mobile = M), RST, state/province/country, and US county.

SCORING:

QSOs with fixed stations are 1 point; portable or mobile stations are 3 points. Multiply the number of QSO points times the number of US counties worked. Mobiles and portables calculate their score on the basis of total contacts within a state.

AWARDS:

Certificates will be awarded in three categories: Fixed—highest fixed or fixed portable station in each state, province, and country with 1,000 or more points; Portable—highest station in each state operating portable from a county which is not his normal point of operation with 1,000 or more points; Mobile—highest mobile in each state operating from 3 or more counties with a minimum of 10 QSOs per county.

Trophies will be awarded to the highest single-operator station in the US in categories P and M. The awards committee will issue additional awards where deemed appropriate.

ENTRIES:

Logs must show category, date/time in GMT, station worked, exchanges, band, QSO points, location, and claimed score. All entries with 100 or more QSOs must include a checksheet of counties worked or be disqualified from receiving awards. Enclose a large SASE if results are desired. Logs must be postmarked by September 1 and sent to: CW County Hunters Net, c/o Jeffrey P. Bechner W9MSE, 673 Bruce Street, Fond du Lac Wi 54935.

RHODE ISLAND QSO PARTY
Contest Periods: 1700 GMT Saturday, July 28 to 0500 GMT Sunday, July 29
1300 GMT Sunday, July 29 to 0100 GMT Monday, July 30

This contest is sponsored by the East Bay Amateur Wireless Association. RI stations work other RI stations and the rest of the world. Others work RI only. The same station may be worked once per band and mode. No repeater contacts are allowed.

EXCHANGE:

RS(T), QTH = RI county or state, province, or country for others.

SCORING:

RI stations score 2 points per QSO; RI Novice and Tech stations score 5 points per QSO. Others score 2 points per RI QSO and 5 points per QSO with RI Novices or Technicians. RI Novices and Technicians sign with /N or /T to designate license class. RI stations multiply total QSO points by the number of RI counties, states, provinces, and DX countries worked. Others multiply total QSO points by the number of RI counties worked (5 max.). All stations score 10 points for QSO with multi-op station operated by club members, N1RI.

FREQUENCIES:

CW—1810, 3550, 3710, 7050, 14050, 21050, 21110, 28050, 28110.

Continued on page 168

Calendar

June 30-July 1*	**Seven-Land QSO Party**
July 4	**ARRL Straight Key Night**
July 14-15	**ARRL IARU Radiosport Competition**
	Colombian Independence Day Contest
July 28-30	**CW County Hunters Contest**
	Rhode Island QSO Party
	New Jersey QSO Party
Aug 4	**DAFG 10 Meter Contest**
Aug 4-5	**ARRL UHF Contest**
Aug 25-26	**All Asian DX Contest—CW**
Sept 8*	**DAFG Short Contest—VHF**
Sept 8-9	**ARRL VHF QSO Party**
Sept 9*	**DAFG Short Contest—SW**
Sept 14-15	**Kentucky QSO Party**
Sept 15-16	**Scandinavian Activity—CW**
Sept 15-17	**Washington State QSO Party**
Sept 22-23	**Scandinavian Activity—Phone**
Sept 29-30	**Delta QSO Party**
Oct 13-14	**ARRL CD Party—CW**
Oct 20-21	**ARRL CD Party—Phone**
Nov 3-4	**ARRL Sweepstakes—CW**
Nov 10-11	**CQ-WE Contest**
Nov 11	**OK DX Contest**
Nov 17-18	**ARRL Sweepstakes—Phone**
Nov 24*	**DAFG Short Contest—SW**
Nov 25*	**DAFG Short Contest—VHF**
Dec 1-2	**ARRL 160 Meter Contest**
Dec 1-3	**North Carolina QSO Party**
Dec 8-9	**ARRL 10 Meter Contest**

*** = described in last issue**

Results

RESULTS OF THE COLOMBIAN INDEPENDENCE DAY CONTEST 1978

AWARDS

World Winner of Ihe Contest—UK2GKW

Continental Winners of the Contest:
North America K5UR
South America HK4DF
Africa
Asia 9K2FX
Oceania
Europe UK2GKW

Multi-Operator/Multiband/One Rig Highest Scoring Station—UK2GKW

Single Operator/Single Band—9K2FX

Single Operator/Multiband—HK4DF

Microcomputer Interfacing

Christopher A. Titus
David G. Larsen
Peter R. Rony
Jonathan A. Titus

SAMPLE-AND-HOLD DEVICES

Sample-and-hold (S/H) devices or sample-and-hold amplifiers (SHA) are analog circuit elements that are the analog equivalent of the digital latch. They are used when we wish to sample an analog signal and then hold it steady at a particular point so that a voltage of interest may be measured or used elsewhere in a system. The operation of an ideal sample-and-hold device is shown in Fig. 1. In this example, the S/H output follows, or *tracks*, the input during the sample period and then holds the latest analog voltage when it switches to the hold mode. In the figure, the input and output voltage lines are offset slightly for clarity.

Sample-and-hold devices are widely used in conjunction with digital-to-analog and analog-to-digital converters. For example, they may be used to:

- Hold an analog signal steady so that an A/D conversion may be performed;
- Simultaneously sample many analog inputs for later measurement (requires one S/H device per analog input);
- Deglitch a D/A converter's output to eliminate output voltage spikes or settling transients; and
- Distribute one D/A converter's output to several points, where analog voltages must be constantly maintained.

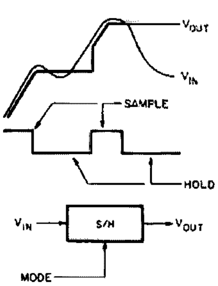


Fig. 1. Inputs and output for an ideal sample-and-hold device. Both the sample and hold modes of operation are shown.

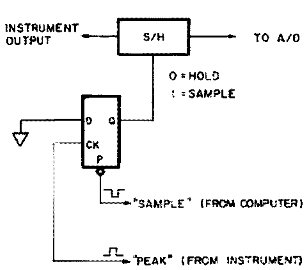


Fig. 2. Block diagram for a typical sample-and-hold microcomputer interface circuit. The instrument supplies the PEAK input pulse to the flip-flop. The SAMPLE pulse from the computer presets the flip-flop to logic 1.

The second and fourth uses listed above are becoming less important than they were two or three years ago. It is probably less expensive now to dedicate an A/D converter to each input to be measured and to have one D/A converter per output, depending upon the specific application.

The most common use of sample-and-hold devices is to sample and hold an analog signal at a particular point while it is measured with an A/D converter. A sample-and-hold device is particularly useful in situations in which a DAC and a comparator are being used in conjunction with microcomputer software to create an A/D converter.[1] When a sample-and-hold device is used prior to the input of the unknown signal to the comparator (or an A/D converter module if one is used), the digitization may proceed to give an accurate representation of the unknown voltage. For example, in Fig. 2 we provide a block diagram for a typical sample-and-hold computer interface that permits you to measure the peak voltage from an instrument. We have assumed here that the instrument provides a positive clock pulse, called PEAK, when the peak maximum is reached. The SAMPLE pulse from the computer allows the S/H module to sample the unknown signal from the instrument. When the peak is reached, the PEAK signal clocks a logic 0 into the output of the flip-flop, forcing the S/H device into the hold mode. Fig. 3 shows the timing diagram that would be generated by the interface circuit shown in Fig. 2. Again, the S/H output and the instrument output have been offset for clarity. Now, either a slow ramp A/D converter or a fast successive approximation A/D converter can be used to provide the correct value for the peak voltage since the S/H device will maintain the voltage until it can be digitized.

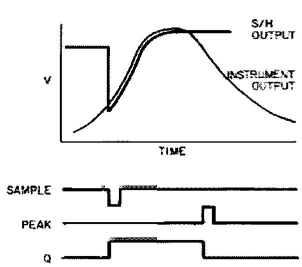


Fig. 3. Typical timing diagram for the interface circuit shown in Fig. 2.

acquisition time	The time required to go from the hold state to the tracking state, in which the output remains within a 0.01% range of the input. This may also be called the settling time when the S/H device is already in the sample mode. The acquisition time is generally a few microseconds. See Fig. 4.
aperture time	The time period required by the device to go from the sample mode into the hold mode once the hold command has been received. The aperture time is generally a few nanoseconds. See Fig. 5.
droop rate, decay rate	The rate of discharge of the sample-and-hold capacitor. The rate is a function of switch leakage current and the current required by other circuit elements connected to the capacitor. It is expressed as millivolts per second. See Fig. 6.
gain error, linearity	The variation of the observed output from the expected output over the entire sample-and-hold device's output voltage range. It is usually expressed as a percentage, say 0.01%. See Fig. 6.
offset	The difference between the input and the output voltages of the device when the input is ground. It is usually expressed as millivolts. The offset may be adjusted to zero using external components, but it will generally change with time and temperature. See Fig. 4.
slew rate	The maximum rate of change for the output, expressed as volts per second. It is a limitation imposed by the charging rate of the capacitors and the actual slew rates of the operational amplifiers present in the S/H circuit. See Fig. 4.

Table 1. Some important concepts associated with sample-and-hold devices.

Sample-and-hold devices are not ideal, and there are some terms that will help you better understand their limitations and uses. These are listed in Table 1, which is keyed to Figs. 4, 5, and 6. As can be observed, there are important limitations to the capabilities of S/H devices. Those devices that have short acquisition times use small capacitors and thus the voltage droop rate will be large. The use of larger capacitors means that the acquisition time will be longer, but the voltage droop will be less. When high acquisition speeds and long hold times are required in an application, two S/H modules may be used: The first quickly acquires the analog signal at the point of interest and the second acquires and holds the output from the first device. The second S/H device takes longer to acquire the voltage presented by the first device, but since a larger capacitor is used, its droop rate will be much lower. For further details, the reader is referred to reference 2.

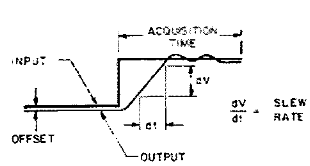


Fig. 4. Representation of the acquisition time, offset, and slew rate. (Courtesy of Analog Devices, Inc.[3] All rights reserved.)

There are a number of commercially available sample-and-hold devices which eliminate the need for you to construct your own. The following modules are representative of those available:

Analog Devices, Inc., Norwood, Massachusetts 02062—SHA-5, general purpose, $47; SHA-1A, general purpose, $150.

Burr-Brown, Tucson, Arizona 85734—SHC80KP, low cost, $34; SHM60, high speed, $104.

Datel, Inc., Canton, Massachusetts 02021—SHM-LM2,

Continued on page 77

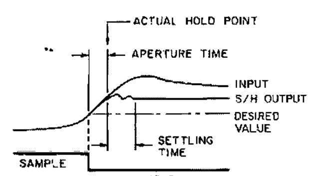


Fig. 5. Representation of the aperture time and the settling time. (Courtesy of Analog Devices, Inc.[3] All rights reserved.)

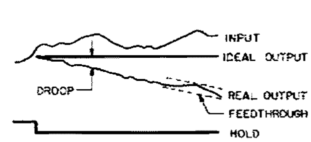


Fig. 6. Representation of the linearity, droop rate, and feedthrough. (Courtesy of Analog Devices, Inc.[3] All rights reserved.)

New Products

KANTRONICS' AMATEUR UPGRADE™

Kantronics' "Amateur Upgrade" is an educational board game that familiarizes players with FCC rules governing amateur radio and elementary radio concepts. The game comes complete with playing surface, playing pieces (coil, grommet, etc.), a die, a deck of exam cards, and corresponding answer sheets.

"Amateur Upgrade" is packaged in a colorful light blue box; it measures 1.5" high by 8.25" wide by 15.5" long. Game pieces and exam cards fit in a pocket adjacent to the support tray. The game surface is 15.4 inches square and is printed in five colors corresponding to beginner, Novice, General, Advanced, and Extra class.

Players roll the die to determine the number of spaces to move. Some spaces players land on have a consequence, such as "taught a Novice class—move again," or "exceeded 1000 Watts—answer question; if wrong, go to start," or "illegal third party traffic—lose one turn."

When a player lands on an exam space, he must take an exam card from the card pile corresponding to the license level he is trying to upgrade to. After three cards have been collected by one player, he must "take the exam." All three questions must be answered correctly to pass the exam. Answers can be checked against the answer sheets. If the exam is passed, the player moves up (upgrades) to the adjacent exam space on the next license level. If the exam is failed, the player remains on the same level and must collect another three exam cards.

The first person to progress through all levels to obtain the Extra-class license wins!

Novice, General, Advanced, and Extra-class questions are included. For a less advanced game, the Novice cards can be used exclusively for all license levels.

Kantronics, Inc., 1202 E. 23rd St., Lawrence KS 66044; phone (913)-842-7745. Reader Service number K13.

NEW COMMUNICATIONS RECEIVER FROM NATIONAL RADIO

National Radio now offers the latest version of its Model HRO-600 high precision/performance solid-state general-coverage communications receiver, conceived for applications requiring wide frequency coverage, high stability, sensitivity, and selectivity. The frequency stability of this professional receiver, over the temperature range of 0° to 50° C., will drift less than one part in one million, and, under normal operating conditions, it can be expected to drift less than one part in one hundred million. The receiver's fine-tune mode, using the Model 602 plug-in module, permits tuning to a fraction of 1 Hz without any loss of stability.

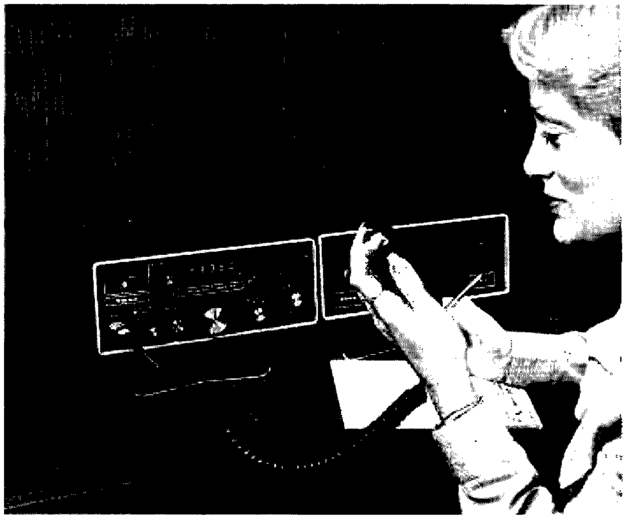
The HRO-600 was originally designed and built to the exacting requirements of the International Maritime Standards. With its versatile plug-in modules and accessories, the Model HRO-600 becomes a custom receiver designed to meet users' specific needs at the lowest cost. The manufacturer states, "The HRO-600 is unmatched in performance and versatility in its price range."

The receiver's excellent rf selectivity from 16 kHz to 30 MHz is achieved by a built-in tunable preselector. Depending upon the plug-in module selected, the receiver will operate at any frequency between 10 kHz and 30 MHz in any of the following reception modes: AM, CW, SSB, FSK, and FAX.

The basic applications of the HRO-600 include: commercial communication, ship-to-ship, ship-to-shore, ground-to-air, frequency/time measuring, process control, laboratory instrumentation, military, paramilitary, international monitoring, limnology, etc.

The HRO-600 meets applicable military standards as to shock and vibration, has an operating temperature range from 20° to +55° C., measures 5¼" high x 17" wide x 15½" deep, and is provisioned for self-supporting rack mounting. The approximate weight is 40 lbs., available from stock, FOB factory.

For additional information, write or call Robert Reeves, Sales Manager, *National Radio Company, Inc., 89 Washington St., Melrose MA 02176; phone (617)-662-7700.* Reader Service number N23.



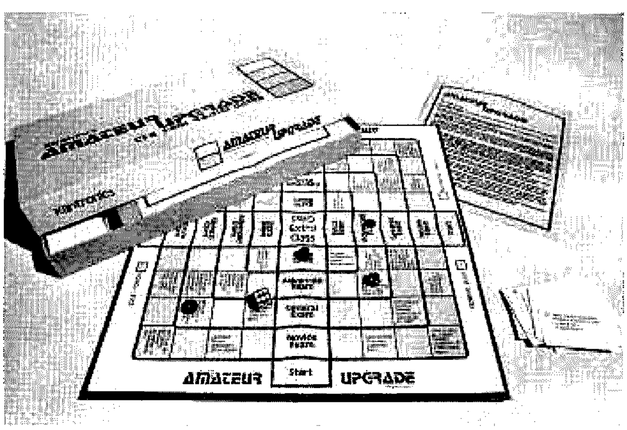
The Astro 150 from Swan.

SWAN'S ASTRO 150 TRANSCEIVER

Swan Electronics Corporation has announced its newest entry into the amateur radio market with the introduction of the Astro 150 transceiver, featuring microprocessor control and memory.

The new solid-sate transceiver, with its microprocessor control, provides more than 100,000 digital-controlled frequencies and variable rate scanning (VRS). VRS is a dramatic new method of tuning which provides ease and accuracy and works in conjunction with hand-held microphone scanning. With microphone "up" and "down" pushbuttons, the Astro 150 can be tuned in accurate 100-Hz steps or at a fixed rate scan. VRS is a supplement to the Astro 150's conventional tuning knobs.

The compact new radio also has additional features which include 235 Watts input power, full and semi break-in CW, narrowband CW filter, expanded frequency coverage, and microprocessor-controlled frequency memory.



"Amateur Upgrade" game from Kantronics.

National Radio's latest version of the HRO-600.

The Astro 150 will be sold through Swan's worldwide network of dealers. For further information, contact Gary Pierce at *Swan Electronics Corporation, 305 Airport Road, Oceanside CA 92054; phone (714)-757-7525.* Reader Service number S44.

METZ COMMUNICATION'S AMATEUR ANTENNAS

Metz Communication Corporation has broad experience in producing mobile-type antennas. However, until recently, the company has concentrated its sales efforts in the commercial land mobile and marine radio markets. Now Metz has entered the amateur marketplace with mobile antennas for the 10-meter, 2-meter, and 70-cm bands. I installed and operated the 2-meter version, the Mobile 2, in preparation for this review.

The commercial heritage of the Metz amateur antennas is readily apparent. Instead of the usual plastic tube to protect the base loading coil from the weather, the Metz coil is housed inside a machined stainless steel cylinder. This cylinder, in turn, is filled with epoxy to completely encapsulate the coil . . . no more worries about a leaky base coil.

The tapered stainless steel whip is held in place by a metal ferrule that is (would you believe?) gold-plated to prevent corrosion. Overall, the construction of the Metz Mobile 2 is so rugged that it will probably still be going strong when you and I are long gone.

The Mobile 2 is designed to operate as a half-wavelength antenna on the 2-meter band. This design makes the antenna a bit shorter than the more familiar 5/8-wavelength 2-meter antennas. I consider the reduced length a plus; in my case, it made the difference between being able to mount the antenna on the car roof (the best location) and being relegated to the trunk lip (for fear of bashing the whip against the garage door).

In operation, the Mobile 2 is a breeze. When cut for lowest swr in the center of the 2-meter band, it's possible to operate from 144-148 MHz with an swr of 2.5:1 or better. Of course, if you work primarily in one end of the band or another, you can optimize the performance for that portion of the spectrum.

I found the Metz to be equal to or better than my 5/8-wave antenna in every respect. Additionally, the completely weatherproof design of the Mobile 2 means that leaking and condensation around the coil are never going to be a problem; you get full performance even in the worst weather. The Mobile 2 is rated at 200 Watts for those who need the extra punch of a linear amplifier. Several mounting styles are available in addition to the excellent magnetic mount I used.

For those who demand quality construction in everything they own, the Metz antennas are going to be tough to beat. *Metz Communication Corporation, Corner Routes 11 and 11C, Laconia NH 03246.* Reader Service number M100.

Jeff DeTray WB8BTH/1
Assistant Publisher

A NEW CONSUMMATE DIGITAL VOLKSMETER

Non-Linear Systems' new Model LM-353 3½-digit digital Volksmeter was designed to include numerous advanced state-of-the-art features. The LM-353 is packaged in a small 1.9-inch-high by 2.7-inch-wide by 4-inch-deep attractive plastic case. It weighs only 9.2 ounces.

Basic functions include ac and dc volts, Ohms, and ac and dc milliamperes. Full-scale ranges are 1, 10, 100, and 1000 volts, 1, 10, 100, 1000, and 10,000 kilohms, and 1, 10, 100, and 1000 milliamperes.

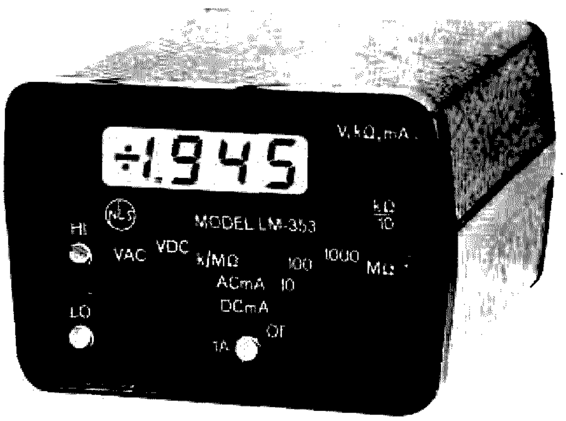
In addition, a low-Ohms capability is present which provides for in-circuit test of resistive components. It is particularly useful for in-circuit test of resistors shunted by semiconductor devices because the low compliance voltage provided does not turn on the semiconductor.

The low-Ohms function adds other capabilities to the meter. It can be used to increase the sensitivity of the voltage ranges by a factor of 10. It provides a 0.1-kilohm resistance range having 100 milliohm resolution. In addition, the milliamperes function is enhanced in two ways. First, a .1-milliampere range is available. Second, the voltage drop across the internal current shunt is reduced by a factor of 10. Measurements from 100 nanoamperes to 100 milliamperes can be made in this mode.

The LM-353 utilizes an LCD display. Replaceable AAA-size batteries allow up to 100 hours of operation. Standard features include auto polarity, decimal location, input overload protection, and automatic zeroing.

Options include a tilt-stand case for bench use and a panel-mount flange case for installation into equipment. A 45-kV high-voltage probe and leather carrying case are also available.

The complete NLS digital Volksmeter line is sold through a worldwide network of leading electronic distributors. The Model LM-353 will be available from distributors in July. *Non-Linear Systems, Inc., PO Box N, Del Mar CA 92014; phone (714)-755-1134.* Reader Service number N22.



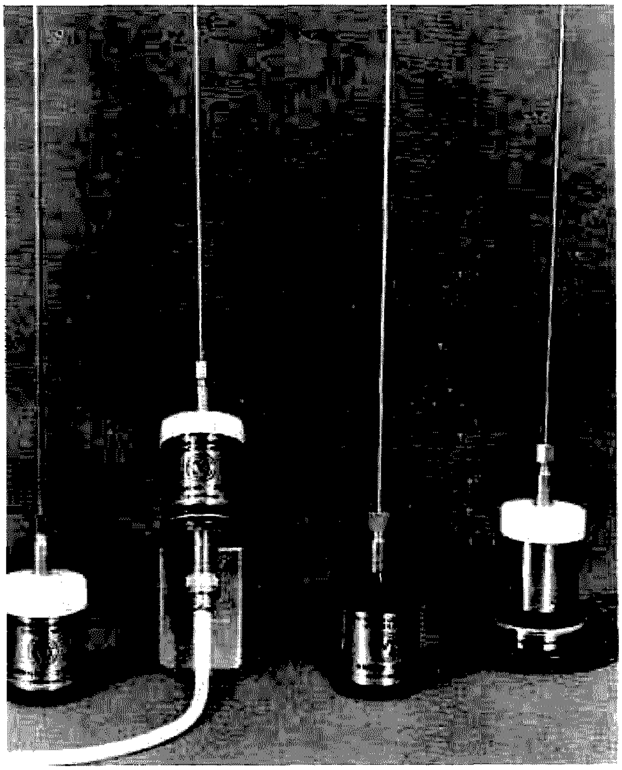
Model LM-353 digital Volksmeter from Non-Linear Systems.

NEW 300-WATT DRY RF LOAD RESISTOR

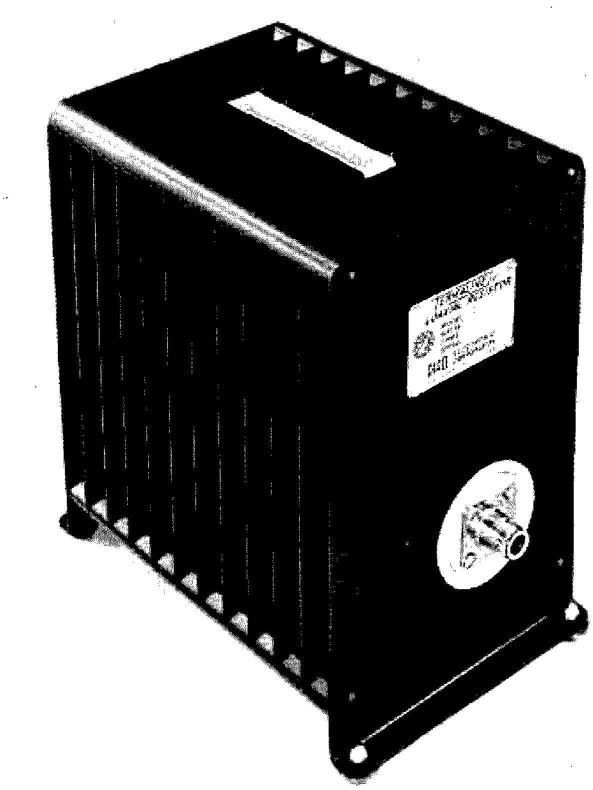
The new Bird model 8173 TERMALINE® dry high-power coaxial load is designed for 50-Ohm rf-line and system termination during design, test, and alignment. At 300 Watts continuous duty, it complements the present Bird Dry Loads group ranging from 2 Watts through 600 Watts. The group, with its rugged construction and air dielectric (no liquid coolants), now includes 2-, 5-, and 10-Watt loads with fixed input connectors, and 25-, 50-, 100-, 150-, 300-, and 500/600-Watt loads with Quick-Change connectors.

The use of Bird QC Quick-Change connectors offers unsurpassed flexibility; a choice of any common rf connector either at the time of order or in the field eliminates adapters and degradation of performance.

Available from *Bird Electronic Corporation, 30303 Au-*



Amateur mobile antennas from Metz.



Model 8173 Termaline from Bird.

rora Road, Cleveland (Solon) OH 44139. Reader Service number B10.

CDE INTRODUCES TWO NEW ANTENNA ROTOR SYTEMS

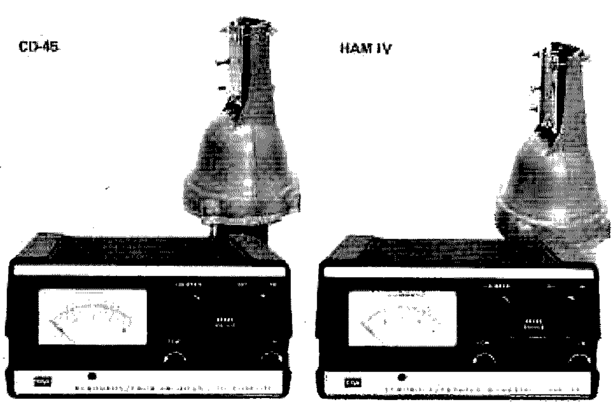
Two new models of high-performance antenna rotor systems, the Ham IV™ and the CD-45, have been introduced by Corneil-Dubilier Electric Corporation, Newark NJ.

The new Ham IV is designed for large communication antenna arrays up to 15.0 sq. ft. wind load area when tower-mounted. Highlights of the Ham IV include power braking, machined steel drive gears, dual transformer circuitry, and other design features that make it "the engineered choice" for serious communicators.

The new CD-45 accommodates antenna arrays up to 8.5 sq. ft. wind load area when mounted in a tower and features a professionally-styled control unit, illuminated metered readout, all-steel drive components, automatic disk braking, and more.

Both the Ham IV and the CD-45 operate at safe low-voltage control levels with reliable snap-action rotational controls for accurate, trouble-free operation.

For more information, write Leonard Sabal, *Cornell-Dubilier Electric Corporation, subsidiary of Federal Pacific Electric Corporation, 150 Avenue L, Newark NJ 07101; phone (201)-589-7500.* Reader Service number C143.



New antenna rotor systems from CDE.

ANTECK MT-1 MOBILE ANTENNA

Improved conditions on the HF DX bands has stirred increased interest in mobile operation on those frequencies by many amateurs. In mobile operation, the antenna is even more important than it is in fixed installations. For one thing, if you've got an inefficient antenna at home, you can always help to make up for its shortcomings by running more power. However, while there are a handful of mobile kilowatts around, most amateurs have to be satisfied with the output from their transceiver, usually in the 100-Watt range.

So, for effective mobile operation, an efficient antenna is of prime importance. It should also be easy to install and tune, weatherproof, and allow band changes without having to change coils. The new Anteck MT-1 certainly meets those requirements and, when properly installed and tuned, should provide a high degree of performance on the HF bands.

The frequency coverage of the MT-1 is 3.5 to 30 MHz, making it perfect for use on MARS and other non-amateur frequencies (in addition to the 10 through 80-meter amateur bands). Its power handling capability is 750 Watts PEP. The MT-1 consists of three main assemblies: mast or base section, loading coil, and whip. The overall length of the mast section and loading coil is 60 inches and the diameter is approximately 1 inch. The total antenna length is 116 inches at 3.5 MHz and 92½ inches at 30 MHz. The antenna is center-loaded on all frequencies except 29 to 30 MHz, where it works as a quarter-wave vertical.

Properly mounted and tuned, the MT-1 will display the vswr/bandwidth shown in Table 1.

The loading coil is tuned from the base of the antenna, using a non-inductive plastic rod which is attached to the base of the whip assembly and extends down into the bottom mast section. The antenna comes with a handy chart that correlates the numbers on the antenna's tuning scale to frequency. To set the antenna for a particular frequency, loosen the knurled nut in the slot in the base section four turns and push the tuning rod to the middle of the base tube so that the tuning rod will move freely without binding. Then set the top of the nylon collar to the position called for on the tuning chart for the frequency in use and retighten the knurled nut. That's all there is to tuning the Anteck MT-1.

The MT-1 mobile antenna is manufactured entirely in the United States using only the best-quality military-standard materials and components. Its three-piece modular construction (base section, loading coil, whip assembly) makes for ease of repair or replacement if damaged. There is a 90-day warranty. Factory service is available.

The net price for the MT-1 mobile antenna is $119.95. *Anteck, Inc., 239 Cedar Street, Box 543, Jerome ID 83338; (208)-324-3400.* Reader Service number A80.

Morgan W. Godwin W4WFL
Brattleboro VT

Band	*Vswr*	*Bandwidth*
80 meters	*Less than 1.2 to 1*	*25 kHz**
40 meters	*Less than 1.2 to 1*	*50 kHz**
20 meters	*Less than 1.2 to 1*	*300 kHz**
15 meters	*Less than 1.5 to 1*	*150 kHz**
10 meters	*Less than 1.2 to 1*	*500 kHz**

*Table 1. *From resonant frequency.*

MICRONTA 12-VDC 8-AMP POWER SUPPLY

Now available from Radio Shack is a new power supply that converts standard 120 V ac house current to 12 V dc at up to 8 Amps output for powering high-power auto sound equipment, mobile CB transceivers, and amateur radio equipment at home.

The Micronta 12-volt 8-Amp power supply includes a heavy-duty transformer and 35-Amp bridge rectifier for handling high current demand devices. Filtered output reduces "hum," and ripple is less than 2 volts peak-to-peak with a full 8-Amp load, according to Radio Shack.

A built-in manually resettable circuit breaker protects the supply and your equipment from damage. An LED indicates power on.

Manufactured in Radio Shack's own USA factory, the power supply is housed in a metal cabinet with rubber feet. Size—3-3/4" x 8" x 5-5/8".

The Micronta 12-volt 8-Amp power supply is available exclusively from participating

Continued on page 174

DX

Chuck Stuart N5KC
5115 Menefee Drive
Dallas TX 75227

NOVICE CORNER

This month we want to pass along a little QSL advice that is aimed not only at the newcomer but to a lot of the oldtimers as well.

If you work a station, such as a DXpedition, several times on different modes at different times, please do not place a card for each contact in an envelope addressed to the QSL manager and include only one SASE.

Because there are often several logbooks involved and several different people or groups handling the QSLing chores, you will stand a much better chance of getting a fast return if you include a separate SASE for each QSL card. If the extra expense is too much to bear, then you really don't need the extra cards.

While we are on QSLing, we will remind you again to always use GMT/UTC time on your card including the date, be sure that your call appears plainly on the report side of your QSL, and to always include a self-addressed, stamped envelope when sending a card to a QSL manager. When sending a card overseas, either direct or to a foreign QSL manager, include a self-addressed envelope along with a dollar bill, foreign mint stamps, or sufficient IRCs to prepay the return postage.

CARIBE DX ASSOCIATION'S PLANS

The Caribe DX Association's Alex Kasevich W1CDC is presently in the process of engineering a large DXpedition to some rare place on the globe. All interested persons who feel they meet the requirements listed should apply for an interview. The time window for this adventure is August, 1980; exact dates will be made available when government legalities and logistics permit.

They have a large seaplane with a pilot and a co-pilot at their disposal. A large manufacturer of amateur equipment has endorsed their intentions by the loan of some top-of-the-line ham gear.

All persons who apply must hold a current amateur radio license, General class or higher; they must also have a doctor's endorsement indicating that they have no physical restrictions that could be affected by extreme heat, sun, humidity, sea/air sickness, possible physical exhaustion, and insect bites. All members shall be proficient CW/SSB contest-style operators and must have a secondary ability to contribute to the expedition in the following categories: 2 persons with some paramedic training; 1 doctor; 2 cooks; 1 navigator; 1 antenna specialist; 1 electronics (solid-state) technician; 1 mechanic, gasoline generator maintenance.

All members of the expedition must be able to swim and have some climbing ability.

These requirements have been made not to discourage anyone from taking part, but to ensure the safety of all members and make the DXpedition a success. It must also be clearly understood with all members that there is always the possibility of hidden dangers in pulling off a trip of this magnitude. I'm sure all of you will have various questions about this subject, and they will be answered in the best interest of all parties concerned.

Please send your reply with your remarks, phone number, and best time to contact you to: The Caribe DX Association, c/o Alex M. Kasevich W1CDC, PO Box 93, East Glastonbury CT 06025.

HEARD ON THE BAND

That 4W2AA being heard from time to time appears to be I2YO who travels to Yemen on a regular although infrequent basis. QSL to I2MVS.

GJ2LU is the official QSL manager for any Isle of Jersey stations.

PY1RO is the first DX station ever to make WAS on 160 meters.

A recent article in the Russian *Radio* magazine notes a decision by the USSR State Commission on Radio Frequencies to allow amateur activity between 1850 kHz and 1950 kHz. Although no date was given, it seems definite that you should be hearing the Russians on 160 meters any day.

Anyone wanting to learn more about the action on 160 meters should drop a note to W1BB along with an SASE and request a copy of Stu's very informative bulletin.

The African swing by N6VR and WA6VNR netted some 3000 contacts from C5ABX/C5ABZ and 2200 from /6W8. They had a 5T5 permit, but time and funds ran out before they got to Mauritania. QSL to 48 South Chestnut Street, Ventura CA 93001.

Slim has been pulling overtime lately what with the good band conditions and cheap airline rates. If you worked any of the following, then know that you have met Slim himself: 6B1B, J1A, 7O1AA, 9N1AB, BY1USA, CR9CB, XZ2BC, KL8AA, and, of course, VR0M from Maiden Island. Being the bashful sort, Slim generally prefers CW, but on occasion he can be found on the phone bands. If you hear the generator whine, you know it's Slim.

SV9JI on Crete has a weekly schedule with W2TDQ on Tuesdays at 2100Z on 14288 kHz.

Lloyd and Iris Colvin, of YASME DX fame, report that with the end of their recent West Indies swing, they have held 104 different callsigns, visited 135 countries, and have made over 500,000 QSOs. They have a QSL file of over 250,000 alphabetized cards, probably the largest collection in the world. *Guinness Book of World Records* is missing out.

A station has been worked on fifteen signing HV2VO and giving his name as Brother Edmund. Said to QSL via I0GPY. This could be the Vatican Observatory station we mentioned a few months back.

Those EJ prefixes heard over the May 18/20 weekend were special calls issued for operation by several GI stations from Inishmurray Island. QSL to GI4FUM.

VR6HI was number 100 on 160 meters for PY1RO.

VP8SU from South Georgia can usually be found with WA2JUQ in a list-type operation every Tuesday/Wednesday/Friday on 14240 kHz around 0100Z. QSL to G3RCA.

After much waiting, the necessary documentation was forwarded to ARRL Headquarters and they are now accepting HZ1BS/8Z4 cards for DXCC credit.

For some time now, rumors have been thick concerning an upcoming Franz Joseph Land effort by some of the UA/UK types. Along this line, UA1OE advised W4ORT that there would be something coming this July. UK1ZAA advised KH6GI that UK1PAA was the only station on FJL and it was crystal controlled on 14030 kHz. Listen for Franz Joseph Land to be activated . . . someday . . . maybe.

9N1BMK was true blue. QSL to his home call JA8BMK.

YU2DX returned home from the Sudan where he was doing some educational work in the electronic field. A radio club has been organized in Khartoum and the club call is 6T1YP. Both 6T1YP and 6U1DX can be QSLed to YU2DX. Other new calls being heard out of the Sudan lately are ST2FF and ST2MM.

U0CR was Leo UA3CR, part of a seven-man skiing team headed for the North Pole. U0CR counts for the RAEM award.

That linear shipped to Father Dave CE0AE should be in use now and the signal should be much improved. CE0AE can often be found on the various DX nets such as the Family Hour on 14225 kHz at 1500Z or the Afrikaner Net, 21358 kHz from 1830Z. Overseas commercial interference has forced the Afrikaner Net to move up from its normal 21355-kHz spot.

4U1UN has moved its location to the 48th floor of the Secretariat at UN Headquarters in NYC. They still have only dipoles and a vertical, but they are working on permission to install a beam.

3B8DA has been inactive most of this year trying to clean up the backlog of some 20,000 cards received as the result of some of his recent operations.

The VR6HI operation from Pitcairn Island by ZL1AMO and ZL1ADI produced an almost unbelievable QSO total of better than 33,000 contacts spread out over six bands. The fewest contacts came on 160 meters with 170, and the most, 10,885, were made on 10 meters. During this same period, VR6BJ and VR6DX from the *Yankee Trader* made 753 and 1100 QSOs respectively. 193 of VR6BJ's contacts were on RTTY. These three operations should have dropped VR6 well down on the needed list.

New officers for the Mile-Hi DX Club are Roger Preece WB0RTZ—President, Bob Pierce WB0OGJ—VP, and Joe Hart WB0HAD—Secretary/Treasurer.

SV1JG expects to be on Rhodes in the Dodecanese group this summer signing SV1JG/SV5. Under the new call allocation scheme there in Greece, SV5 is Dodencanese and SV9 is Crete. This was done no doubt to aid the deserving DXer in his never-ending search for a new one.

Several VE types are working on the necessary permission to activate Sable Island during July or August. They have authorization from the DOC but were awaiting other required documents before firming up the details.

As this column is being written, the YV0AA DXpedition is going hot and heavy giving out a new one to deserving DXers all over the world. While we realize the DX bands are crowded these days, it seems a little ridiculous to spread the calling stations out over a forty kHz section of the band. Listening from 14200 kHz to 14240 kHz makes that section of the band useless for any normal DX activity and certainly does little to

enhance our image among the sizable segment of our fellow amateurs who somehow fail to see the need to bring the normal day-to-day activities of amateur radio such as skeds, ents, SSTV, etc., to a screeching halt while we deserving ones strive to exchange signal reports with a temporary station located on an uninhabited island covered solid with birds and their natural residue. How anyone could fail to understand this and start complaining about *those DXers* is certainly beyond us. Transmitting below the American phone band and listening up is the only way for many DX stations to be able to make any contacts with USA stations, but it seems that listening over, at most, a fifteen or twenty kHz portion of the band should be sufficient. How do you feel about this practice?

Still nothing heard from China but a few phonies. A usually reliable source from Europe reports that one of the eastern Eurpean countries will be sending a team of radio technicians to help the Chinese develop knowledge in that area. Some among this team will be amateurs ready to demonstrate the finer points of amateur radio should the opportunity arise. The source seems rather definite that something will be heard this fall.

There are serious discussions going on between some of the biggest of the big-gun-type DXers concerning a concentrated effort this summer to wipe Mt. Athos (SY) from the face of the most needed lists. More information will come as plans gel.

If you think some exciting times can't be experienced in amateur radio, then you obviously were not in on the recent 1S1DX operation from Spratly. The initial landing was planned for Amboyna Cay. When the Spratly crew got close, they could see that there were people on the island and they cautiously came inside the reef to a point some 300 yards offshore. Through binoculars it was easy to detect military personnel in black uniforms grouped around what appeared to be weapons. One of the military types began signaling with semaphore signals, but unfortunately no one in the crew understood the signals. As the crew moved in closer, the message became somewhat clearer as four warning shots were fired across their bow. Feeling at this point they were not wanted and seeing that they could easily be blown out of the water with little effort, the little group again headed out to sea.

After this initial problem, the group returned to Brunei, regrouped, and decided to make another run, but this time to Pearson Reef, located some eighty miles northeast of Amboyna Cay and hopefully less inhabited since it had an elevation of only three feet above high tide. The approach to Pearson Reef showed how when it rains, it pours. Not only was the small reef occupied, but there were buildings and small craft around. Fortunately, the group had selected a third alternate, which they now headed for. It was from this spot, Barque Canada Reef, a sand bar some 150 feet in length, that the much-delayed, constantly-in-danger 1S1DX operation finally took place.

Most of the sixty hours stay on Barque Canada Reef was spent operating, often with more than one station on the air. Ten, fifteen, and twenty netted some 13,300 contacts with about half coming on fifteen. Phone seemed to result in a higher QSO/hour rate, so the concentration on this mode resulted in a 77%/23% phone/CW split. Forty percent of the contacts were with Japan, thirty-five percent were with stateside, fifteen percent were with Europe, and the remainder were scattered around the world.

QSL to Harry Mead, Box 85, Round Corners, 2158 Australia. Expenses were excessive due to the problems and any financial aid can go to K2TJ or via the Northern California DX Foundation.

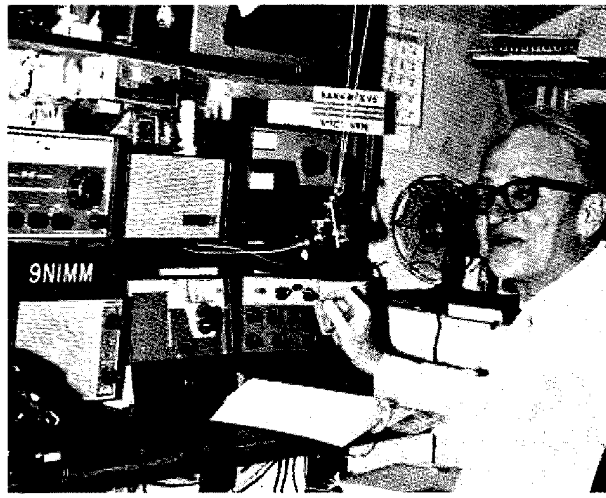
The recent volcanic activity on St. Vincent Island in the West Indies found VP2SQ providing emergency communications for the local authorities. He is reported as having phone-patched Prime Minister Cato to other islands when there was a need for quick communications. It is this type use of amateur radio that we have been trying to demonstrate to the Third-World nations preceding WARC 79.

Rubin WA6AHF and his XYL Ferne have had to curtail their YASME QSLing efforts on the recommendation of their doctor. Although giving up the YASME effort, they will continue to handle cards for those stations they are QSL managers for.

Some EP stations are again being heard on a sometime basis, although the situation is far from being settled in Iran.

That 9N1YU being worked a few months back is reported by HS1ABD to be a true-blue type used by a Yugoslav mountaineering group in the Mt. Everest area.

S2BTF continues to show from Bangladesh on the weekends working a list-type operation. Look for him on 14226 kHz Saturdays from 1300Z and Sundays from 1200Z. QSL Peter via Box 108 in Dacca.



Father Marshall D. Moran, S.J., Kathmandu, Nepal, better known around the world as 9N1MM. Father Moran has been a regular fixture on the DX bands since 1961.

9N1MM has been keeping a fairly regular schedule around 14243 kHz after 0100Z. QSL to Ed Blaszczyk N7EB, 12802 Sun Valley Drive, Sun City AZ 85351. Ed has been handling Father Moran's QSL duties since 9N1MM first came on the air in 1961. Ed, who has also held the calls W3KVQ, W2KV, and KX6EB, asks that we remind those needing a 9N1MM QSL to please enclose an SASE. It makes the job much easier.

As we have often mentioned, it's usually easier and cheaper to just enclose a dollar bill (green stamp) with your QSL when a direct airmail reply is required than to go through the hassle of buying IRCs or foreign mint stamps. We also mentioned that there were situations when it was best not to enclose money with a QSL going overseas. A letter from Mansur AP2MQ brings up a case in point. Incoming mail is often checked by the Pakistani postal authorities, and since the importation of foreign currency is illegal in Pakistan, this often leads to embarrassing circumstances for the amateur to whom such mail is addressed. It is always best to follow the QSL instructions given by the DX station. In the future, do not send green stamps to Pakistan.

There is a report that the number of complaints to the FCC concerning the Russian "woodpecker" have risen sharply. It is sometimes a bit frustrating to report such interference and realize that the person on the other end has never heard of the "woodpecker." Check last month's column for the telephone number of your closest FCC monitoring station. Keep them advised of the "woodpecker's" activity and someday the "woodpecker" will vanish. Some claim that if we had reacted immediately two years ago, he would now be only a bad memory.

A couple of months back we mentioned the possibility of a Swedish group operating from Albania. The expected callsign was mentioned as being ZA5T. Late word on this operation has been zilch, but if anything new develops, we will certainly pass it along.

Those new Pacific area prefixes still seem to be causing trouble. It was sure easier to remember when KM6 was Midway, KW6 was Wake, etc. To help you learn the new designations, we will list them again:

KH1	Baker, Canton, and Howland
KH2	Guam
KH3	Johnston
KH4	Midway
KH5	Kingman if K suffix, Palmyra if not
KH6	Hawaii
KH7	Kure
KH8	American Samoa
KH9	Wake
KH0	Northern Marianas

UK0YAH is being worked around 14050 kHz after 1800Z. We mention this as a reminder that Soviet Siberian stations whose suffix begins with a Y are located in Tana Tuva in rare Zone 23.

The Brussels Millennium Award is available to anyone working ten of the OS prefixes on at least two bands. Send log data and three IRCs to Brussels Millennium Award, PB 1000, B-1040, Brussels, Belgium.

Continued on page 172

A Visit to Antenna Specialists

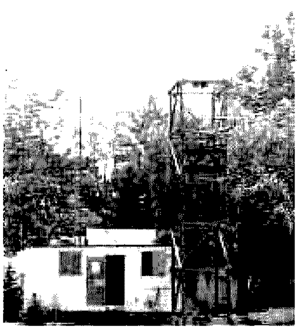
—Wayne tours the test range

Wayne Green W2NSD/1
Editor/Publisher

The science of measuring antenna performance as part of the design process has come a long way in the last twenty years. A recent visit to the Antenna Specialists test site in northeastern Ohio brought back memories of my past visits to other such sites . . . and the enormous changes in test equipment and procedures which have come about.

Let me tell you about my visit to Antenna Specialists' test site.

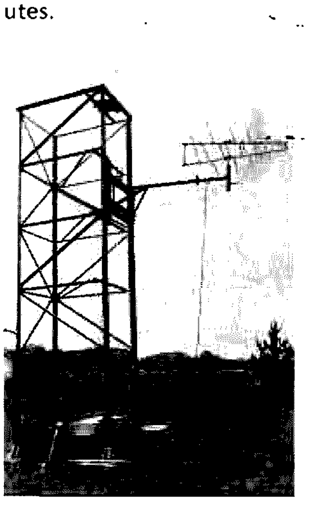
Sherry and I were met at the Cleveland airport by Al Dolgosh K8EUR, who led us out to the test site, over an hour's drive away. There we met Dick Leach WA3HSE/WB8ZAA, Tom Baker K8MMM, and Rick Davis K8DOC, the test site team. The lab was set up in a trailer with a reference dipole nearby. The test antennas were set up on a platform a couple hundred feet away.



This is the trailer with the laboratory equipment for running the antenna field strength tests. The tower to the left is for a ham station in the house to the rear of the trailer. It's nice to have a ham living right there to watch out for the test lab equipment.

Was it only a little over twenty years ago that I visited a top manufacturer of ham antennas and watched them run tests on a long two-meter beam, measuring the signal strength every few degrees and writing down the figures? Today, this is all automatic. Today, they can run tests in a few minutes that used to take days, thus making it possible to design much more effective antennas. When you can make a small change in the antenna design and measure the results of that change quickly, it is relatively simple to explore many more variables for optimum performance.

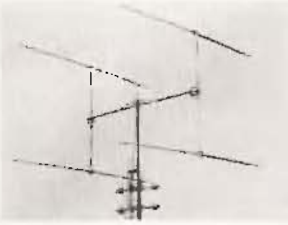
With modern equipment at a test site, it is possible to measure the vertical and horizontal radiation characteristics of an antenna as well as the frequency response—all in a few minutes.



This is a small tower right beside the mobile lab. It is designed for mounting the transmitting antenna for the tests. Notice that this antenna can be raised and lowered to get the optimum vertical pattern of radiation.

You're looking at an enormous investment in test equipment. This gear is made just for labs of this nature and allows the automatic testing of the antennas, complete with the graphing system on the right.

Here Tom is showing the reference antenna which he set up by the receiving platform. This is a simple reference dipole.



The tests this day were going to be run on the Antenna Specialists 44-element beam.

This is the mechanism which is used to hold up the antenna to be tested and to turn it in time with the graph in the lab. The tilting gears allow the antenna to be brought down for mounting or changes. The whole mechanism is on the track and can be moved toward or away from the lab.

That's Tom on the left in back, Al on the right in back, Rick on the left in front, and Dick on the right in front.

The test platform is being rotated so that the other two 11-element yagi antennas can be mounted on the boom. The rotating is all done remotely from the trailer.

Al Dolgosh K8EUR, who organized everything for us.

Rick Davis K8DOC, who is lucky enough to live at this extremely low-noise test site, complete with his ham rig and a good beam.

Tom Baker K8MMM.

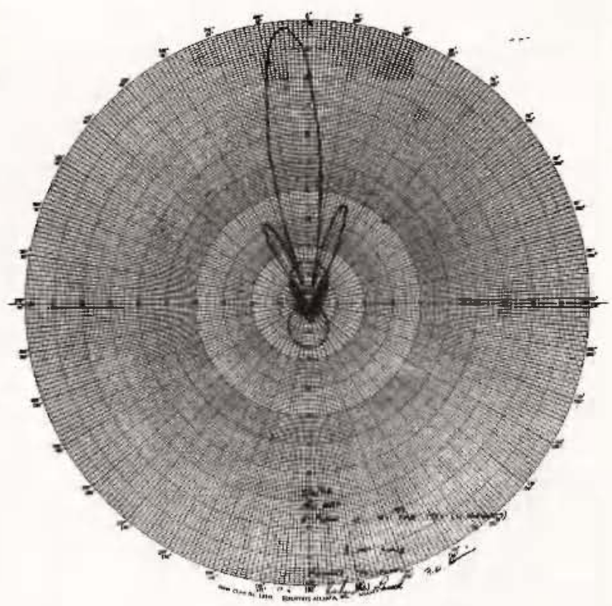
Dick, Al, and Tom get the beam onto the boom and tightened in place for the tests.

Here's the beam all set up and raring to go, about 300 feet from the source site.

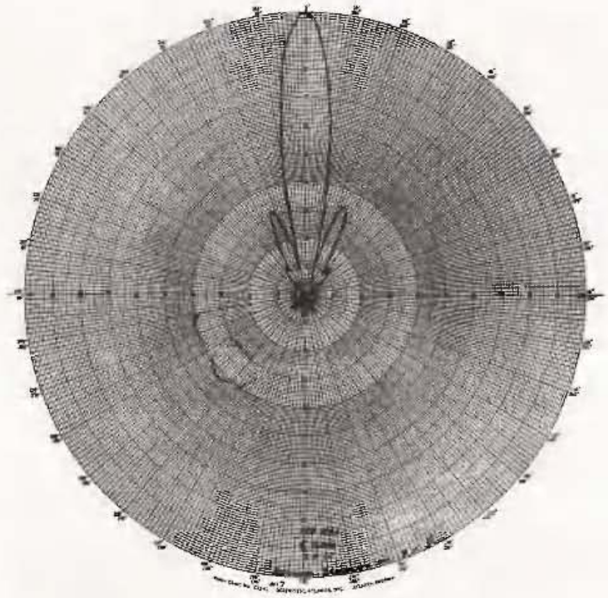
Dick runs the antenna array through a complete rotation, watching the pen on the chart as it traces the pattern of the beam.

Here you see the finished pattern of the array. How about all that gain! And you surely can null out the interference with that incredible front-to-back ratio.

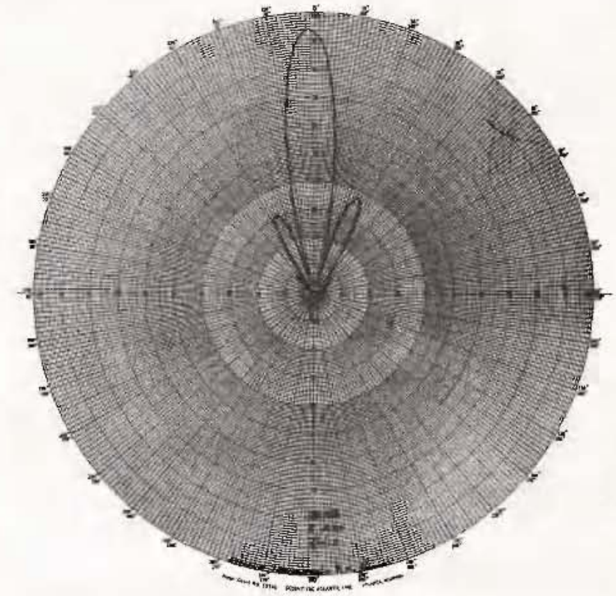
Over to the right of the test platform I found these tracks. They are for rotating cars to measure the radiation patterns of mobile antennas mounted on different parts of different cars. They drive the



This is the pattern drawn by the chart recorder for the 44-element array on 146 MHz with the comparison from a reference dipole (dotted line).



This is the same array, but measured at 148 MHz. Not a lot of difference—certainly none that you would ever notice in use.



One more run was made with the array on 144 MHz to make sure that it was capable of working over the entire 2m band. It takes a lot of careful design to make a high-gain array such as this work over a four-megahertz bandwidth with as little loss as this one shows.

car with the test antenna onto the tracks and then rotate the whole works to get the pattern. It's quite a complete test site facility.

After the test, Al had the 44-element array boxed up and shipped to the 73 lab. It took longer than we figured to get it airborne, due to some serious delays in getting a promised tower. The antenna puts out one whale of a signal, as you can see from the pattern on the graph. ■

Reader Service—see page 211

Secrets of Guyed Towers

—put 'em up and keep 'em there

Trade real estate for security.

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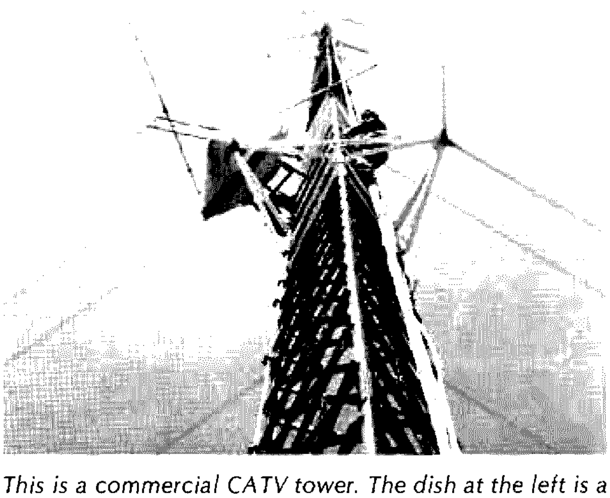
Ridgway PA 15853

There is an old saying among hams that "if it stays up, it's too small." Who among us can truthfully say that on those long winter days we haven't spent a moment or two thinking how great it would be to have a five-element, 40-meter beam in the backyard, fed with 2 kW, and a hundred feet above ground? Dreams? Well, maybe. But it's sure that whatever your idea of the "ultimate" antenna array, it's got to be held up by something.

Since the best antenna farm starts with the support equipment, let's look at the best antenna support: the guyed tower. A tower is like a chain, in that it is only as strong as the weakest link. Self-supporting towers are linked to Mother Earth at one point—the base. Guyed towers, on the other hand, have four support points over which to spread the load—three anchors and the tower base. The penalty for this added strength is the larger chunk of real estate required to accommodate the guy-anchor supports.

In planning to erect a tower, there are some decisions and compromises to be made. One must be realistic about what will adorn the top of the tower and the worst case of wind loading that can be anticipated. The antenna load must be added to the wind loading to determine the total load environment in which the tower will be operating. Most antenna manufacturers publish load figures as part of their advertising, or will furnish data on request. The same goes for tower makers, and they also have data about



This is a commercial CATV tower. The dish at the left is a microwave receiving antenna. Mounted below it is a "star mount" anti-torque guy wire/frame system. The tower height is 500 feet.

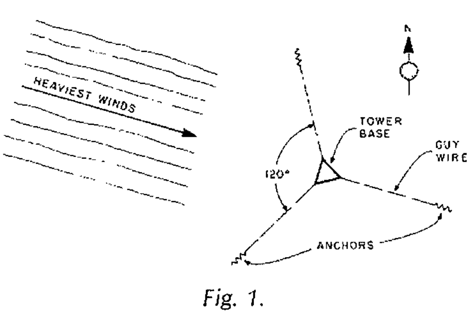


Fig. 1.

Here is a commercial tower anchor and "eyeplate." Note the length of guy wire laced through the turnbuckles to prevent loosening.

The bottom two guys shown here are attached to the anchor plate and to the "star mount" just below the microwave dish.

wind and ice conditions throughout the country to help in figuring the operating load.

As a rule of thumb, anchors should be placed out from the tower base a distance of between one-half and two-thirds the tower height. For a hundred-foot tower, this means the distance from base to each anchor will be from fifty to seventy-five feet. Since this distance determines the angle of the guys at the tower, it represents a compromise between the ideal one-foot-up for one-foot-out, or guy angle of forty five degrees, and some even sharper guy angle which conserves real estate. These considerations outline the practical limits of tower height.

Other factors which limit tower height are: surrounding objects like houses and trees, sloping terrain, local building codes, and neighbors. Each should be taken into careful consideration since towers are no less expensive to take down than to put up.

Since the load of a tower is in two parts, it is best to look at each in choosing a brand and model of tower. The side load is the force which is supported by the anchors and guy lines. The vertical load is supported by the tower and base alone. Most towers are triangularly shaped, and the wider the spread between the vertical legs and the larger in diameter they are, the greater the vertical load they will hold. Knowing the antenna loading figures and the weather conditions for your area, it is possible to have a tower manufacturer recommend the proper size tower for your needs.

Two last considerations should be figured into the choice of heights. How far will the rig be from the antenna, and what will the cable loss be, compared to the benefit of added height? In addition, who will service the array? It seems that the number of volunteer climbers varies inversely with the height of the work!

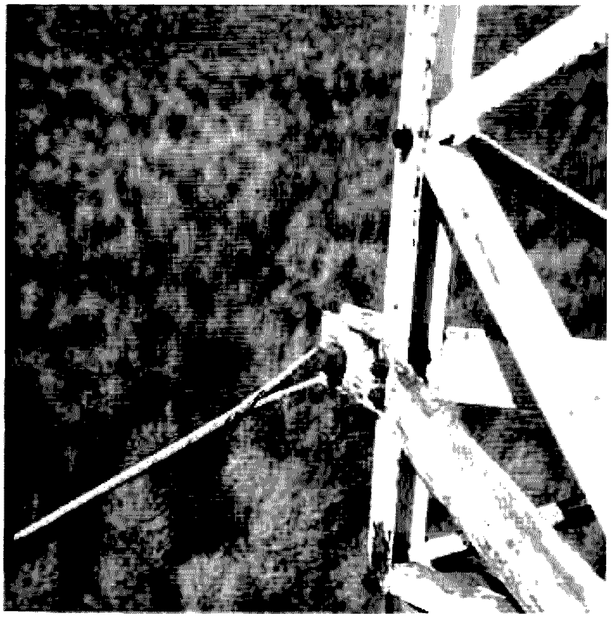
Planning the actual construction is the next step in the process. Survey the land for the locations of the base and anchors. Let's say you come up with a layout similar to the one in Fig. 1.

In this "helicopter" view of the project, we see that the anchors are laid out 120 degrees apart and that two of them are upwind of the tower base. This spreads the worst of the wind loading between two anchors.

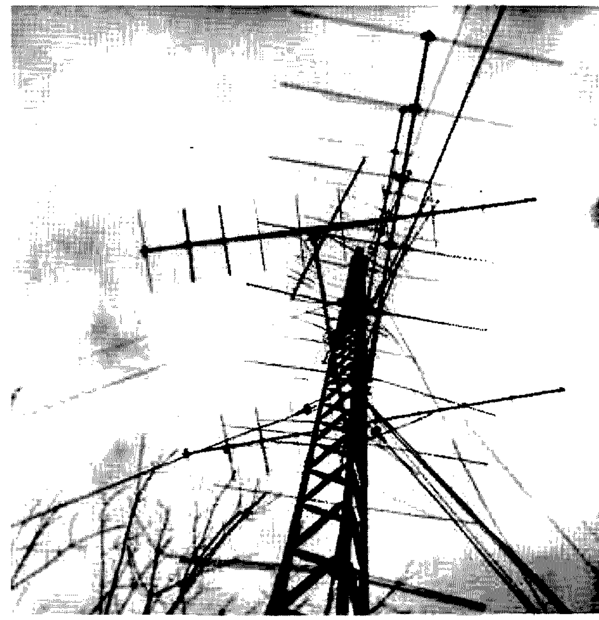
The type of soil will determine what type of anchor should be used. There are screw-type units which don't need a hole but are screwed into the undisturbed earth. These are okay for smaller systems with light loading and with firm to slightly-rocky soil. The other type is the bell anchor which requires that a hole be dug. The bell-shaped bottom of this type of anchor is attached to a long rod which sticks out of the ground after the anchor is placed in the hole. When the bell is struck with a heavy bar, the anchor will spread out and dig into the sides of the hole. The hole is then backfilled using small rocks and well-tamped dirt. These bell anchors hold a larger load since they are bigger at the bottom and deeper in the ground than the screw type.

The tower base also is chosen after considering the type of soil at the construction site. Since the base has to support only the vertical load, it doesn't have to be very deep. It should be down far enough, however, so that frost will not cause it to shift position. Manufacturers' recommendations should be followed here so that a firm footing is assured.

Finally, make a list of the required tools and gear for the actual job. Try to obtain the services of someone who has done similar work before, and rely on his experience. If no hams are around to fill the bill, try the local power or telephone company. Their construction crews routinely handle projects similar to this, and probably will know where you can obtain the ropes, guy/jacks, strain dynomometers, and climbing equip-



Guy wires and preformed wrap-on grips are shown at the tower end. Note that the bolt acts as an axle for the grip. The height is 375 feet.



A Dill tower in CATV service is pictured here. The tower is 100 feet tall, in 10 foot sections weighing about 60 pounds each. The sections are 11 inches on a side.

ment you will need.

Before getting into the actual nuts and bolts of hanging up the tower, it's good to discuss various aspects of safety on the job. Advance planning on paper of each step in the process will allow each member of the crew to familiarize himself with the sequences involved. Line up enough people to do the job, and don't forget that at least one should be experienced. All climbing tools and small hand tools should be in first-class shape. Hardhats are a must for the ground crew, and no one should be closer than twenty feet to the tower base for any reason other than to attach gear to the ropes going up the tower. The auxiliary leg, which sometimes is used to hold the weight of a tower section as it is placed on already erected sections, should be inspected carefully. The combined weight of the leg and section can do considerable damage and injury if they fall.

The Dill tower base rests on a large flat rock two feet down and buried in small rocks and well-tamped dirt.

When everything needed is on hand, the anchors are dug in, and the necessary personnel have been lined up, it is time to pick a day to complete the job. Weather is the main consideration here since to be safe the entire job should be completed in one day. The Flight Service Center at the local airport is an excellent source of weather information, and their forecasts of wind conditions are especially good.

On the morning of the big day, begin by bolting the first three sections of tower together on the ground. Attach to the top of the assembly three guy wires which have been cut to roughly the correct length. Set the bottom of the assembly next to the tower base (which is in the ground) and lay out the guy wires down the length of the three-section assembly, over the base, and straight out beyond. With one man holding down on the bottom to make it dig into the ground, and three more pulling at the guy wires, have the remaining people lift the top of the tower and raise it over their heads. As they walk toward the base raising the tower above them, the guy wire attendants will steady the tower side-to-side while at the same time helping to pull the tower vertical.

When this move is completed, the tower should be standing on the ground next to the base, stabilized by the guy wires. Next, lift the tower onto the base and install the three bottom bolts. Attach the guy wires to their respective anchors, and, using a spirit level, a plumb bob, or other sighting line, snug up the guys until the tower is exactly vertical. This operation is important since when later sections are installed, the tower will be put into a bind if it is not

The anchor rod holds three guys using preformed grips. The rod is six feet long and is buried nearly five feet down.

This is a partly installed preformed grip. No tools are needed, and it may be removed for re-tensioning of the guys and easily reapplied.

exactly vertical.

The climbing people are now sent aloft, and the auxiliary leg (or stiff-leg), pulleys, and hand ropes are made ready to raise the next tower section. Since it is very hard for a person to get good lifting leverage while leaning back in a line belt, the ground crew should raise each section while the climbing crew steadies it and guides its placement atop the last section erected.

Remember that during this operation those on the ground should not stand near the tower base, or in an area where dropped tools or parts might fall.

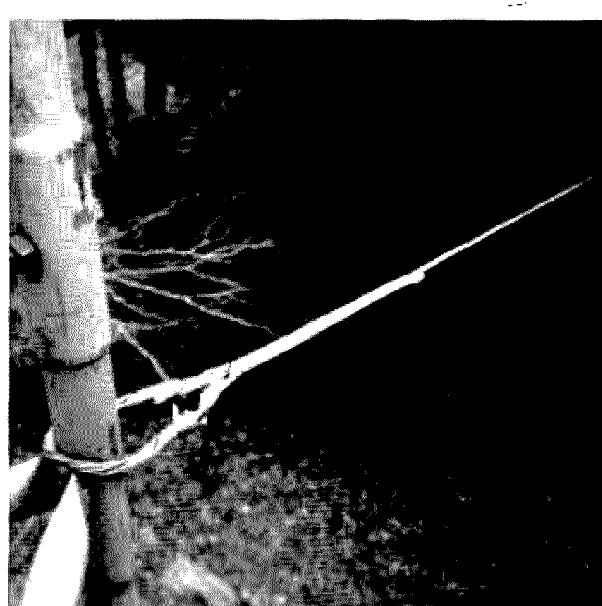
Continue adding tower sections and guy wire sets until the tower is complete. Since the last section normally is built to accept an antenna rotator and mast, these items are more easily installed before that section is raised.

Having aligned the tower each time that a set of wires was installed, the complete unit should be pretty close to vertical. By sighting upward along each leg of the tower, any bends will be seen easily and can be removed by adjusting tension on the appropriate guy wire.

Now that the tower is straight, the next step is to equalize the tension on each set of guy wires. A device called a strain dynomometer is used to read tension on a cable. If this is not available, the only recourse is to pull each guy wire slightly out of line and feel the tension by hand. Sighting up each guy wire from anchor toward the tower and judging the sag is another method, but it is not as reliable due to the varying lengths of the lines. The aim is that each guy wire should carry the same strain as every other.

The tower is now complete and ready to accept antennas and downleads. Even though it is ground-mounted and is attached to guy wires and anchors which also are at earth ground potential, it still is wise to electrically ground the tower. Most commercial installations use a six-foot ground rod at each tower leg, driven as close to the base as possible. This is sufficient to protect the tower, although lightning protection at the shack end of the downleads still should be used. In the event that lights are required, or any source of commercial power is used at the tower, the ground system should be tied into the neutral of the electric line.

When very large arrays are rotated on a tower, the torque will cause twisting of the structure. While this does not affect the life of the tower, it does affect the aiming accuracy of VHF directional arrays during windy conditions. The cure is to install another guy system by bolting to the tower a length of pipe or angle iron about six feet long, as per Fig. 2.



Guy wires and grip are attached to a tower leg.

Since this guy system carries only the twisting load applied to the tower, it need not be as heavily constructed as the main system. Screw-type anchors and number ten steel fence wire are more than adequate, along with TV-type U-bolts connecting the pipe to the tower legs. With this arrangement mounted about three-fourths of the way up the tower, it should remove most of the twisting action and considerably reduce the whiplash effect on the antenna elements.

There you have it. Guyed towers offer the most stable platform for large arrays and greater heights under the most extreme weather conditions. They also offer confidence in the knowledge that those expensive antennas are mounted up where they operate best and are supported by a system which will offer safe and reliable operating for years to come. ■

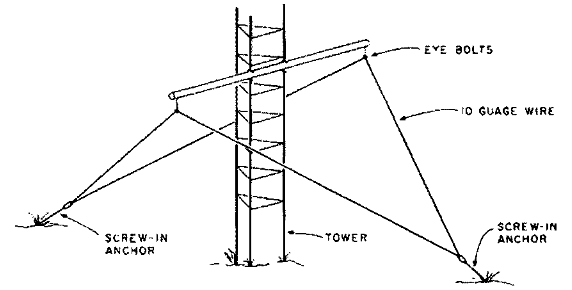


Fig. 2.

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Death-Defying PL Mod for the KDK 2015

—not for the squeamish

No more clipping.

Author's Note: Since this article was written, KDK has improved their "fix" by adding additional RC filters between the NOR gate and the base of the output transistor.

This article is not for the timid soul. It takes considerable courage to take a brand new rig and cut the circuit foil and drill holes in the PC boards. This statement is not intended to scare you off, but to forewarn you. The results, however, are well worth the effort.

A prerequisite for outlining any solution is to first define the problem. The basic complaint with the original KDK PL is that it may or may not activate a given repeater, and when it does, there are complaints of the PL being audible and clipping with modulation.

Investigation of the existing PL circuit reveals a CMOS 2-input NOR gate chip (MC14001) connected as a square-wave oscillator as shown in Fig. 1. They couldn't have planned it worse. The fast rise and fall time of the square wave produces many harmonics of the 100-Hz fundamental at 200, 300, etc., accounting for the audible complaint.

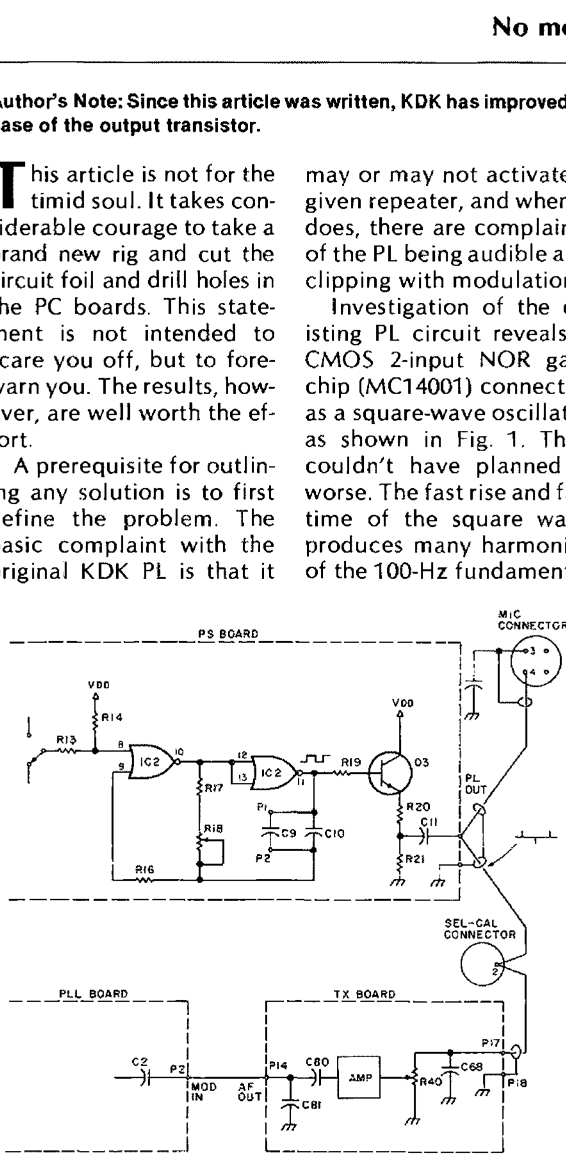

Fig. 1. Existing KDK PL circuit.

To make matters worse, the square wave is differentiated by the .01-uF coupling capacitor to the speech amplifier, producing narrow pulses from each edge of the square wave (pulse modulation, yet). This has to be a terrible shock to the preamp and is probably the reason why the repeater does not recognize the PL. Attempts to activate the repeater by increasing the PL level further aggravate the audible problem.

The official "fix" available as a modification kit from the US distributor of the KDK units leaves much to be desired, since it simply adds a 0.1-uF shunt capacitor from the base of Q3 to ground to drastically slow up the rise and fall times, making it a triangular wave.

The ultimate solution, of course, is to change the PL signal to a sine wave. This is where the timid souls can leave to purchase their ME-3. The hardy and courageous individuals, however, should stay while we discuss how to linearize the existing CMOS digital gate for analog operation to generate a sine wave.

Any digital logic-inverting element (NAND or NOR gate or inverter) produces a high-level output with a low-level input and vice versa. The input switching threshold for a CMOS logic element is approximately 45% of the supply voltage (9 volts in the KDK). When the input signal passes through the threshold (4 volts), the output switches. It is at this switching level that the gate is operating in the linear region. A feedback resistor connected from output back to input, as shown in Fig. 2, linearizes the gate since a high output fed back to the input would tend to drive the output low, which when fed back to the input tends to drive the output high, which . . . etc. The gate finally compromises itself with both input and output floating at the 4-volt switching threshold level.

This circuit configuration lends itself very well for a Wein bridge sinewave oscillator (sometimes

called a twin-T) by simply dividing the feedback resistor into two parts and adding the other necessary RC constants as shown in Fig. 3. The basic frequency of oscillation is given as $F = 1/(2\pi RC)$, but this is not exact and may vary considerably. A word of caution here: The capacitors must be a good quality ceramic or mica with good temperature stability, and the resistors must be 100 part-per-million temperature-coefficient units. One such circuit constructed with miniature plastic capacitors changed frequency by 50% when sprayed with Quick Freeze circuit cooler.

The final circuit design and KDK modifications are shown in Fig. 4. Note that the second gate is no longer used. The IC pad of pin 11 on the circuit board is still utilized, however, so the legs of the chip (pins 11, 12, and 13) were cut and a jumper added to connect circuit board pad 10 to 11 to complete the path to the output transistor. The legend for the various circuit modifications appears below the schematic. The 0.15-uF capacitor across the 287-Ohm resistor and 1k pot was required to eliminate a secondary high-frequency oscillation. The value of this capacitor, although not critical, will have some effect on frequency.

The major problem encountered was getting the PS board out far enough to work on it. There are a few wires from the PS board which are routed under the PLL board. This problem is solved by removing the four PLL mounting screws and tilting the board forward towards the front panel. A piece of masking tape will hold this board in the upright position.

The second problem is caused by the choke mounted on the rear plate and the ground wire from the power input connector. These leads are very short and make it impossible to move the PS board. It may be possible to unsolder the choke leads; however, I chose to unmount the choke, leaving it attached to the board. This is accomplished by gently removing the rear identification plate by lifting with a small screwdriver (sticky back) to expose the choke-mounting screws. The ground wire can easily be unsoldered at the power input connector.

The transceiver is then positioned on its side and the PS board separated as far as possible from the chassis with all other wires still connected. Not an ideal work situation, but tolerable.

The following is a complete step-by-step procedure for making the modification. Refer to the PS board layout diagram on page 12 of the KDK manual to locate the various points referenced.

1. Unsolder the two shielded audio cables from the PS board, cut them to a length sufficient for splicing, and cover the splices with shrink tubing. This disconnects the PL output and completes the microphone cable routing to the SEL-CAL connector and speech amplifier.

2. Cut the legs of pins 11, 12, and 13 on IC2.

3. Solder a jumper across pads 10 and 11 on rear of board.

4. Cut circuit foil between P1 and junction of R19 and C10.

5. Cut circuit foil between P2 and R18 potentiometer.

6. Replace R16 470k resistor with a 16.9k resistor.

7. Replace R17 33k resistor with a 14.3k resistor.

8. Replace R18 50k pot with a 5k pot.

9. Replace C9 .033-uF capacitor with a .15-uF capacitor.

10. Replace C10 .068-uF capacitor with a .15-uF capacitor.

11. Replace C11 .01-uF capacitor with a .22-uF capacitor.

12. Replace the combination of R20 4.7k and R21 470-Ohm resistors with a single 5k miniature potentiometer (about the size of a transistor). Mount this pot with one end in the R21 ground pad, the other end in the R20 pad which connects to the emitter of Q3, and the rotor in either of the two pads at the junction of R20, R21, and C11.

13. Drill a hole through the ground plane at the edge of the PC board in line with R16 and next to the nicad battery. Mount the .33-uF capacitor from the junction of R18 pot and R16 resistor to the ground-plane hole.

14. Position the 1k pot next to the nicad battery such that the rotor and one end are over the ground plane and the other end is over the open area (no ground plane). Mark the points, drill the holes, and mount the pot. Make sure the speaker clears the pot when the bottom cover is mounted.

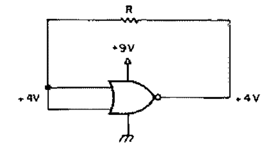

Fig. 2.

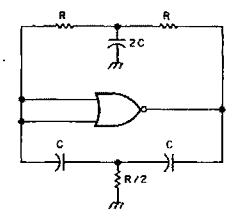

Fig. 3.

15. Drill two more holes in the open area for mounting the 287-Ohm resistor next to the 1k pot. Mount the resistor in the holes and bend one lead over and solder it to the open pot lead.

16. Drill another hole in the open area next to the 287-Ohm resistor hole and also another hole through the ground plane for mounting the .15-uF bypass capacitor across the 187-Ohm 1k pot combination.

17. Connect a wire from

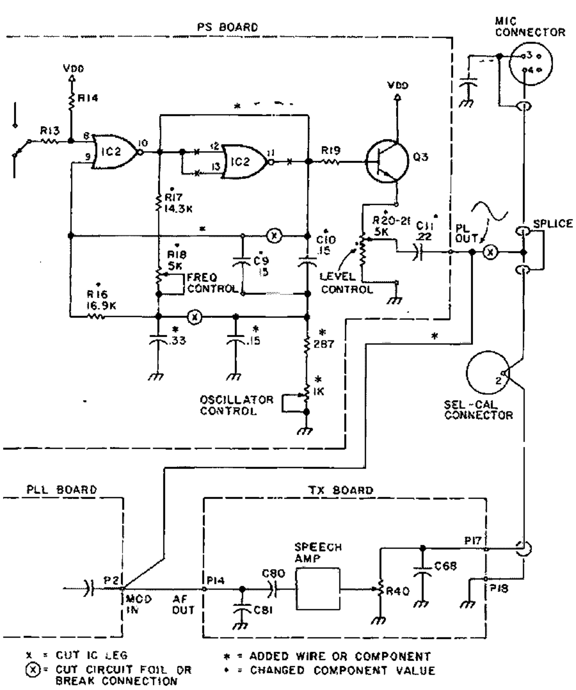

Fig. 4. Modified KDK PL circuit.

the junction of the .15-uF bypass and the 287-Ohm resistor to P2.

18. Connect a jumper wire from P1 to the pin 9 end of R16.

19. Connect a wire from "PL OUT" (open end of C11) to P2 "MOD IN" on the PLL board (terminal with green wire).

Adjustment is best accomplished with a scope and counter; however, it may be possible to "ballpark" the frequency adjustment by comparing it to a strong signal with PL on the repeater input with an auxiliary receiver. The 1k oscillation control should be adjusted for the maximum resistance possible that will sustain oscillation without distortion of the sine wave. A rough setting of the level control can be made by measuring the audio voltage level with a voltmeter at the "MOD IN" terminal under normal modulation and adjusting the PL "LEVEL" for 10% of this value. Final tweaking may require on-the-air tests with assistance from another operator.

This modification has been in use for several months with excellent results. Temperature stability is very good (±0.2 Hz) when sprayed with Quick Freeze circuit cooler (−50° F.) and heated with a heat gun. Both temperatures were well beyond my operating thresholds. Final results—no more clipping or complaints of audible PL with 100% solid QSOs.

Next project—slowing down the scanning rate so more than two words can be heard when continuously scanning the memory channels for familiar voices or calls. Maybe we can start a KDK "mod squad." ■

Feed-Horn Mounting Made Easy

—solution to a pesky problem

More on microwaves.

Dr. Ralph E. Taggart WB8DQT
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Mason MI 48854

Until you know a little bit about the subject, the antenna portion of a microwave project seems quite simple. The most difficult aspect is building or finding a dish—or so it seems! No matter how you acquire the dish, however, you will discover that your problems have just begun.

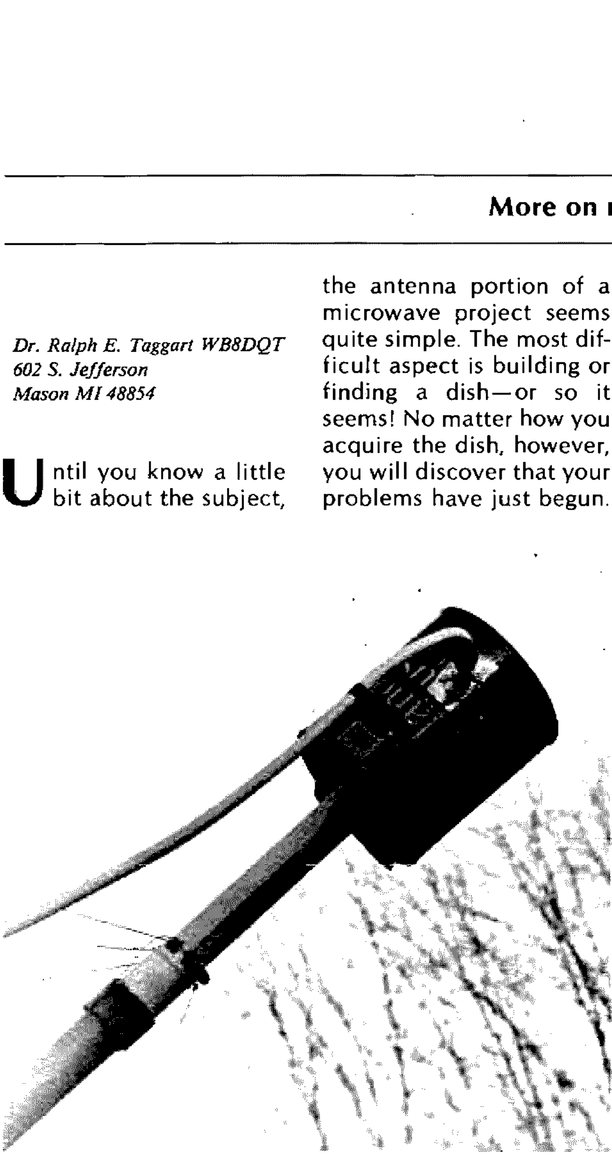

Photo A. This is a feed-horn assembly for use at the 1.7-GHz satellite frequency.

Next you must find a suitable feed, and if this search leads you into the literature, you will discover that that subject can be quite complex indeed.

In the final analysis, one of the simplest and most effective feeds in the low-frequency end of the microwave region is the horn feed. Rectangular horn feeds are superior, in the sense that the illumination pattern can be controlled with some precision. Their main drawback is that they are mechanically unwieldy.

Despite their reduced illumination efficiency, cylindrical feed horns are quite popular in that they can be constructed of metal pipe, tubing, or cans. A number of articles have appeared in the amateur literature describing the construction of horn-feed systems. They are quite non-critical in use—particularly in receiving applications.

Horn Mounting

Once you have obtained a dish and constructed a horn, you inevitably encounter the real problem—how to get the darn thing mounted! I have been working on antennas in the low microwave region (S-band) for the past two years now, in conjunction with a series of projects involving the GOES weather satellites. These satellites transmit pictures on a frequency of 1691 MHz, and thus I was forced to deal with the feed-horn mounting problem. The answer to it has proved to be quite simple and effective and should be applicable to similar situations involving operations on 1296, 2304, and 3300 MHz.

The key point in any mounting scheme is to avoid obscuring the open end of the horn with metal in any form. Any metal will serve to shield out a certain portion of the received rf, all of which will be focused into the mouth of the horn in a well-designed system. The two most common mounting schemes are shown in Fig. 1. One of

these is excellent but largely impractical, while the second is very inelegant and somewhat inefficient.

The first involves the use of either three or four spider-arm assemblies running from the horn to the periphery of the dish. The arms do not impede the rf front reflected from the dish surface into the horn, and they can be made even of metal for, although they do intercept the wave front as it arrives at the dish, their area is quite small compared to the area of a typical dish; the gain reduction is not measurable.

This does, however, highlight why obstructions to the horn are so critical. *All* the rf energy reflected by the dish surface must pass into the relatively small opening represented by the mouth of the horn. Any metal obstruction here can cancel out a good percentage of the gain!

The primary disadvantage of the spider-arm system is the difficulty in fabricating it. One must have considerable mechanical ingenuity to devise fastenings to secure the arms to the horn and to the edge of the dish. The arms must be of equal length, provide rigid support, and must hold the horn at the proper focal length for the dish in use while also permitting rotation of the horn to match polarization with the transmitted signal. Since the precise position of a particular feed horn relative to a particular dish at a given frequency can be determined only approximately at first, one is in for a considerable period of tinkering to get everything right.

The second approach is to use a support rod at the center of the dish—usually fabricated of plumbing tubing and fittings—with an offset to accommodate the horn radius, as shown in Fig. 1(b). The horn is clamped to the tubing using large hose clamps or some other system. It is an easy system to adjust, since the horn can be moved up or down the tube for focusing prior to being clamped in place. The major disadvantage is that the tube does absorb rf coming in from the dish surface. Also, the system looks terrible!

Figs. 2 and 3 show a much better system. The horn is mounted to a square of unclad G-10 board material (no copper) using four small metal brackets outside of the horn. The G-10 square is just slightly larger than the outside diameter of the horn, and the horn brackets attach within the corner areas that extend beyond the edge of the horn.

Other materials may be used for the mounting square if they pass a simple test. Simply hold a sheet of the material across the mouth of the horn and observe the indicated signal strength on the receiver. If there is no noticeable drop in the signal level, you are getting minimal attenuation and the material may be used. Most plastics appear to work fine, but be sure to check them out anyway, as the composition of a few plastics or their additives can sometimes show unexpected rf absorption at some frequencies in the microwave region.

The mounting square is attached to a mast of PVC plumbing tubing (don't use metal!) that holds the horn at the proper focal point. The mast is mounted to the center of the dish by sliding it over a stub of metal pipe secured to the center of the dish with a pair of pipe-mounting flanges. The PVC mast is slit where it slides over the pipe, and the entire mast assembly can be moved both up and down the pipe to optimize focus and rotated to match polarization. Once the proper orientation is achieved, the mast is locked into place with one or more hose clamps.

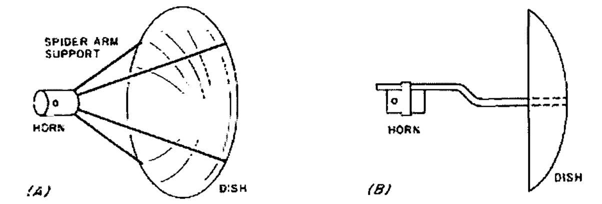

Fig. 1. Two common methods used to mount cylindrical feed horns. (A) shows the use of spider-arm support rods—an efficient system, but difficult to construct; and (B) shows the use of a support pipe, offset to accept the horn. This system is easy to construct but is unsightly and somewhat inefficient.

If the mast is quite long or the feed horn is heavy, the assembly can be guyed with dacron lines run from the corners of the G-10 mounting plate to screw-eye and turnbuckle assemblies attached to the rim of the dish.

Construction

The diagrams in Figs. 2 and 3 provide most of the information required, but a few points are worth discussing. First, the mounting plate *must* be attached to the PVC mast using nylon mounting brackets and hardware. If you use metal here, you will eliminate most of the advantages of this particular mounting scheme. The brackets and hardware can be obtained from hobby shops that carry supplies for radio-controlled airplanes.

The PVC tubing is cut about four inches shorter than the focal length of the dish. This permits the focal point to fall about 2 inches (5 cm) into the horn while

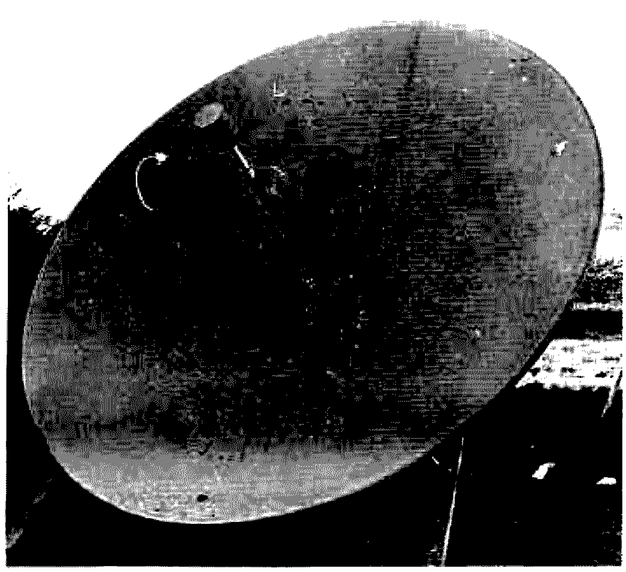

Photo B. Pictured here is a 10-foot (1.3 m) dish, complete with horn feed, used for GOES satellite reception. With a small dish in the 4- to 6-foot range, and depending on its weight, the horn may not require guying. With a larger dish of the sort shown here, the long mast does need dacron guys.

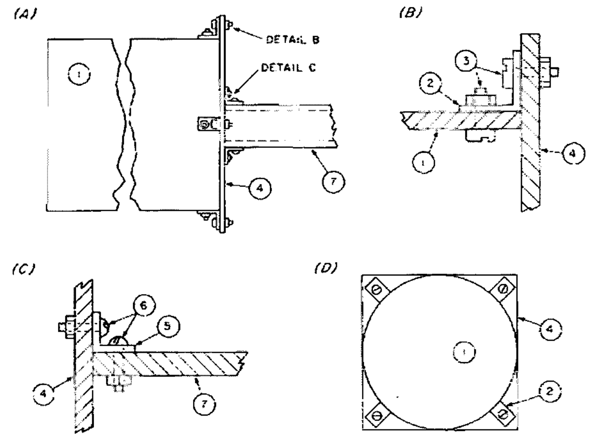

Fig. 2. (1): feed horn; (2): metal mounting brackets; (3): 6-32 pan-head hardware; (4): G-10 fiberglass mounting plate; (5): nylon mounting brackets; (6): 4-40 nylon hardware; (7): PVC pipe mast. (A) General view of the relationship of the cylindrical feed horn, mounting plate, and PVC mast. (B) Detail showing the attachment of the horn to the plate using metal brackets and 6-32 hardware. Use pan-head screws with the heads inside the horn to minimize metal protrusions into the cavity. (C) Detail of the attachment of the mounting plate to the PVC mast using nylon *brackets and hardware. (D) End view of the horn, looking toward the dish, showing the relationship of the metal mounting brackets to the corners of the square G-10 mounting plate.*

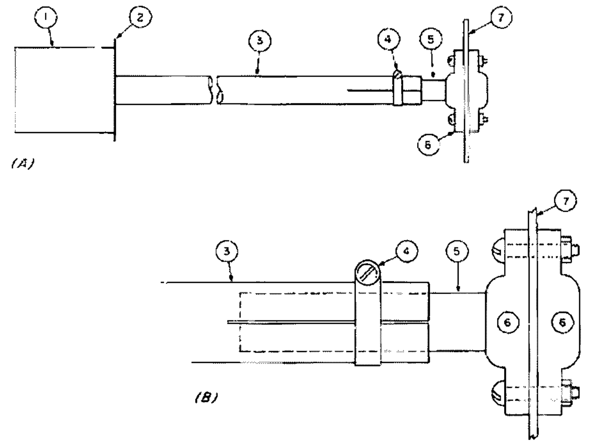

Fig. 3. (1): horn; (2): G-10 plate; (3): PVC pipe mast; (4): hose clamp; (5): steel pipe stub; (6): pipe mounting flanges; (7): dish surface. (A) The general relationship of the horn mounting-plate, PVC mast, pipe stub, and the pipe flanges used to secure the mast to the center of the dish. (B) Detail showing the attachment of the mast to the dish surface. Two pipe flanges, one on either side of the dish center, are used to provide rigidity. A pipe stub, which may be up to 1/3 of the dish focal length, is used to provide support to the mast. PVC and steel pipe sizes should be chosen so that the steel pipe is a slide-fit in the PVC pipe. The PVC mast is slit at the dish end and tightened down with one or more hose clamps.

still permitting about the same distance for downward movement of the assembly if required for focusing. The following assembly sequence should be followed:

(1) Mount the nylon mounting brackets to the end of the PVC mast. Doing this first lets you get pliers or fingers down inside the mast to tighten the hardware!

(2) The mounted brackets then can be used as a guide for marking the G-10 plate which can be drilled then and mounted to the end of the mast—again, use nylon hardware!

(3) The brackets (aluminum, brass, or other metal is OK) then may be mounted to the horn and the horn attached to the plate. In mounting the horn brackets, be sure to use pan-head screws with the heads inside the horn and the nuts outside. This minimizes metal protrusions into the horn which could distort the wavefronts in the waveguide horn assembly.

(4) The entire assembly is placed over the pipe stub, its position optimized, and then everything is tightened up with hose clamps.

If guying is required, it can be installed now. In the case of an antenna used for support of a satellite ground station, the guying system can perform a fine-tuning function in the alignment department. Large dishes (8-10 feet or larger) are quite critical in orientation, and it often is possible first to horse the dish into the best possible orientation, and then to use the guy adjustments to shift the horn position laterally as required to peak the signal level. If large displacements of the horn are required (more than an inch or so), it means that the dish was not aligned properly. The horn should be centered (guy lines of precisely equal length) and the alignment of the dish altered to bring up the signal. You then can fine-tune the alignment with the guy cables.

Since the pipe attached to the dish can provide some rigidity to the PVC mast, it is useful to know how long the pipe can be without absorbing significant rf. This is dependent upon dish focal length. Generally, if the pipe is about one-third of the focal length, it will not affect the signal level. This is because the horn obscures the center of the dish and the converging wavefront from other areas of the dish will not intersect the pipe as it would if the pipe were much longer.

If desired, you can run a bead of silicone seal around the edge of the horn where it attaches to the G-10 plate, to provide some weather-sealing. This is usually most important with antennas used for point-to-point ground service, as the horn is not likely to pick up water or snow when pointed up in the air at a satellite! In the latter case, it is not even necessary that the plate cover the entire opening to the horn. I have built several feed assemblies where the plate was simply a wide strip across the opening of the horn. In making an inspection of one GOES satellite installation, however, I discovered a nice wasps' nest in the feed horn! I suppose that if a bird decided to use the horn for its spring nesting ritual, it might result in some puzzling signal-level anomalies! It probably is best to seal up the horn—if only to exclude the local wildlife!

This mounting scheme has been used in a number of GOES satellite ground station installations, with antennas ranging from 3 to 10 feet in diameter, with excellent results in all cases. Cylindrical feed horns are certainly simple to construct, and they provide fine results. I think you will find that this mounting system will make them just as easy to use! ■

Antenna Tuning Joy Revisited

—remember the Tektronix 190B?

Amplifying K5QY.

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In the May, 1978, issue of *73 Magazine* there was an excellent article by Dick Sander K5QY entitled "Make Antenna Tuning A Joy." The article described the modification of a Tektronix 190B constant-amplitude sine wave generator. It is my intention in this follow-up article to add to Dick's comments and ideas and give a few basic details that he left out on the generator itself.

I can testify to the long-term worth of his unit, because I did the same modification 2 years ago. It has proven to be worth at least a hundred times the time spent on it. When I say I did the same modification, like any ham, I have to add an important word—almost. It is additional information and some of the ways I did things as a VHF ham that I believe will be of additional value to readers.

To keep this as short and to the point as possible, I'll first cover the additional specifications you may find of interest. We both started off with the 190B. This unit will run on 105 to 125, or 210 to 250 V ac, with a very slight wiring change similar to Heathkit® equipment (change jumpers, etc.). Further, it runs fine on 50 to 400 Hz. The latter part may not seem important, but I have found that I can use part of an old 6 meter AM mobile power pack unit that was designed to put out around 250 V dc. If you take out or disconnect the dc portion (mine was shot and burned up, anyway), you get, from the ac portion, about 230 V ac and 360 Hz, in my case. The 190B requires about 100 W on 120 V ac, 60 Hz, but the power pack only warms to the touch after about 30 minutes of use. Just a thought for those of you who really must be portable and dc only.

The gear is quite compact and portable compared to some of the older tube-type bench or rack-mounted equipment. It measures only 9-3/4" wide, 13½" high, and 11" deep. Its all-aluminum alloy construction gives it a total weight of only 24 pounds, so it is no surplus boat anchor.

The frequency indication specification for the dial readout is quite good at 2%. This is nice, even if you use the generator only as a generator, but invaluable if you modify it, as Dick and I did, into an antenna bridge.

The output amplitude is continuously variable over a 40-mV-to-10-V peak-to-peak range. Looking into a 50-Ohm load, you have 5 volts peak (times .707 for rms volts). Square that result over a 50-Ohm load, and indeed you have an output of about 250 mW.

This brings out the only point I question in Dick's article. I am a QRP power nut and a VHF/UHF ham. I often have worked another ham 63 miles away with only 16.5 mW on 6 meter CW. That's no great feat, but it all started by accident and has continued using the same setup: my transmitter coupled to a light bulb dummy load in the basement! All I am driving at is, while this may be the handiest device you have ever built for antenna work, remember: You are radiating! Use the minimum on-air time you need for antenna pruning and try to pick non-peak hours in your locale—especially on VHF.

The original ouput meter read the output peak-to-peak volts at that funny-looking connector your unit will come with and is accurate only to ± 10% of full scale. This is really no problem in the modified version, as the absolute value of forward power (voltage) is not important as long as it will drive the swr meter to full scale in the forward mode. Dick mentions changing to a plain voltmeter with a different scale from the original and using a chart supplied by him in the article to calculate vswr. I went one better, I think, and it is by total accident that we were working toward the same general ends at nearly the same time. I found the meter for the Heath VHF wattmeter (HW-2102) to be a great replacement in the $15 range, as it has a direct reading scale for swr. You can ignore the power out-

put scales! I used the bridge basically out of the Heath wattmeter, but have constructed Dick's, too, and either seems to be fine for my VHF work. If you are HF inclined, stay with Dick's resistive version. The Heath meter has a white-on-black scale that is both very attractive and easy to read out in the bright sunlight.

If you contemplate operating at the stock upper limit of 50 MHz, for 6 meter work, by all means use an N-type (50-Ohm) panel-mount female connector to replace the weird little output connector on the front panel of the 190B. Dick used a UHF-type connector here, which is fine at HF frequencies. Unfortunately, due to the huge demand created by the CB market, some UHF connectors are showing up that are UHF in style and name only. Some are OK at CB frequencies and useless at 50 MHz and up. Some would be junk at dc! Why have your worst swr "lump" built right into your test equipment? The extra cost for the N connector is worth it.

If you are *un*fortunate enough to get the attenuator that plugs into that same weird little connector on the panel, do *not* get any ideas about using it for any kind of accurate readings on antennas or any other load with reactance. As you do the band-wandering trick to prune an antenna, as Dick describes, the output impedance of the attenuator wanders all over, and right on the specification sheet it states the following information: Output amplitude is constant ±5% from 30 to 50 MHz, *if* the load capacitance does not exceed 10 pF on the 10-V range. This can be a fixed C, or the antenna reactance! In the 1-V-to-.5-V range, it improves by allowing 50 pF for the same ±5%. Further, it is stated that all changes will be related to, and dependent on, the load capacitance, the length of cables (more on that later), the voltage range in use, and the frequency.

These facts are primarily for those of you who may want to use the generator as a generator with the attenuator. Dick comes right off the generator at the strange little plug you replace with the N fitting, and so did I. Speaking of the attenuator, and to further induce you to go buy a 190B, consider the following.

It's an old flea-market sales trick, but the truth is that you don't want the attenuator unless you intend to outboard the bridge in a box, and swap back and forth between it and the attenuator as the attenuator replacement accessory. So, why let someone run the price up on you by saying he is offering more, or something the unit won't work without? On the other hand, if he doesn't have an attenuator to sell with it, you may succeed in driving down the price by screaming that you must have one!

Fair? It all depends which side of the flea-market table you are standing on at the time, and I have spent 18 years on one side or the other. *"Caveat emptor,"* no doubt, has a seller's corollary, too, and rightly so. The only good deal is where both parties feel they have a bargain—so bargain away!

Before we get away from the specifications on the stock 190B, there is one more thing you should know. If you are working with wideband or multiband antennas (log periodics, discones, trap dipoles or verticals, etc.), you should know that there is *no* specification made for the harmonic content of the 190B! I heard of a case where it was typically less than 5%, but that was a new unit in perfect shape.

If you are going to use your unit seriously, then it would pay to at least spot check it at your points of interest. Even a simple check on a shortwave/allband-type receiver will give you a good idea of where the unit is at. For instance, set the generator up on 7 MHz into a 50-Ohm resistor, with enough leads to radiate a little, and drive the generator up to where the S-meter reads S6 to S9 depending on the linearity of your particular receiver's agc system. Tuning the receiver to 14, 21, 28 MHz, etc., should produce readings in the range of S1 or at least as low as the meter reads, with the receiver input terminals shorted by a 50-Ohm resistor (or proper load to match receiver input impedance).

As for the unit you are looking for, I assume you are not rich enough to see Tektronix for a new one (and I doubt if they still even build it), and the used gear catalog prices are still quite high and are aimed at the small business user. This leaves the hamfests/flea markets. I mention this because the unit is easy to open up so you can look at the condition inside. You can plan on cleaning up a little dust, but beware of anything that resembles saltwater corrosion (white, chalky, lumpy), extreme rust, or missing, bent, or battered shields or covers. You want a piece of test equipment, not junk.

I got a real bargain on mine—fully working and intact, for $20, from a man who knew not what he had!

I sprayed over the slightly-scratched case with a forest green by Rust-o-leum, which is great for equipment you want never to rust or corrode. Besides, this is a nice match for the Heath meter, which has a black face and green plastic bezel, and it contrasted nicely with the brushed-aluminum panel.

My next modification will obviously be to get higher frequency operation out of this wonder of wonders. Even if I get a sudden interest in the low bands and get my Advanced license, I don't really need the .35- to .75- and .75- to 1.7-MHz bands. The 21- to 50-MHz band on my unit does make it usable on 6 meters, but a bit of coil adjustment may be required on some you might purchase. If you have to juggle, my suggestion is to move the whole band up by 1 MHz and recheck the tracking. Use the allband receiver again to align the tracking by adjusting C on the high end and L on the low end until the dial tracking is as close as possible.

That wraps up my way of attacking the 190B and achieving the joy Dick mentioned in his title. I got my first exposure to this instrument at work and know it is a good one. I kick myself for not seeing the full LC impedance bridge Dick goes on to mention, but you can bet I am working on trying it soon. If anyone has any ideas on putting the higher bands into this gear (at least 2 meters), please write it up or contact me.

I promised to cover more on the capacitance effects, cables, etc., and I left it for last because it really does not pertain only to the 190B. Dick touched briefly on using the modified generator to check old coaxial cable. A lot of bridge, swr, and loading problems can be eliminated or minimized by using the same general techniques. By using a *new* piece of RG-8 foam, commercial grade and quality (not the CB-grade junk), and cutting it to ½ wavelength or even 1 wave-

length at the desired and most-used frequency (allow for the velocity factor of the cable), you can make a simple swr transformer. As you know, voltage and current repeat themselves in the cable at ½-wave intervals, and, therefore, so does the swr reading. By first cutting the coax close to the calculated length, but slightly long, and shorting out the far end from the generator, you can determine the exact resonance of the coax just like an antenna. When you have it properly trimmed for the frequency chosen and connectors are on it, hook it up to a good 50-Ohm load like a Heath "Cantenna." Your resonant point should remain the same (matched resistive load) and the swr should be 1:1. If the coax is good and cut to the correct length and the load is really 50-Ohms resistive, any remaining swr is the combined result of bridge unbalance, coax connectors, and coax reflections (bumps or imperfect cable); all, in total, should be very small. Note it on the generator panel for future reference if you can't eliminate it. If the unit won't get 1:1 with a perfect load, it will never get it with the antenna under test. A digital swr meter readout would make the unit perfect, and I am working on that very thing right now.

I can only repeat Dick's closing statement that the 190B in modified form is the "... most practical and economical antenna tuning aid I've used in my antenna experimentation ...," and I hope my article will help make Dick's article and a great piece of gear more useful to all of you who try it. Drop me a note and an SASE if you have any problems with what I've written here.■

✓ Reader Service—see page 211

Modern Solid-State Equipment Design: A Better Way

—sorry, tube fans

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Most books and articles on solid-state design for rf stress the parallels between transistor/FET circuitry and tube circuitry. These parallels are accurate enough as far as they go, but they also are misleading. To the average reader, they imply that equipment design using transistors or FETs should parallel tube equipment. In many ways, especially for the amateur, this inference is wrong and accounts often for why we never get some piece of equipment to work.

In this article, I want to compare old-style tube techniques with some tried and proven principles for transistors. These principles are not for the engineer or the commercial manufacturer; they are for the home builder. They call for some changes in the way we think about building up a fairly complex piece of rf equipment. In this review of the similarities and differences between vacuum tubes and transistors, all of the ideas I give will be commonplace. But when set next to each other, they suggest new ways of doing things for the ham constructor.

Changing an old way of thinking is probably the hardest thing for any of us to do, but if you think through these ideas, and then take a look at some of the projects that have appealed to you (transmitters, vfos, receivers, and the like), you will be in a position to make the change. No longer need you believe that you can never get a bunch of transistors to do what the original author got them to do. By some simple redesign work, you can have confidence that you can do it, too—and maybe do it better.

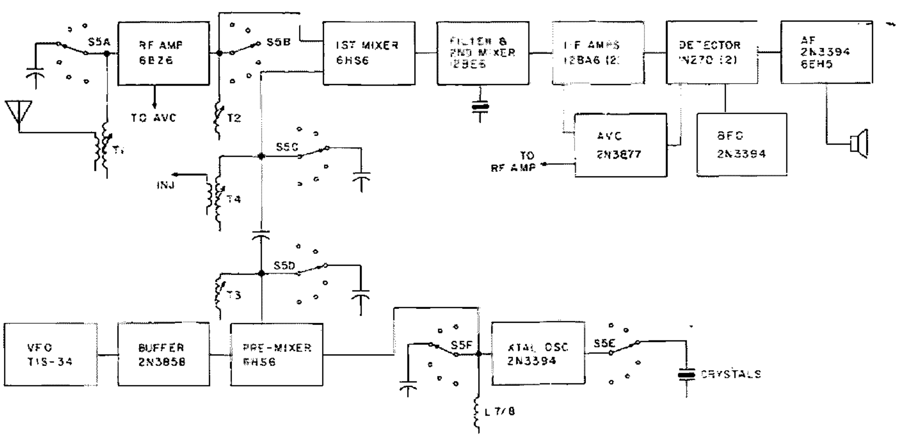

Fig. 1. Simplified block diagram of a tube-type receiver, adapted from the R-4B and drawn to show the methods of switching rf-tuned circuits for each stage prior to the mixer, i-f, and af stages. Note that a 6-pole, 6-position switch is required to accomplish band changes. Although the method of mixing frequencies to reach the i-f differs among manufacturers, the relationship of band changing to the various stages is common to almost all of them. In this late model tube-type receiver, some solid-state devices have been introduced. Tuned circuits have not been terminated because of complexities in the full schematic of this Drake receiver.

Designing with Vacuum Tubes

The design of rf equipment using vacuum tubes has changed little in the past forty years. Perhaps the major change—outside of improved tube construction and improved individual circuits—has been the introduction into amateur gear of the heterodyne vfo system of frequency control. The 5- to 5.5-MHz vfo heterodyned to the ham band of choice has eliminated most of the prob-

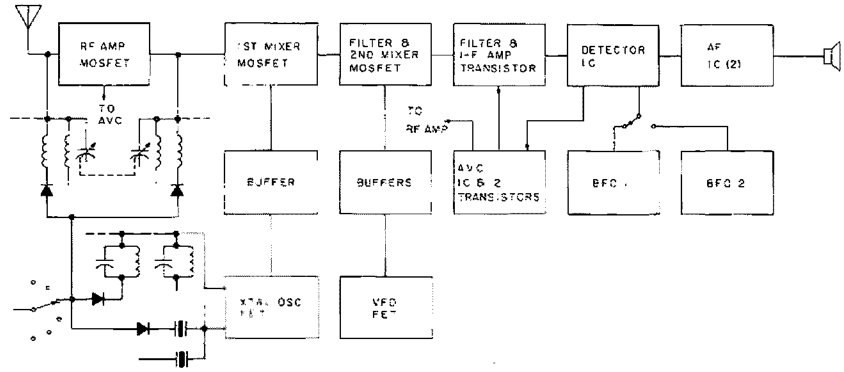

Fig. 2. Simplified block diagram of a recent commercially-manufactured solid-state ham-band receiver. Note the similarities to Figs. 1 and 3: All use single devices in the critical rf circuits and switch-tuned circuits. Problems of lead length and switch expense are solved in this design by the use of a diode switching system. The switch handles dc, and all rf remains on the printed circuit board. This, plus the use of a high-impedance device, the MOSFET, minimizes some problems of multiband operation, but not all. Compare this to Fig. 4 in which the rf circuits are optimized for one band. This diagram, with modifications for simplicity, is based on the Heath HR-1680. Both the HR-1680 and the Drake R-4B of Fig. 1 are fine receivers in their respective price classes, but their design philosophies may not be best for the ham builder.

lems inherent in the bandswitching vfo or the vfo multiplied to frequency. The instability of vfos required to cover a ten-to-one frequency spread, as well as instabilities introduced by switching tuned circuits, held back single sideband and serious communication on VHF frequencies for many years. Likewise, when we used frequency multipliers, we also multiplied any flaws in the vfo.

Other than this, equipment design has changed little. To illustrate this fact, let us look at Fig. 1, a simplified diagram of a straightforward receiver. In the diagram, I have shown most of the switching circuits, but omitted other circuit details. In both amateur gear and commercially-made gear, this basic system design has been standard. With vacuum tubes, there are good reasons for this standardization.

Notice that most of the switching involves the replacement of one frequency-determining circuit for another. To switch bands requires the exchange of several tuned circuits, as well as a change of crystals. Here are some of the basic reasons for working out the system design in this way:

1. The system permits the least number of tubes, which is desirable because, (a) tubes are large—they take up space; and (b) tubes are heat generators, and this system minimizes heat.

2. Tubes, being high-impedance devices (high especially when compared to the frequency-determining circuits associated with them), usually require little attention to perfect matching, and are, therefore, reliable for a given biasing arrangement over a large frequency spread.

3. Tubes are large compared with tuned circuits and switches (especially at low power levels), thus making it more economical of space and cost to switch tuned circuits.

4. Tubes are inherently expensive; for receivers, five tubes can cost five times as much as one five-position switch section.

5. Tubes, as they come into the hands of either the commercial manufacturer or the building amateur, are reliably similar, varying well within a 20 percent range in characteristics within types.

6. Most modern tubes have input and output capacitances which are small enough to present no design problems in the 3- to 30-MHz range (unlike the old '24 and '27, so popular around 1930).

Fig. 2 shows a simplified diagram of a relatively recent piece of ham gear. The diagram has been drawn to bring out the similarities between tube and transistorized gear commercially available. Note that the switching arrangement is not materially different from that of Fig. 1. Single solid-state devices are used at each stage, and the frequency-determining circuits are switched with the traditional bandswitching arrangement.

Fig. 3 shows a simplified diagram of a piece of equipment taken from a recent ham publication. Notice that it, too, uses the very same system of switching and design.

Unless one is an engineer or has access to select components, circuit design of this order is difficult to replicate. Among the reasons for the difficulties we face in making a complex circuit work just as some article claims are these:

1. Transistors may vary greatly in characteristics from a design center. This problem is aggravated by the fact that hams generally have access to culls, hobbyist-grade devices, or surplus, any of which may vary by an even greater extent. For this reason, the amateur designer must do his own selection from among the batches of 20-cent transistors he has on hand, and he must be willing to rework bias and drive circuits to make the device work as it did in the original. To expect a complex group of transistors to perform reliably over a wide frequency range under these conditions often strains the imagination and the experimenter's patience.

2. Other materials of the system of circuits may not be available, and the amateur designer substitutes what he has on hand. He may use surplus or junk box coil forms or toroids of dubious ferrite or iron content. What this may do to circuit Q is anyone's guess. Capacitor quality is another overlooked problem, one aggravated by the uncertain history of the short lead parts in the junk box.

3. Those who attempt to reproduce equipment shown in articles and books often lack the test equipment necessary to perform the right measurements so as to find out what in a circuit may not be working correctly. Among our common building practices are these: tapping coils just as specified in the article, rather than determining the actual impedance to be matched; assuming that the bias circuitry of a transistor provides the correct parameters, rather than measuring actual currents drawn; and assuming that proper

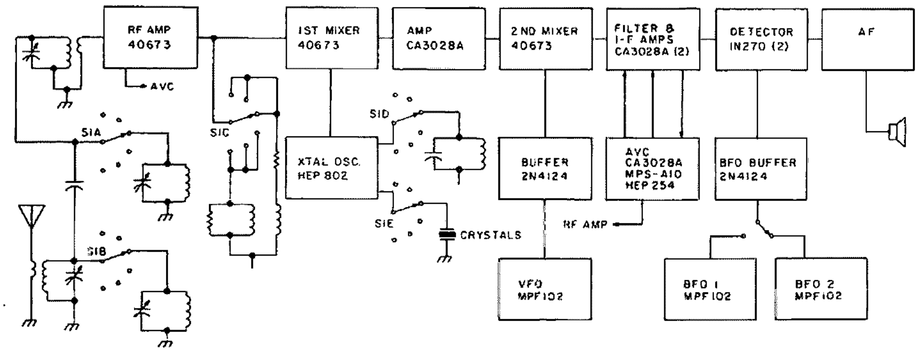

Fig. 3. Amateur receiver (simplified block diagram), adapted from the 1974 Handbook. *This particular unit was originally built in two pieces: a basic receiver from the CA3028A amp through the af board, and a converter section for all the HF bands. Note the attempt to use high-impedance devices—MOSFETs and JFETs—to minimize problems with switching-tuned circuits. Even so, a long five-section ceramic switch is required. Among the positive design features of this receiver are the provision of avc voltage to the first rf stage, upward conversion to minimize birdies, and switched bfos. Front end compromises would have been further minimized through the use of separate converters for each band.*

drive levels are present from stage to stage, rather than measuring rf voltage.

Add up all these conditions and practices, plus perhaps a dozen others peculiar to certain kinds of builders, and it is little wonder that the amateur who tries to build a receiver designed like one in Figs. 2 and 3 has little luck making it work.

Now, it is not reasonable to believe that every ham builder will spend the money it takes to obtain select components or to set up complete test facilities. Nor should we expect that in the near future, circuit reliability will increase to make every wide-range rf system easily repeated. Does this doom the amateur builder to failure? No, not if we change some parts of our design philosophy.

Some Useful Things to Remember about Transistors

Transistors and FETs resemble tubes in these two main ways: First, they may be operated Class A, AB, B, or C (plus some other ways to which experimenters have given new class names); second, any element may serve as the common element, so that we have corresponding common cathode/emitter/source amplifiers, common grid/base/gate amplifiers, and common plate/collector/drain (cathode/emitter/source follower) amplifiers. Knowing this much is important in determining the details of individual circuits. However, transistors also have significant differences from tubes, differences which are very important in the development of a design philosophy for complex pieces of equipment. As we did with vacuum tubes, let us set them out together:

1. Transistors and FETs are very small and take up little space on a chassis or circuit board. About fifty of them might fill the space taken up by one miniature tube and its socket. *Principle: Unless we are interested in the greatest degree of microminiaturization, it really does not matter how many transistors we use, so long as each is used well.*

2. Transistors and FETs create little heat at low powers, i.e., under a Watt. *Principle: No matter how many low power stages we use, heat will probably not be a factor in either the stable operation of a circuit or in the lifetime of the circuit.*

3. While MOSFETs are very high input impedance devices, transistors especially, and to some extent JFETs, will have lower impedances which require attention to matching. There are, of course, many more wide-range circuits for FETs than for transistors, which require little attention to matching. *Principle: For transistors, at least, matching to the individual device is still best.*

4. Transistors, especially in the hobbyist class available to most ham building, will vary in characteristics and require attention to operating levels. *Principle: Bias levels for transistors may need to be fiddled with, and may not work consistently across wide frequency excursions.*

5. Transistors and most FETs are cheap; to buy them five for a dollar is not uncommon, and even specified types like the popular 40673 or MPF 102 cost under a dollar. *Principle: The number of transistors and FETs in low power stages is not likely to make a ham project too costly to build.*

7. Compared to other components, such as switches, coils, and capacitors, transistors and FETs are small and inexpensive, and their associated biasing resistors may cost a nickel or less apiece. *Principle: It is better to substitute small, inexpensive components for big expensive ones wherever circuit reliability can be maintained or improved.*

From these points of comparison and their associated principles, you can see a design philosophy beginning to emerge. Since it is often (though not always) necessary to tweak a circuit up for an individual frequency band, and since the necessary components are cheap (and for other reasons which will become obvious in a few more paragraphs), it is better for the ham to build rf systems of circuits for one band at a time, and then to switch them in and out as needed, rather than to use the tried and true (for tubes but not necessarily for transistors) method of switching frequency-determining components. Not only can this method assure better circuit reliability, but it can also simplify the process of building, provide operational equipment before the entire unit is functional, and save money for the builder.

Some Examples

Let us look at a couple of examples of this design philosophy and see how they work out in practice. First, go back to the receivers of Figs. 1, 2, and 3. Fig. 4 shows how the receiver can be designed using the principles above.

The revised receiver employs converters for each band except 80 meters. This is a scheme used extensively and, with the exception of separate converters, goes as far back as the Drake 2 series of tube-type receivers. The i-f frequency is a matter of choice in accord with the design objectives, and can be a function of up or down conversion. The

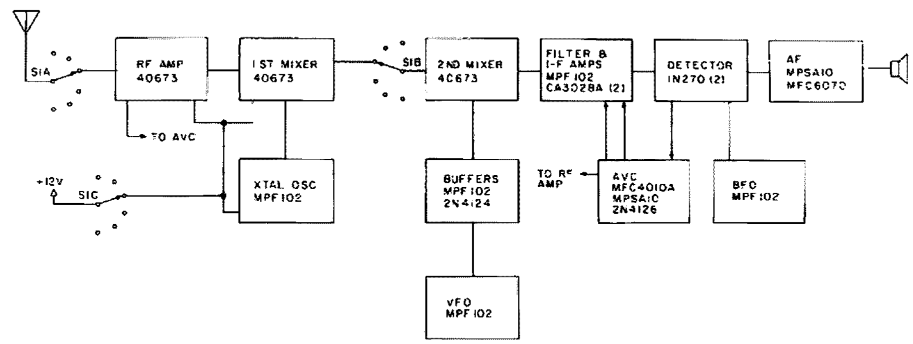

Fig. 4. Block diagram of a receiver most closely meeting the design principles enumerated in the article. In general, this is part of WA1JZC's receiver in the 1978 Handbook, *with some alterations. Unlike the original, avc is shown for the rf amplifier. My personal choice calls for different circuitry, but this design is readily available for study by the prospective home builder. Note the simplified switching of rf circuitry. The originator in fact optimized converter design for each band using JFETs in a grounded-gate circuit (except on 80, where he omits the rf amplifier) and a 2N4124 crystal oscillator. His commentary is worth repeating: "Separate converters were incorporated to eliminate the need for complicated bandswitching, and also to permit optimization of circuit values for each band of interest. The system used in this receiver calls for switching of only dc and 50-Ohm circuitry. Low-impedance switching eliminates problems caused by long switch leads. Switching at high impedance points, which is the usual technique in multiband receivers, can impair the quality of the tuned circuits and makes isolation of critical circuits more difficult." (See pp. 280-281.) Although some of these problems can be overcome by the diode-switching techniques of Fig. 2, optimizing performance and being able to assure full frequency range repeatability with home construction techniques require adoption of something similar to the design philosophy of this receiver.*

main design features to note are these:

1. No device operates at more than one frequency or band, thus allowing for optimization of all parameters. Among these are gain, bandwidth, oscillator-output level, stability, and avc action. For each converter, bias values, coupling capacitors, LC values, and the avc voltage-divider network can be juggled either to provide equal gain for all bands or to emphasize or de-emphasize some bands. (Maximum gain for 80 and 40 meters usually means more noise than signal.) The remainder of the circuit is standard, in the sense that almost all receivers operate i-f and detector stages at one frequency.

2. Note the switching system. Converters which are not in use are not powered, thus eliminating some potential birdies. Switching, however, requires only a three-pole switch, one each for antenna input, converter output, and Vcc. Moreover, by using shielded signal leads (and shielding the power lead is not a bad idea) and minimal inter-section shielding of the switch, the entire switching network can be made very compact. In some receivers using similar schemes, I have seen retained the classic long switch, running from front to rear on the chassis. It is quite unnecessary.

3. The avc system employs resistor-divider sections to limit or expand voltage excursions so that the avc action is controlled for each band. Many receivers of this design omit avc to the converters, relying upon the basic receiver sections to do the job. Given the gain of the converter sections, overloading can become a problem. Tailoring the avc action to each converter solves the problem. Avc voltage can be switched or not, depending on circuit design; it should be switched out unless the converter, when not in use, shows an open circuit to the avc voltage. Otherwise, it will load the avc system. A compact fourth pole on the bandswitch solves this potential problem.

4. Unlike many handbook designs, there is no need to make each converter identical. Single-ended rf stages operate well on all HF frequencies with MOSFET devices, but experimentation with a pair of grounded grid amplifiers in cascade, or with cascode circuits, is worthwhile. Moreover, one can try push-pull circuits, since the usual mechanical problems of band changing with balanced LC circuits are not present. I am often amazed at the lack of experimental ingenuity which appears in rf designs in the ham journals, despite the large number of possible circuits available for use, and the variety of devices which just might make one or more of them a good performer.

5. The main limitation on this design philosophy is that it does not produce the most compact equipment possible. For subminiature gear, perhaps another method of design should be used, but for home station use, miniaturization is not the ideal situation. The two main physical considerations should be experimental flexibility and accessi-

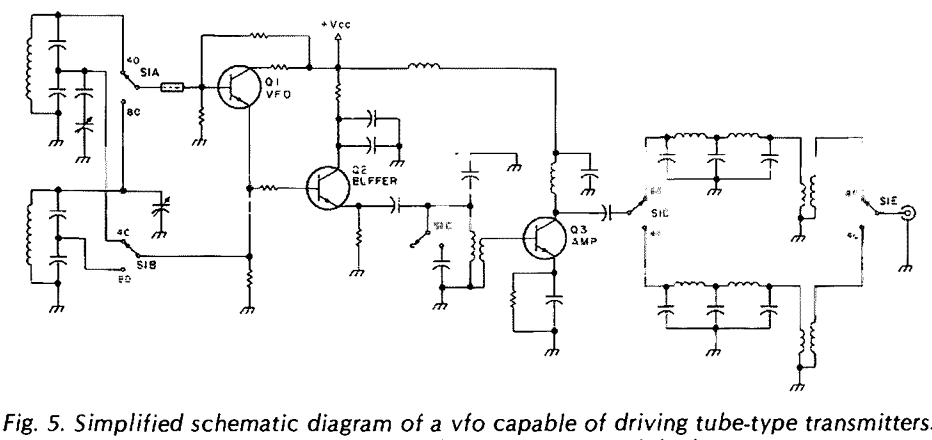

Fig. 5. Simplified schematic diagram of a vfo capable of driving tube-type transmitters. Note that LC combinations are switched by S1A and S1B, while the input to Q3 is tuned by switching a capacitor across a fixed coil with S1C. From the ARRL Handbook.

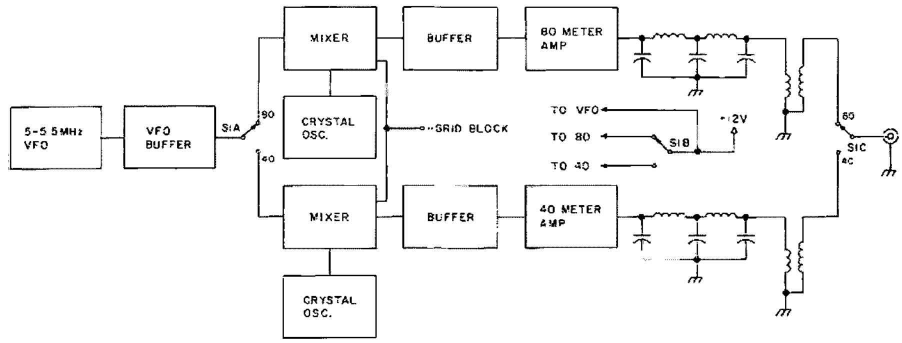

Fig. 6. Block diagram of mixing vfo for tube-type transmitters. Individual circuits are similar to those of Fig. 5. Buffers are untuned. Mixers are FETs with about −4 volts grid/gate block. Note especially the simplification of switching, which allows a single wafer to be used rather than the 8″ switch used in the original of Fig. 5. Notice also that either mixer-amplifier section may be removed for adjustment or experimentation without disabling the vfo completely. Total cost of the "extra" mixer-oscillator-buffer-amplifier devices was under $2.00.

bility, and operating ease. The mechanical size of easily read digital- or mechanical-readout systems is still the main factor limiting miniaturization. Within the size limits of most convenient readouts for main station use, there is plenty of room for the boards for each converter. In fact, many of the imported transceivers, when mobile use is not intended by the operator, appear to be excessively compact both for operating ease and for maintenance convenience. Heat is a constant worry with them.

The amateur designer, therefore, might well take a page from the notebooks of home computer designs. Within whatever case one uses, develop a main frame with plug-in units at every stage, along with space for future, more complex circuits. With careful attention to routing rf paths, you can use plug-in circuit boards or plug-in perfboards. Shielding between most boards is a must. The advantage of this system is that replacement circuits can be developed independently and tried in the receiver, without losing the receiver from service for long and without mechanical alteration to the basic unit. This not only ensures an operative receiver at all times, but also eliminates future mechanical costs for new versions. Your equipment will be as up to date as your latest experiments, however old the case may get.

These advantages accrue not just to receiver design, but also to transmitter stages as well. Fig. 5 shows an 80/40 meter vfo that appeared in the *ARRL Handbook* for several years. Notice that the tuned circuits in the vfo are switched. Note, too, that the input circuit to the power amplifier is changed from 40 to 80 meters by the addition of a capacitor. Neither of these schemes is optimal, and their correction is hinted at by the design itself. The output filters are switched in their entirety. Why not the entire power train?

Fig. 6 shows a simplified diagram of the revised system built for a ten-Watt standby rig using tubes. The 5- to 5.5-MHz oscillator runs all the time. Separate mixer, buffer, and amplifier stages give 80 and 40 meter output. They are built on separate boards and require only a three-pole switch, one each for vfo input, amplifier output, and power. If one desires separate output jacks for each band, one pole of the bandswitch can be eliminated. Tuned circuit and bias values have been optimized for each band. Since the transmitter with which the vfo is used supplies not only the twelve volts, but also blocked grid-keying voltage, the mixers are keyed. Because of the transmitter design, more output was required on 80 than 40, a problem easily solved using this scheme. If I ever use the vfo with another rig, equalizing the vfo output will be no problem either. Despite the fact that the vfo uses an old ARC-5 tuning capacitor, the entire unit fits in a 4 x 5 x 6 case. Obviously, little is lost to compactness by the use of the design principles enumerated here.

The purpose of this article is not to get you to build what I have built. Instead, it is designed to encourage you to build what you want, by showing that there are some basic principles which take the scariness out of complex rf equipment that appears in the ham journals. The basic idea to get rid of is that you have to make a tricky device like a transistor operate all the way from 80 or 160 up to ten meters. Doing your work one band at a time and building your equipment one section at a time not only makes building for the amateur non-engineer possible, but also makes it fun. What you learn from trying new bias values and schemes, or from trying different LC values, will soon give you confidence that you can make almost anything work.

building, and that is to give you my personal prejudices about what test equipment the ham builder ought to have. A VTVM with regular and rf probes is essential—preferably one that has a range of about a volt and a half for reading partial volts. My trusty Heathkit has stood me in good stead for many years. A grid-dip meter for testing LC circuits or for a signal source is also very useful. A VOM for current readings is needed, but it need not be an expensive model. Beyond that, the rest is up to you. Oscilloscopes, frequency counters, impedance bridges, and the like are all useful, but with them I notice that I do not have to clean off my fingerprints nearly as often as I do with other pieces of test gear. Finally, station operating meters for swr, power output, and dummy loads are useful only for some projects. An all-wave HF receiver, however inexpensive and inexact in dial reading, can help a great deal, especially in testing things like heterodyne oscillators. For me, however, the big three are the VTVM (and rf probe), the gdo, and the VOM.

The principles I have given can be expressed in many ways. I welcome additions to the list, and new ideas to improve my own techniques. Hopefully, the ones given here are enough to encourage you to make the move from building station accessories to building your entire station. Then you can use that commercial rig as your standby. ■

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Shortened Antennas for 75 and 80

—designs which fit your QTH

Slopers exposed.

During 1975 and 1976, I tested various 75 meter antennas with several ZLs and VKs. This band is generally open from there to the United States during the early mornings (local US time) around 1000 to 1200Z. I have been trying to determine if there is any particular 75m antenna best suited for this 7- to 8-multihop 8000-mile-plus path. There are usually a number of US hams working the ZLs and VKs on SSB between 3775 and 3850 kHz. The ZLs are permitted to work this portion of the band. As the VKs' highest frequency end is 3700, they generally transmit SSB between 3680 to 3695; therefore, split operation must be used with them.

75m antennas tested here during 1975-76 were: several dipoles at various heights (40 to 70 feet); three delta loops; a two-λ horizontal quad at 70 feet; two ½-λs in phase, collinear at 70 ft. (broadside to NZ); several ¼- and ½-λ verticals; a 3-element yagi at 60 feet; and three horizontal monoband dipole log periodics (DLP), one 3-element, one 4-element, and one 5-element, all at 60 feet.

At times, I have had as many as 3 or 4 75m antennas up at the same time for making direct comparisons between the various types. During the tests, the best reports from the ZLs and VKs have been with the log periodics and the yagi. As all of my antennas are supported by pine trees, the maximum height above ground for the horizontal antennas is limited to 60 to 70 ft., or approximately only ¼ λ above ground at 3.8 MHz. These are, of course, fixed-wire beams.

At times, the yagi or the log periodic would be reported as much as 10 dB better than some of the other types being tested. The yagi and the LPs were all beamed west or SW.

The log periodics and

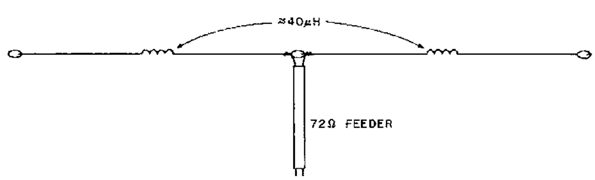
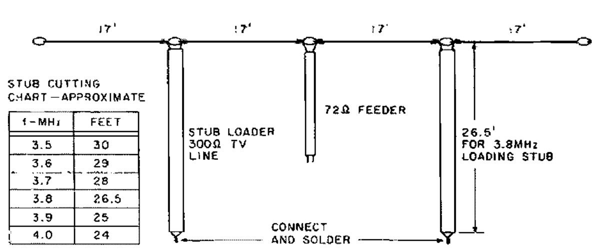


Fig. 1(a). Coil-loaded shortened ½-λ dipole.



f-MHz	FEET
3.5	30
3.6	29
3.7	28
3.8	26.5
3.9	25
4.0	24

Fig. 1(b). Stub-loaded shortened ½-λ dipole.

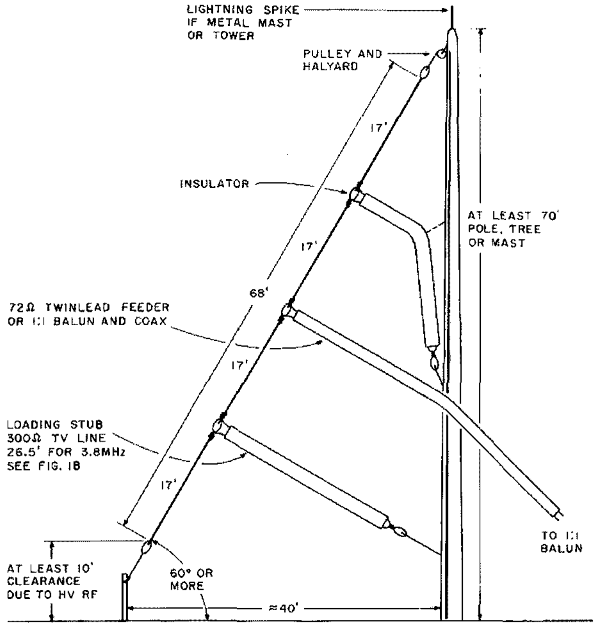


Fig. 2. Shortened ½-λ dipole sloper, stub-loaded.

the yagi, although producing the best reports from "Down Under," are quite large, requiring a width of approximately 150 feet and a boom length of at least 100 feet. The general design of the 5-element monoband log periodic is given in reference 1, Fig. 6, reference 2, Fig. 2, and reference 3, Fig. 4. The dimensions for the frequency range 3.8-4.0 MHz are given by reference 2, Table 1. This LP was supported at about 60 feet by 8 pines.

As an antenna of this size is generally impractical for the average ham on a city lot, during 1977 I tested 75m antennas requiring less space but still giving some gain and more directivity than the usual 75 or 80m dipole or inverted vee when limited to a height of only sixty to seventy feet. These are described in the following.

Shortened Dipole Slopers

During the tests with the ZLs and VKs, it was noted that W2GO, one of the more consistent early morning DXers, uses a single shortened (66-foot) dipole as a sloper to the west with very good reports.

Shortened dipoles using off-center loading coils were well covered by Jerry Hall K1PLP (*QST*, Sept., 1975, page 28). By use of two 40-μH loading coils, the 75m dipole was shortened to 66 feet. This is the type used by W2GO for his shortened 75m centerfed ½-λ sloper, which requires only a single 60- to 70-foot pole, tower, or tree support. It is sufficiently compact to be used on a small lot. This was the type which I selected as being the most simple and compact antenna requiring minimum space.

As I did not have a pair of loading coils as specified in the *QST* article and did not wish to take time to wind them, I used instead two lengths of 300-Ω TV line as loading stubs for the shortened dipole. See Fig. 1(b). As a start, I used 30-foot stubs which resonated the shortened 68-foot dipole at approximately 3.5 MHz. Resonance can be determined by a GDO or by running an swr.

Next, the stubs were each pruned about 6 inches and the resonance was again checked, and then another 6 inches were removed and the frequency checked. This procedure was continued until the dipole resonated at 3.8 MHz. A total of 3.5 feet had been removed from each stub, making them each 26.5 feet in length. These loaded the dipole to the desired center frequency, 3.8 MHz. An swr was then run to determine the usable bandwidth of the shortened stub-loaded dipole, illustrated in Table 1. It will be noted that the bandwidth is quite narrow but usable ±100 kHz covering the DX portion of the 80m phone band.

This shortened or loaded dipole was then suspended as a sloper (Fig. 2) from the top of a 70-foot tree and sloped SW for tests with the ZLs. Although the overall length of the sloper was only 68 feet, it worked surprisingly well, considering its simplicity and ease of construction. It was fed with 72-Ω twinlead connected via a 1:1 balun to a buried coax to the shack.

For a dipole-type sloper to be effective for DX, or rather to have a fairly low angle of radiation, it should form an angle of at least 60° to ground. 70° to 80° would probably be better. It, no doubt, acts as a ½-λ vertical or semivertical. Being centerfed, the necessity of an elaborate ground radial system as required with a ¼-, ½-, or basefed vertical is probably not as important. None was used during these tests. If the slope angle is less than 60°, say 45°, it will probably have more horizontal polarization and higher angle radiation and would become more like a low horizontal dipole with the major radiation lobe at 90° or straight up. In this configuration, it would no doubt show an improvement with nearby stations up to a few hundred miles, but DX operation would suffer.

A second sloper using an old Hy-Gain 40/75 trap dipole (overall length about 110 feet) also was tried, suspended from a 100-foot tree and aimed SW. This sloper seemed slightly better than the original 68-foot stub-loaded sloper. This was no doubt due to greater overall radiating length, more effective height, and an angle of about 70°. It had the advantage of also being usable on 40, though no extensive tests have been made with it on this band.

Phased Slopers—Endfire Array

As above slopers gave fair results considering their simplicity and ease of construction, it was decided to try a 3-element phased sloper (all elements driven) in a log periodic, endfire sloper array configuration. This was constructed by using a nylon line catenary stretched between two high pines separated by about 200 feet and oriented to give a beam at about 225°. The higher, rear tree was about 75 feet in height and the forward tree was about 60 feet high.

As the use of stub-loaders was not desirable due to complications in suspending the stubs so that they would come off at about 90° with respect to the sloper elements, it was decided to use end loading instead of stubs. This was accomplished by folding about 25% of each element end to the rear and securing them to the top and bottom catenaries, as illustrated in Fig. 3(a).

As it was desired to operate this beam centered on 3800 kHz, it was adjusted so that the longest rear element, #1, resonated at 3.7 MHz, #2 at 3.8 MHz, and the short forward element, #3, at 3.9 MHz. The easiest

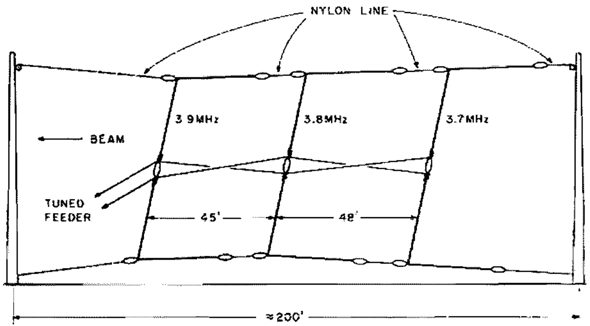


Fig. 3(a). Log periodic phased sloper, end-loaded.

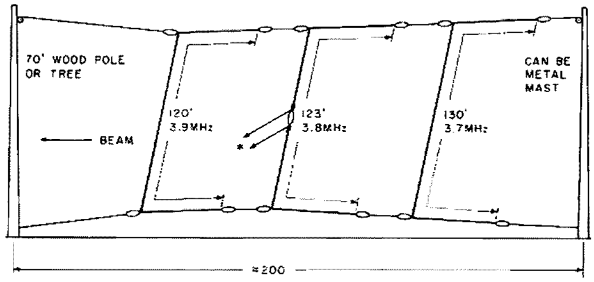


Fig. 3(b). Yagi phased sloper, end-loaded.

way to adjust this is to cut each element slightly longer than its required frequency. Then put temporary jumpers across the center insulators (feedpoints). Secure the ends of each element (folded back portion) to the catenaries and then raise the array to its normal suspended height. At this point, the 2-wire center feeder is not used.

Next, check resonance of each of the three elements separately by holding the GDO near the horizontal section at the bottom of the catenary, and pruning the ends as necessary to the three frequencies, 3.7, 3.8, and 3.9 MHz, as mentioned above. This must be done with the array suspended at its final location due to variations of resonance depending on the height of the three elements above ground. These three frequencies were selected so that the completed antenna would be centered on approximately 3800 kHz, and also to allow the array to operate as a log periodic.

Once the three elements are tuned, the array can be lowered, the jumpers across the three center insulators removed, and the 2-wire open feeder or phasing line connected as shown in Fig. 3(a). Note the transposition required for the array to perform as a log periodic or an endfire array. Each element must be out of phase with its neighbor, as required of any log periodic. The construction of the feedline is presented by the articles in references 1, 2, 3, 4, and 6, covering log periodic wire beam construction, and will not be repeated here.

A large array of this type for 75, even though using only 3 elements, must be assembled and tuned on site for its particular surroundings and height above ground. Table 2 is overall swr covering 3.5 to 4.0 MHz, after adding the center feeder to the array. It then centered on about 3.7. However, as the swr at 3.8 was only 1.25:1, no further changes were made since the beam was usable between 3.6 to 3.9 MHz.

Although this phased-sloper log periodic was only tested for about one week, it appeared to have gain and directivity as hoped. During one of the tests on 3808 kHz, Bob Tanner ZL2BT advised that it was about the same as the 3-element horizontal yagi at 60 feet which I was using at the same time.

The main advantage of the above phased sloper is that only two trees or masts are required, as compared to 6 or 8 necessary to support the 3-element yagi or an equivalent 3- to 5-element DLP. Further, the phased array, being primarily vertically polarized, should have a lower angle of radiation. Since the radiating elements are semivertical dipoles (centerfed), a ground screen or counterpoise was not used during the tests. Although the length requires about 200 feet of mast spacing, its width is less than 1 foot, compared with the 150-foot width of a 75m dipole log periodic or yagi.

For those who prefer yagis, the same 3-element sloper could, no doubt, be arranged as a 3-element yagi by deleting the open wire center feeder, deleting the center insulators from elements #1 and #3, and feeding the center of #2 element directly with 72-Ω twinlead or, better still, with an open tuned line. See Fig. 3(b).

The array would then become a yagi with #2 the driven element, #1 a parasitic reflector, and #3 a parasitic director. The yagi sloper array would, no doubt, have a more narrow bandwidth (possibly no more than ±50 kHz) than the bandwidth of the log periodic configuration. I have not tested the sloper array as a yagi, but, on previous tests comparing a 3-element horizontal monoband DLP with an equivalent 3-element yagi, a greater bandwidth was given by the log periodic.

Test Results

Shortened loaded slopers—

From the tests made with ZLs and VKs on these 75m antennas, and also from comparing notes with the previous tests with ZL1BKD during 1975-76, it appeared that the single shortened loaded-dipole sloper was equal to the larger delta loops, 2-λ horizontal quad, verticals, etc., which were tested then versus the large 75m yagi and/or log periodic (horizontal dipole-type) beams. The latter did average out about 10 dB better than the more simple antennas, including the slopers.

Considering the simplicity and ease of building the loaded sloper, and the fact that only one support is required as against 6 to 8 to support my large beams, it is believed the loaded sloper is the least expensive 75m DX antenna and about the only one suited for a city lot except, possibly, a single ¼- or ½-λ vertical, which can be quite expensive if a 60- or 120-foot tower or mast is used and the required 60 feet or more of ground radial system buried. The latter may also be a problem on a city lot.

During the tests, the large beams would show as much as 15-dB increase over some of the more simple antennas, but these differences would vary from day to day. The 10-dB gain over the more simple antennas was more the average.

Comparing the simple sloper with the delta loops, the type with apex topside requires only one high support but needs about 120 feet of space for the lower horizontal section. The type with the horizontal section up and apex down requires two supports spaced at about 120 feet.

Comparing it with the

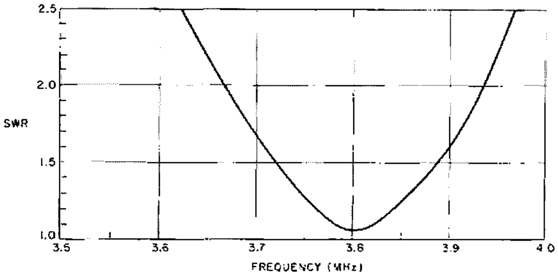


Table 1. Shortened dipole sloper.

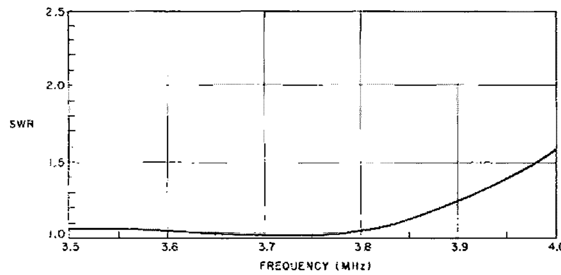


Table 2. Log periodic as in Fig. 3(a).

horizontal 2-λ quad, the latter requires four supports arranged in a square with about 130-foot separation, hardly suited for a city lot. The delta loops and quads also require more wire. 75m phased verticals are also impractical in a small space.

Therefore, the simple loaded-dipole sloper is recommended as a good all-around and inexpensive DX antenna if one does not have an open space of about 150 x 150 feet for a large beam to provide gain. Further, the latter, requiring 6 to 8 supports, also requires considerably more wire, insulators, etc., and a great deal more effort and labor!

For anyone not interested in 75m DX, a shortened or loaded sloper used as a high-angle radiator, either as a sloper at about 45° or as a low dipole at about ¼ λ or at approximately 60 feet above ground, will be a good average short-haul antenna for several hundred miles.

One suggestion would be to have two anchor posts for the bottom end, one to provide a slope angle of at least 60° for low-angle DX, and the other to give about a 45° slope for general short-haul communication.

The 3-element phased sloper—

Although this is a more elaborate beam, having gain, it is not generally suited for a city lot, since two masts with a 200-foot separation are required. It does have an advantage in that very little width is required, but it does require considerably more wire, insulators, and labor to assemble. It did appear to be about neck and neck with the yagi (also being used at the same time) from the ZL and VK reports. It may have been just a bit noisier on reception due to being more nearly vertically polarized. However, I did not have time to determine this for sure. It did make a good showing "down under" when compared directly with the yagi being used then.

A 3-element wide-spaced horizontal log periodic beamed west was set up later, which Bob Tanner ZL2BT advised was the best antenna tested here over the past 3 years.

I might add that, when comparing the various 75m antennas during this period, if the ZL or VK reported a 1 or 2 S-unit or 5- to 10-dB increase or difference between two antennas, the same difference on reception of their signal would generally be noted, as would be expected.

On this multihop 75m path, there is generally less QSB than on the higher bands. When there is fading, it is usually slow, unlike rapid QSB on 20.

For the information of those who do not work 75m DX, the VK and ZL signals generally have a slow buildup about 15 minutes before sunup, when they peak. They remain peaked for 15 to 30 minutes, and then start a decline for 30 minutes to 1 hour after sunup, local time.

As yet, I have not determined if the sunrise peak is due to "gray line" propagation or possibly due to a change in ionization of the F-layer, causing less attenuation at this end or possibly in the last hop (received at this end), thus giving the 5- to 10-dB signal increase which is generally noted at sunup.

It is doubtful that "gray line" affects the US-NZ path since they are in total darkness approaching midnight (sunup here in the east). "Gray line" might affect the W-VK path since sunup here is about sundown in certain parts of Australia.

To get more firsthand information on this, I am now (as of this writing) in the process of putting up two beverage receiving antennas, one N-S and one E-W. These are 2-wire reversible-direction beverages, each 520 feet in length, for use on 160, 80, and 40. Some very excellent data, suggestions, and material have been made available to me by Paul W6PYK for this test, for which I am very grateful. I had previously tested several simple single-wire beverages, resistor-terminated, to improve S/N.

The beverage project was started here originally to try to improve reception which is extremely poor, especially on 75, at this QTH. This is due to very poor ground conductivity, extremely high noise level (both QRN and man-made) on 75, and the fact that it is surrounded by high pine trees (60 to 90 feet) except to the NE and E. They extend for several miles to the SW and W.

For this reason, there is little open space for verticals, since trees higher than a ¼-λ vertical would surround it. There would be some trees separated from them by less than 50 feet, very thick in the direction of the ZLs and VKs. The two single-wire slopers which were tested were suspended from trees in open areas, although there were trees within about 100 feet to the W and SW.

For those who may become interested in 75m DX, there are some very good suggestions on propagation, "gray line," 75m antennas, receivers, a list of 75m DXers, beverage antennas, etc., presented in John Devoldere ON4UN's ham book *80 Meter DXing*, published in 1977. He includes a very complete list of 86 previously-published articles in the various ham publications covering these subjects.

Other Suggested Sloper Designs

In addition to the shortened loaded sloper and the 3-element phased sloper described above, the following are several suggested slopers and phased slopers. I have not actually tried these, but they are described briefly for anyone wishing to experiment or

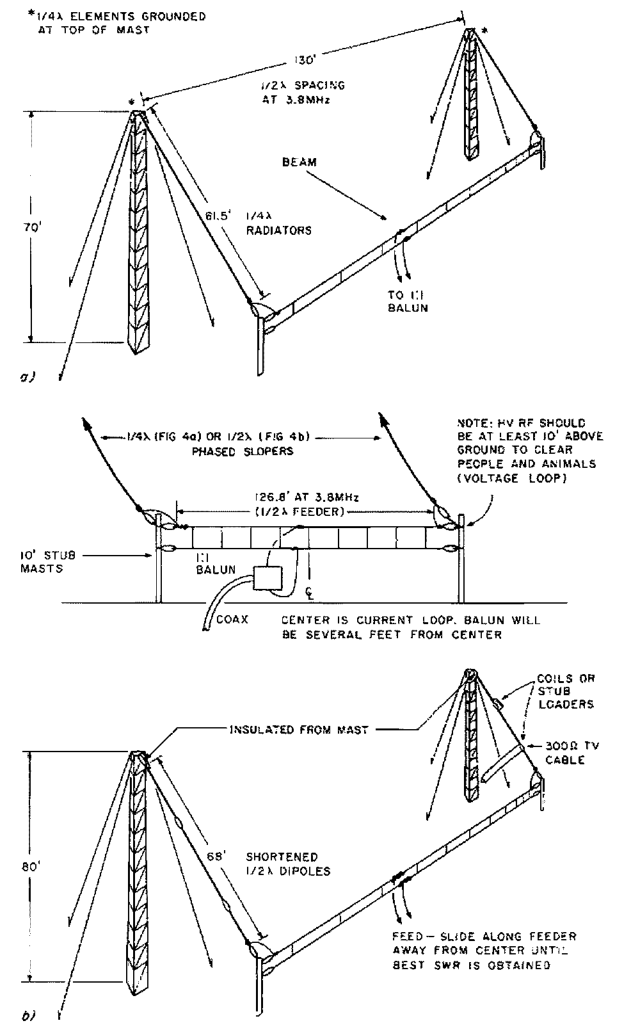


Fig. 4.(a) ¼-λ phased slopers. (b) ½-λ shortened phased slopers.

who is interested in antenna design.

Multidirectional slopers—

If there is sufficient open area around a single high mast or tree, 3 or 4 of the shortened 75m dipole slopers could be used for several directions as per K1THQ's 40m four-direction sloper described in the *ARRL Antenna Book* (Figs. 8-12, page 200, 13th edition). According to his measurements, the forward gain was about 4 dB and front-to-back up to 20 dB. Note that the coax to the relay box must be just over 3/8 λ. At 3.8 MHz, this length would be approximately 63.4 feet of RG-8/U or RG-58/U (VF = 66%), or 74.9 feet of RG-8/AU or RG-58/AU (VF = 78%).

I have not tried this 4-directional sloper, but it sounds interesting for anyone having the room and needing a lobe in more than one direction. If a mast at least 130 feet in height is available, full ½-λ sloping dipoles could be used without loading and would no doubt be more effective. The dimensions would then be about double those given for K1THQ's 40m switchable sloper.

¼-λ slopers—

Not having a tower, I have been unable to test a ¼-λ inverted sloper fed by coax at the top of the tower (with the coax sheath grounded to the tower near the feedpoint). I have worked several on 75 who have reported good results with this type of inverted sloper.

Theoretically, this should be a good antenna, since the current loop of the ¼-λ sloper is topside and generally in the clear. The tower provides a ground plane or acts as a reflector, which should give some directivity. However, this type appears to be tricky (and they either work or they don't). No doubt the ¼ wavelength and the angle between the sloper and the tower are critical, probably affecting the impedance at the top feedpoint, which is probably low. Possibly a matching network between the coax and the feedpoint would help, or possibly the top of the ¼-λ element could be grounded directly to the towers and the lower end voltage fed at the bottom with a tuner or a ¼-λ tuned line used to voltage or end feed, similar to the old Zepp. Using voltage feed at the bottom also saves the length of coax from bottom to top of tower.

I have one friend, YV5DLT, who put up two of these ¼-λ inverter slopers (topfed), one for 75 and one for 40. He said the 75 worked with no problem, whereas the 40m refused to work. I have noted that about 25% of those using the ¼-λ sloper have gotten them to work; the rest had problems or became discouraged if they did not work right away.

Possibly those using these successfully can give some suggestions. Also, the estimated angle of radiation, H-plane pattern, etc., would be interesting.

Dual ¼-λ phased slopers—

Possibly, using two of these side by side, in phase, spaced ½ λ broadside to the desired direction, might be of interest, as per Fig. 4(a). The two ¼-λ elements spaced ½ λ would be grounded topside, as mentioned above. The two bottom ends (voltage loop) would be voltage-fed with a ½-λ open phasing line feeding the ends, so the two ¼-λ radiators will be in phase. The ½-λ phasing line is current-fed, slightly off center directly with the coax or with a 1:1 balun. For 3.8-MHz operation, the two ¼-λ slopers would be approximately 61.5 feet and the 2-wire open phasing feedline approximately 126.8 feet long. This beam requires two 70-foot towers spaced about 130 feet apart and oriented broadside to the desired direction. A few wire reflectors between the towers might improve the lobe in the desired direction.

This array would be similar to the broadside or side-by-side phased slopers described below, except ¼-λ slopers would be used in place of the ½-λ shortened dipoles. See Fig. 4(b).

½-λ phased-sloper or vertical-dipole arrays—

If a mast at least 130 feet high is available, it could be used to support a full ½-λ phased sloper or vertical dipole endfire array. The elements would then be a full ½ λ (no endloading required), thus being more efficient and having greater effective height.

Another advantage of greater height would be the possibility of having the three elements near or exactly vertical, so the array would then become a 3-element vertical (dipole) log periodic or 3-element vertical yagi (whichever configuration is preferred) as was described above under "Phased Slopers—Endfire Array."

With the shortened dipole sloper or multi-element sloper arrays, the loaded elements probably reduce efficiency about

50%, as the shortened radiating portion is only approximately ¼ λ. Their ¼-λ radiating portion should be about the same as the vertical radiating portion of a Bruce array.

The end-loaded sloper array might be considered as a 3-element endfire array, as opposed to a 3-element Bruce array which is a bidirectional, broadside one using ¼-λ radiating elements in phase spaced ¼ λ. The 3-element endfire array would be unidirectional and should give greater gain. The Bruce would, however, probably have a greater null to the sides (180°).

If a single high mast is available, it could also be used as the center support for 3 or 4 separate phased endfire arrays, thus providing 3 or 4 separate beam headings or separate selectable lobes at 120° for 3 arrays or 90° for 4, for beaming N, E, S, or W.

Granger, Trylon, and Hy-Gain manufacture commercial or military fixed-wire monopole and vertical dipole log periodic wire beam arrays of these types for frequency ranges 2.5-32, 3.0-32, 4.0-32, and 6.0-32 MHz. These are recommended for long-haul HF circuits. See the Hy-Gain commercial catalog E, 1969.

Incidentally, if any hams are interested, these commercial wire beams are generally in the $20,000 to $50,000 class. However, this does include an 100- to 240-foot steel tower. A 3- to 5-element vertical (monoband) dipole log periodic for 75m can generally be ham-built for $100.00 or less for wire, insulators, etc., less tower and coax.

Broadside or side-by-side shortened slopers—

Another suggested phased sloper could be the use of two shortened 78-foot ½-λ (loaded) sloper dipoles suspended from two 70-foot masts spaced ½ λ (approximately 130 feet at 3.8 MHz). See Fig. 4(b). The two slopers would be operated in phase with 130 feet of separation. A ½-λ tuned feeder/phasing line would be required for feeding and phasing the two slopers, similar to the dual ¼-λ phased slopers described above in Fig. 4(a).

Better still, if the two phased slopers could be a full ½ λ (requiring two 130-foot masts), they should give about maximum gain to broadside for an array of this type. I believe I have heard of some ham using this type of beam.

There are, no doubt, many phased-sloper-array combinations which can be designed. I again wish to point out that I have only built and tested the loaded sloper of Fig. 2 and the 3-element (end-loaded) phased sloper of Fig. 3(a).

I would appreciate hearing from anyone who is using or has tried any phased-sloper arrays or has any suggestions along this line. ■

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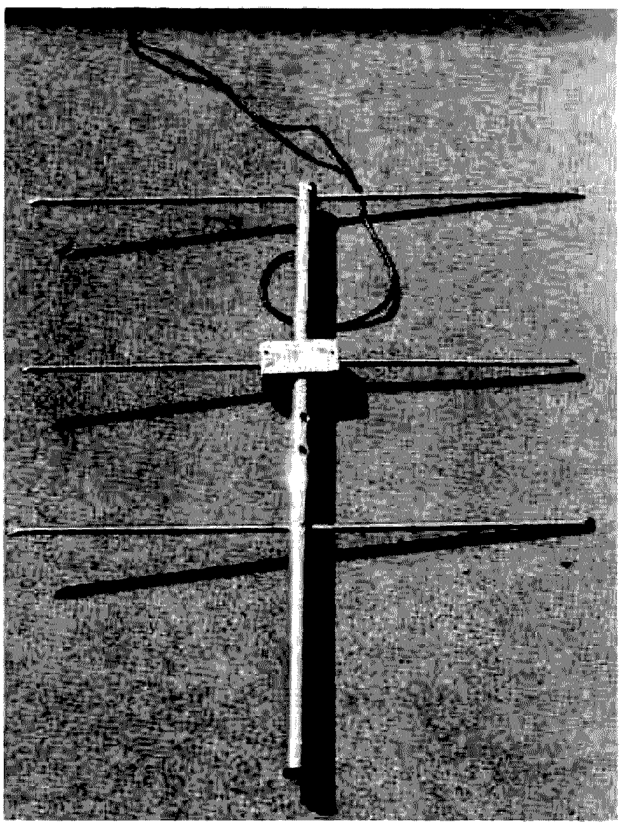
✓ Reader Service—see page 211

Frederick James Bartolomei N8AJA
19442 Rockport Drive
Roseville MI 48066

Build This Simple 220 Yagi

—3 elements, 6 dB

The $5 AJA special.



The completed 220-MHz beam.

If you're looking for an expensive, double-figure-dB gain HF antenna, try another article, because this construction project won't help you at all—especially if you want an HF skyhook. However, if the idea of a $5.00, 3-element yagi with about 6 dB of gain for 220 MHz suits you, then read on.

When the June, 1978, issue of *220 Notes* (volume 1, number 4) arrived at my doorstep, I was new to 220 MHz; in fact, the ink on my Tech ticket was still moist! So the blurb titled "Your Own Little 220 Beam" on page one captured my immediate interest. Although *220 Notes* included a marvelous sketch of the antenna (which they adapted from C. N. Zornes W9TAL), the newsletter contained no instructions for assembly. Fig. 1 is redrawn from *220 Notes* and shows antenna dimensions.

To build W9TAL's beam, I purchased a GEC-52 conical TV antenna, made by RMS Electronics, 50 Austin Place, Bronx NY 10462, for five bucks from a local radio-electronics store. I chose this model because of the cheap price, but any television antenna will do. Another route is to buy a boom and 1/8" or 3/8" aluminum rods separately.

Step 1: After taking the TV antenna from the shipping carton, remove the elements (secured to plastic hubs with pop rivets) by drilling out the rivets with a bit slightly larger than the head. Now you have several aluminum elements of various lengths and a boom.

Step 2: Measure the length of your boom. It must be at least 30 inches. The mast-cum-boom supplied with the GEC-52 is 31½ inches long. If your boom exceeds three feet, I recommend shortening it

to 30 inches. A hacksaw or saber saw will do the job. Now mark a ¾-inch point in from either end; mark another ¾-inch point on the other side, i.e., directly behind it. You will be drilling through these points, so make sure they line up! Make similar marks 19½ inches in front of the first two. Measure the diameter of your elements, add 1/16 of an inch, and drill holes in each of the four marks. The drill bit will not slip if you first punch holes in the boom with a large nail.

Step 3: Make marks midway between the holes you drilled for the reflector element. These are perpendicular to and ¼ diameter away from the original holes. Stove bolts will drop through these points to secure the reflector. Repeat this procedure for the director. Once the spots are marked, drive a large nail through them and wiggle it around to ream out the aperture.

Step 4: Time to cut your elements. Measure and cut one element 27-1/8 inches long—this is the reflector. Measure and cut another 24-1/8 inches long—this is the director. Measure and cut two elements each 12 inches long—these are the driven elements.

Step 5: Crimp the open ends of the reflector and director and one open end of each driven element with pliers to prevent water from entering and rusting them. If the crimped ends are rough, a file or sandpaper will smooth them off. Locate the midpoint of each element (13-9/16 inches for the reflector; 12-1/16 inches for the director) and punch a hole, using the nail from Step 3, to allow a bolt to pass through it.

Step 6: Take a 4-inch piece of 2" x 4" and bore a hole in it as shown in Fig. 2, to accommodate the boom. Use a smaller bore (or large bit) to drill holes in the sides of the 2" x 4". These holes should be ¾ of an inch to 1 inch deep and under no circumstance should they intersect with the boom bore.

Set a driven element in each of the two side holes (make sure it is snug against the back) and screw a 1½-inch wood screw into the top of the 2" x 4" about ½" from the edge. The screw will secure the element and will later serve as a conductor between the coax and element. Slide the 2" x 4" on the boom so that the elements' centers are 10½ inches from the middle of the reflectors' holes.

Step 7: You're in the home stretch . . . final assembly begins here. Place the reflector (remember that's the longer element) in the large holes near the rear of the boom. Align the holes in the boom and reflector so that they match. Set a flat washer over the topside hole and drop in a bolt. Tighten the bolt with a lock washer and nut on the underbelly. Repeat this for the director.

Strip 1½ inches of the coax's outer covering off the end. Twist the shielding braid into a "wire" and remove the plastic insulator from around the center conductor. The total distance between the split in the coax to the end of each driven element is 12½ inches. Measure the length from one screw in the 2" x 4" to the tip of the corresponding driven element. Subtract this size from 12½ inches and wrap all but the difference of the twisted coaxial braid around the head of the wood screw. Drive the screw as deeply as possible into the 2" x 4". Repeat this part of Step 7 for the remaining screw and the cable's center conductor.

I wrapped silver duct tape around the 2" x 4" to isolate it from the nasty Michigan winters and to increase the beam's life.

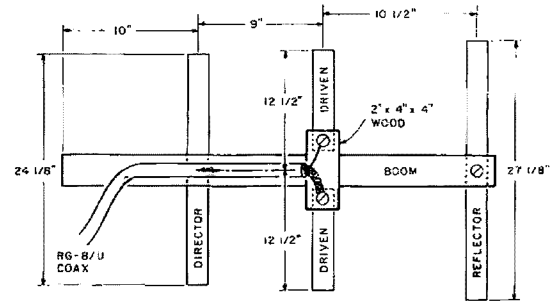


Fig. 1. Antenna and dimensions. Adapted from: 220 Notes, *volume 1, number 4, June, 1978, page 1.*

Bathtub caulking is another solution.

Results

In preliminary tests the yagi performed admirably. My first simplex contact was with Tom WB8GVC in Detroit (a distance of about fifteen miles), and the antenna was only ten feet above ground level. When I taped the beam on a twenty-foot makeshift mast (and had my father and Tom WD8OTN take turns playing rotor), I raised the WR8AOK repeater in Livonia, Michigan. WR8AOK sits forty-five miles from my home QTH—not bad for a ten-Watt Midland 13-509 rig and a twenty-five-foot run of RG-58/U. In the low power position (one Watt), I full-quieted the WR8AEF machine in Mt. Clemens, Michigan, a six-mile haul. All in all, I've been impressed with the results of W9TAL's design.

For maximum results, mount the beam as high up as possible—or, at least above surrounding trees—away from other metallic objects, and use RG-8/U coaxial cable to minimize transmission line loss.

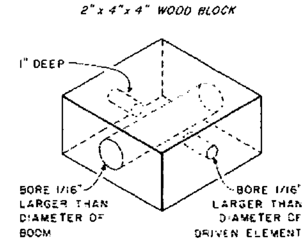


Fig. 2. Sketch of wood block holding driven elements.

I purposely neglected VHF/UHF antenna theory in this article. If you're curious about why it works, then consult one of these fine books: *VHF Antenna Handbook* from *73 Magazine* for $4.95 or *The Radio Amateur's VHF Manual* from the ARRL for $4.00. I felt the underlying theory was too much to tackle here and many hams, like myself, are more concerned with putting out a good signal. Any comments, questions, or objections you have on this fine, 6-dB, 220-MHz antenna at the minimal cost of five bucks will be answered, provided, of course, that you enclose an SASE.

As for me, I'm heading back to the radio . . . "QRZ rare DX from N8AJA in Roseville, Michigan." ■

Parts List

TV antenna (GEC-52) *or* 6½' of 1/8" or 3/8" aluminum rods and 30" boom
4" piece of 2" x 4" wood
saber saw or hacksaw with blade
2 wood screws (1" long)
2 stove bolts (1½" long) and lock and flat washers
wood bore and drill bits
electric drill
RG-8/U coax with 1 PL-259
rosin core solder and soldering iron

Alexander MacLean WA2SUT/NNN0ZVB
18 Indian Spring Trail
Denville NJ 07834

Beware of the Dreaded Phantom Ground

—exorcise those antenna gremlins

Avoiding the non-radiant antenna.

The article by John Cranston WB2DYU/2 in the March, '78, issue of *73* ("I Need A Contact!") brought back many unpleasant memories of past station operation and more than too many of how it works now. I, too, have a long history of inventing the non-radiant antenna. However, a few of the rules of thumb (or burned fingers, if you will) arrived at may be of help to other hams starting out.

If you don't read too much theory, it is harder to build an antenna that will not work than to build one that works.

From the description of what Cranston has, there seem to be a few old friends. One of my favorites is the phantom ground. All the books say that you should ground the equipment, particularly the transmitter, to avoid all sorts of troubles. Usually this leads to all sorts of troubles just like the ones you wanted to avoid, like TVI and rf burns when you touched the rig.

So what happened? Well, the ground was always shown in a picture-book station. There was all that beautiful gear, all hooked up together with a heavy copper braid ground bus to a conveniently located ground. It is the "conveniently located" that kills you. When they say ground, they mean ground, as in nice wet earth. To work, the direct earth connection must be quite close to your equipment and connected with a solid hunk of metal.

Many hams have some heavy copper water pipe that goes right through the basement shack and into the ground. Now that is a reasonable ground. If you don't have that, you don't have a ground. The further away from that you are, the less ground you have.

If your shack is on the first floor, or more probably the second floor or attic, you don't have any ground at all. What you do have is a hunk of far too thin wire draped all through the house to a water pipe and maybe a long run of that to the ground. For rf purposes, you aren't even connected to the ground. What your transmitter sees is what looks like another hunk of antenna. That, added to your nominal antenna, results in almost as good a radiator as your store-bought dummy load.

I have tried a number of different configurations of this basic circuit and can recommend it for tune-up purposes. It also is very impressive to show visitors how you can light a small neon bulb with your nose when you key the rig.

Let's get back to practical for a bit. There is no such thing as a long ground unless you can run something the diameter of a sewer pipe from the rig to the ground. I don't think that will work well, either.

So, forget the ground. Build an antenna that will work without the ground. This is not as hard as it sounds. Without the false ground to give trouble, many antennas will do the job without trouble.

Most rigs are coax-fed these days, so the basics will be for that type of output. The coax-fed antennas, dipole, beam, quad, etc., will work fine without the earth ground. Here you may want a balun or other matching device to go from unbalanced line to balanced, but it should not be critical.

If you can do it, the attic shack is the ideal location for the roof-mounted antenna. A simple mast with a small beam or quad will do nicely. From there it will be a short coax run to the rig.

So far, so good. What about that dipole you wanted to have? It doesn't matter that the rig is in the attic, but it usually happens that when you have met the condition that your rig is nowhere near a good ground, it probably is situated where you can't have a good antenna. Somehow the landscape has been carefully arranged so that there is no possibility of stringing a dipole, inverted V, or

anything resembling the antennas shown in the book.

Now what? This is where the all-time easy antenna comes into its own—the classic random-length antenna. What this is is a long piece of wire. You make it as long and as high as you can. Nominally, you want it more than ¼ wavelength long. It would be nice if it was in a straight line, but it is quite accommodating to being bent into odd shapes. It would like to be free and clear of other objects, particularly metal ones.

With a little thought, it is almost impossible to not be able to meet the requirements of this antenna, but there are a few little hitches.

It runs from your transmitter to where it ends. That means there will be radiation in the shack; however, this should not be what is usually thought of as rf in the shack, i.e., burned fingers when you touch the rig. It just has to be hooked up right. Most rigs have a 50-Ohm output. The random is high impedance. You have to use an antenna tuner. This can be as simple as a coax jack, a variable capacitor (with insulated shaft), a coil and a few clip leads, or a fancy store-bought tuner. A short run of coax from the rig to the tuner and the antenna goes from there to the great outdoors. It works quite well.

It's hard to miss, but you're not home free yet. The books still say to ground everything together. This is how you get all that rf in the shack, plus assorted rf burns and minor jolts.

You still will have your phantom ground problem. It wasn't until I got rid of both the ground and connecting the various chassis together that my setup got tamed.

Don't connect anything to anything else that you don't have to. They fight with each other. This will leave you with only one problem.

There may be potential differences between the various chassis. If you are holding onto one and reach for another, you may get bitten. This is not pleasant, so learn not to do that any more. Don't grab two pieces of gear when both are live (or plugged in). This is a small price to pay for a reliable attic system. It may not happen that your particular gear does that. Some of mine does and some doesn't.

Of course, you are going to ground your antenna when not in use . . . or are you? You will have the same problem trying to ground your antenna to a phantom ground as your transmitter had working with it.

Antenna grounding is supposed to serve two purposes. It is fondly believed that it will protect your rig from a direct lightning hit.

Lots of luck. Even with the usual textbook ham ground setup, that is asking a lot. A direct lightning hit will go to ground, but it is probably going to take everything along the path with it. I don't know if the usual antenna, lead-in, and grounding setup is going to stay put for that, not to mention any gear connected to it. The best you usually hope for, and the usual case, is protection against the static charge buildup from a nearby electrical storm. While this is not usually big enough to turn your antenna into abstract artwork, it is often big enough to put a walloping charge into the front end of any rig that's there.

Here the solution is simple. It is not so much a direct earth ground you need as a chassis ground connection. Any of the antenna switching arrangements can usually be hooked up to short the antenna lead directly to the ground of the coax connector (chassis ground).

I haven't seen it mentioned in years, but there was a time when many schematics made a distinction between chassis ground and earth ground. There are different schematic symbols for each. The familiar ground symbol, Fig. 1(a), is the one for chassis ground. Fig. 1(b) is the symbol for earth ground.

If your shack location is such that you can't get a good earth ground for antenna grounding, the chassis ground will still work a lot better than leaving your rig there to get hit.

It also doesn't cost much to run a ground wire to your shack and try it for rf purposes. Then if you have trouble with operating, remove it when you use your rig and reconnect it just for

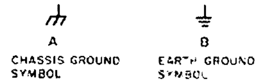


Fig. 1. Schematic ground symbols.

electrical safety when you are not operating.

The key is to go by the book as far as you can and only make such modifications as you have to for your particular circumstances. Then do as much as you can to restore non-operating safety.

I hope these two particular techniques, the use of a tuned random-length antenna and the avoidance of a phantom ground, will help solve a few problems for those who are just beginning or not able to use a more conventional configuration.

It drove me nuts for quite some time until I got the hang of it. It's not the best, but it will be reliable when properly applied. ■

A Close Encounter With Voyager I

—the W6VIO story

Voyager II is next.

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Jet Propulsion Laboratory Amateur Radio Club members gave up lunch periods, many after-work hours, and weekends during the period from March 1-11, 1979, to operate their club station W6VIO in celebration of the close approach of the *Voyager I* space probe to the planet Jupiter and its four Galilean satellites, Io, Europa, Ganymede, and Callisto.

Dick Piety K6SVP at the SSTV position. The image on the screen is of Callisto, one of Jupiter's moons.

Dick Piety K6SVP organized and managed the operation. He was assisted by Jim Lumsden WA6MYJ. Jim mounted a Herculean effort in getting the newly refurbished trailer which constitutes the W6VIO shack ready for the event. Equipment, stored in many locations during the refurbishing, had to be returned to the shack and reinstalled in the beautifully arranged shelves and decks.

The 1540 contacts made in the various bands on which the operation was mounted include:

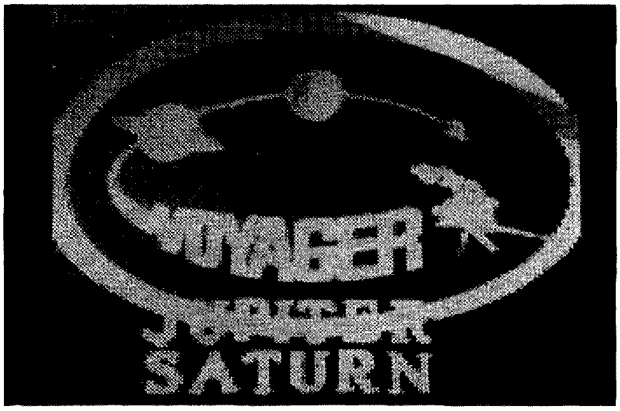
10m	phone	281

(includes a number of SSTV contacts)

10m	CW	21
15m	phone	123
15m	CW	164
20m	phone	362

(includes many SSTV contacts)

20m	CW	157
40m	CW	10
75m	phone	1



One of the SSTV monitor views of the W6VIO ID during the Voyager I *commemorative.*

A slow-scan image of the great red spot on Jupiter.

2m	FM	348

(includes check-ins to various JPL/Goldstone* nets run during the commemorative)

220 MHz	FM	72
OSCAR		1

There were 79 contacts outside the United States.

Interesting sidelights arose during the commemorative. Dick says he "doesn't believe" the contact on 2 meters who gave a K7 call and said he was speaking from Seattle. (Seattle to Pasadena on 2m?) Merv MacMedan N6NO began a CW contact with a Spanish amateur who wouldn't let him go on to others. Merv explained to him in Spanish about the *Voyager* commemorative. The Spanish amateur wanted to "rag-chew." Jim made a contact on SSTV with a Wichita Falls, Texas, amateur who said he was recording the pictures for his high school class of fourteen-year-olds. Dave Ingram K4TWJ telegraphed that he was recording the Jupiter images and sending them to the local press as fast as he received them. A Denver amateur contacted the Denver *Post*. They called K6SVP on the phone to interview him about the operation. A contact with F6KCP by W6VIO led to five or six other French amateurs joining the activity.

The promised QSL card, including Jupiter pictures made by *Voyager I's* cameras, was a magnet to pull in the contacts. All who contacted W6VIO during the March 1-11, 1979, period will receive QSLs if they send an SASE to W6VIO or QSL through their bureaus. The card also identifies the major discoveries about Jupiter and its moons made by the *Voyager I* spacecraft in its close encounter of the most spectacular kind. Those who remember the *Viking* commemorative card from N6V, operated by the JPL club during the landings on Mars, can appreciate the beauty of these very special QSLs.

From July 6-15, 1979, there will be a second Jupiter fly-by commemorative for the *Voyager II* Mission. It will have a somewhat different card. If you missed out on *Voyager I*, try for *Voyager II*.

The individual members of the JPL ARC (in addition to myself) who took part in the *Voyager I* commemorative are: Dick Piety K6SVP (chairman of the commemorative operation), John Repar WA6LWD, Stan Sander N6MP, Ron Zenone W6TUZ, Warren Apel K6GPK, Merv MacMedan N6NO, Jim Longthorne WA6KPW (off-lab member), Bob Gosline AE6S, Rich Soikkele WD6ERI (an Arcadia, California, high school student, 16 years old, who is communications associate on the Sunfire I project), George Morris W6ABW, Jim Lumsden WA6MYJ (facilities chairman for W6VIO), Mike Griffin N6WU (president of the JPL ARC), and Glenn Berry K6GHJ (who organized the reconstruction of the trailer).■

*The JPL Amateur Radio Club (operating on 220 with WR6APS at La Canada CA) and its affiliated Goldstone Club (operating on 220 with WR6AZN from Table Mountain, near Wrightwood CA), are linked together for a general amateur radio news net on each Tuesday at 8:00 pm PST and for an AMSAT/OSCAR news net on each Wednesday at 8:00 pm PST. The combined net covers all of southern California.

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GIANT Wire Antennas

—impress the neighbors

Have you ever found yourself wanting an antenna that was easy to put up, had gain over a dipole, was simple to match, and could work on more than one band? Then read on. This article shows how to design and build wire antennas which are longer than a half wavelength. These antennas may be operated as dipoles or V-beams. By careful choice of leg length, it is possible to build an antenna which will work on several amateur bands, but requires only a single feedline. The input impedance is about 200 Ohms and may easily be matched to 50-Ohm coax with a 4:1 balun.

Background

One advantage of the half-wave dipole is its low feedpoint impedance. The reason for this is shown in the upper drawing of Fig. 1. This drawing shows the standing waves of voltage and current which are present on a resonant antenna. From Ohm's Law, the input impedance is equal to the voltage divided by the current at the feedpoint of the antenna. For a half-wave dipole, the voltage at the feedpoint is low and the current is high, which gives a low value of impedance —typically, 50 to 70 Ohms.

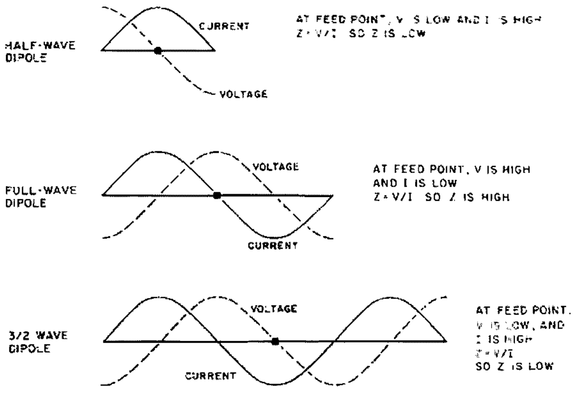


Fig. 1. Antenna impedance is determined by voltage and current at the feedpoint.

Many hams use half-wave antennas, but it is also possible to make a dipole in which each leg is much longer than a quarter wavelength. Fig. 1 also shows the voltage and current distributions for 1-wavelength and 3/2-wavelength dipoles. Notice that the current in the center of a full-wave antenna is low and the voltage is high, resulting in a very high input impedance on the order of several thousand Ohms. However, the 3/2-wavelength antenna has a voltage minimum at its center, similar to the half-wavelength dipole. The feedpoint impedance is again relatively low—around 100 Ohms or so.

At the ends of each dipole drawn in Fig. 1, the current is shown to be at a minimum value and the voltage is maximum. This makes good sense if you think about it. The current flowing at the end of a piece of wire must be zero because it has nowhere to go. On the other hand, the voltage at the end of a wire easily can be quite high. The important point to remember is that to get a low value of input impedance, there must be a voltage minimum at the center of the antenna. In other words, each leg of the antenna must be an odd number of quarter wavelengths. For the half-wave dipole, each leg is ¼ of a wavelength, while for the 3/2-wavelength dipole, each leg is ¾ of a wavelength. Each of these antennas has a voltage minimum at its center, and each also has a low value of input impedance.

Determining the Correct Antenna Length

Table 1 shows the formulas to use in order to calculate the right length for each leg of the antenna at the frequency of interest, once you have chosen how many quarter wavelengths you want each leg to be. Notice that a ¾-wavelength leg is *more* than 3 times as long as a ¼-wavelength leg. This is because the influence of "end effect" diminishes as the number of quarter wavelengths in each leg increases.

The antenna may also be oriented as a V-beam rather than a dipole, if directivity is desired. Table 2 shows the included angle (angle between the two legs of the V) for several different V-beam leg lengths, as well as the approximate gain of each configuration.

For those of you with lots of real estate, Table 3 gives the data required to design and build antennas which are truly giants. The feedpoint impedance of these monsters is in the neighborhood of the 200-Ohm value given for the antennas of Table 1.

Leg Length in Wavelengths	Leg Length in Feet (f in MHz)
1/4	234/f
3/4	738/f
5/4	1230/f
7/4	1722/f
9/4	2214/f
11/4	2706/f
13/4	3198/f
15/4	3690/f
17/4	4182/f
19/4	4674/f
21/4	5166/f
23/4	5658/f
25/4	6150/f
27/4	6642/f
29/4	7134/f
31/4	7626/f
33/4	8118/f
35/4	8610/f
37/4	9102/f
39/4	9594/f
41/4	10086/f
43/4	10578/f

Table 1. Determining the correct leg length.

The formulas shown in these tables will give leg lengths which are approximately correct, but these values should be used only as starting points. All antennas should be cut a little bit long to allow for trimming to the exact length which is required. The actual resonant frequency of any antenna is affected by factors such as height above the earth and proximity to other objects.

Multiband Use

Certain leg lengths will resonate on more than one amateur band, which can be very convenient. I used to work in a small coal-mining town deep in the hills and hollows of southern West Virginia. I lived in a mobile home and had 340 feet of RG-8 coax which ran from my ham shack up the hollow to a hilltop behind my trailer. I badly needed an antenna which could cover several bands with a single feedline and which had some gain to make up for the cable losses.

While reading Ed Noll's book, *73 Dipole and Long-Wire Antennas*, I came across the information given here as Table 1. Ed explained that multiband operation was possible, so I got out my calculator and made a list of antenna lengths which would be resonant in the bands I wanted to operate (80 and 20 meters). Then I looked through my list to see if any of the numbers matched. It turned out that a ¾-wavelength leg on 80 meters was the same size as a 11/4-wavelength leg on 20 meters—about 190 feet in length.

This antenna was built from #12 copperweld wire and fed through a W2AU balun with a 4:1 impedance ratio. The swr was below 2:1 across the whole 20 meter band. On 80 meters, the resonant frequency was lower than I had planned (3.7 MHz versus 3.9 MHz), but I still was able to operate my Triton II on 75 meter phone with the swr around 3:1.

Other suitable combinations can be found by plugging desired frequencies of operation into the various equations and making a list of the resulting leg lengths. For example, a leg length of about 440 feet should resonate on both 80 and and 40 meters, while 428 feet looks good for 20 and 15 meters. It has been my experience that the actual leg lengths on 80 meters are somewhat shorter than the formula values, so a leg length of 428 feet may work well on all bands from 80 to 15 meters. A leg length of 362 feet should work on 40 and 20 meters, 330 feet on 10 and 15 meters, and 310 feet on 80 and 15 meters. For really big antennas, a leg length of 710 feet looks good on 40, 20, and 15 meters, 943 feet for 160 and 80 meters, and 673 feet for 160 and 20 meters.

Leg Length in Wavelengths	Included Angle in Degrees	Gain in dB
11/4	60	5.3
13/4	56	5.8
15/4	52	6.3
17/4	48	6.8
19/4	46	7.2
21/4	44	7.6
23/4	42	8.0
25/4	40	8.4
27/4	38	8.8
29/4	37	9.2
31/4	36	9.6
33/4	35	10.0
35/4	34	10.3
37/4	33	10.5
39/4	32	10.7
41/4	31	10.9

Table 2. Gain and included angle for V-beams.

Conclusion

This article has described large centerfed antennas where the length of each leg is an odd number of quarter wavelengths. Multiband use of a single antenna is possible by a judicious choice of leg length, and low-standing wave ratios are achieved by placing a 4:1 balun at the feedpoint. These large antennas show gain over a normal dipole and may be oriented in either straight-line or V-beam configuration. ■

Acknowledgement

Formulas and tables in this article were taken from *73 Dipole and Long-Wire Antennas* by Ed Noll W3FQJ.

Leg Length in Wavelengths	Leg Length in Feet (f in MHz)
45/4	11070/f
47/4	11562/f
49/4	12054/f
51/4	12546/f
53/4	13038/f
55/4	13530/f
57/4	14022/f
59/4	14514/f
61/4	15006/f
63/4	15498/f
65/4	15990/f
67/4	16482/f
69/4	16974/f
71/4	17466/f
73/4	17958/f
75/4	18450/f
77/4	18942/f
79/4	19434/f
81/4	19926/f
83/4	20418/f
85/4	20910/f
87/4	21402/f

Table 3. Leg lengths for very long antennas.

Microcomputer Interfacing

from page 20

low cost IC, \$8; SHM-CM, general purpose, ±12 V, \$89.

Hybrid Systems Corporation, Bedford, Massachusetts 01730—SH703, low cost, \$22.

Intersil, Inc., Cupertino, California 95014—IH5110, low cost IC, \$9.

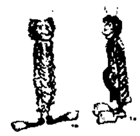
National Semiconductor Corporation, Santa Clara, California 95051—LF-398, low cost IC, \$5.

Teledyne Philbrick, Dedham, Massachusetts 02026—Model 4853, high speed, \$125.

Prices of the above S/H devices are subject to change without notice. However, keep in mind that the general price trend is down, as is true for almost all semiconductor devices.

References

1. Titus, J. A., *Microcomputer Analog-Digital Conversion Devices*, E&L Instruments, Inc., Derby, Connecticut 06418, 1977.
2. *LF-398 Data Sheet*, National Semiconductor Corporation, Santa Clara, California 95051, 1976.
3. Sheingold, D. H., *Analog-Digital Conversion Handbook*, Analog Devices, Inc., Norwood, Massachusetts 02062, 1972.



Corrections

It has been called to our attention that the breadboard shown on page 51 of our June, 1979, issue is indeed Continental Specialties Corporation's Model EXP-300 Experimentor Proto-Board®.

John C. Burnett
Managing Editor

In my article "Build the \$80 Wonder" (November, 1978), there was an error in the input amplifier shown in Fig. 6. The corrected portion is shown below.

Howard M. Berlin W3HB
Newark DE

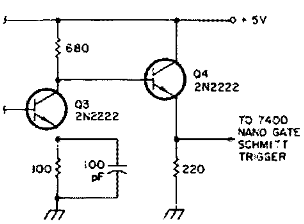


Fig. 6 (partial), "Build the \$80 Wonder."

In my article "12 Volts, 5 Amps, 3 Terminals" (April, 1979), there was an error in the schematic—the electrolytic cap should be somewhere in the range of 2500-4000 uF at 30 volts or so, not 500 uF at 1000 volts. My power supply has two 100-uF, 35-volt caps in parallel, but it should be emphasized that this was a commercially-built supply (minus the regulator which is what the article was intended to introduce). The designer of the supply took a shortcut in the cap's value in order to retain the small size of the supply. I am recommending the 2500-4000 uF, 35-volt electrolytics to those who have been writing, if they can get along with the extra space that is required.

Again, the intended purpose of the article was to introduce a very effective way to obtain regulation of a power supply with a minimum of external parts (one!). If anyone was to duplicate the circuit shown, it does work, and will make an effective supply at a small cost as long as the cap's value is changed as noted here. Any "computer-grade" electrolytic with a rating of 30 volts or more—and many are advertised at bargain prices in *73*—should work just fine.

Readers might also be interested in knowing that one supplier of the chip, Tri-Tek, has just dropped their price for the 78H12 to \$6.50. Fairchild has also introduced several other new regulator chips that might prove of value.

Gary H. Toncre WA4FYZ
Miami FL

Ham Help

I am looking for a schematic of a device which would allow me to tune in a CW signal and have the received Morse characters translated into Baudot and ASCII. Once translated, the signal could produce a teletype™ copy of the CW being received.

There did exist the Converter Shift Register Group AN/UGA-3A (designed and built in the 1960s) which translated CW to Baudot. This unit used discrete components and weighed some 110 lbs. Its CW speed capability range was 10-110 wpm, machine-sent. Two-level Morse-keyed dc, or Morse-keyed audio signal inputs were accepted and translated to 5-level Baudot, and then to TTY copy.

I would appreciate hearing from anyone who may have an arrangement such as this. Thank you.

C. H. Wiedeman K4KOE
204 Anne Burras
Newport News VA 23606

Would anyone who has had problems with the Sigma XR3000 linear please write to me and state the trouble and where they obtained parts?

Jack W. Greenwood WB7QDN
Box 249
Wolf Point MT 59201

I am looking for any modifications to the Collins R-388, especially in the area of a product detector.

W. Cooledge, Jr. W1IOO
15 Newport Dr.
Westford MA 01886

Microcomputer RTTY . . . a Software TU

—use your 8080 and very little else

Count frequencies, too.

Albert S. Woodhull N1AW
Enfield Road, RFD 2
Pelham MA 01002

Microprocessors are not just super calculators. They are general-purpose electronic circuits waiting only for programs to transform them into specialized devices. In this article I will describe how a computer can be used as a frequency counter, and I will show how the counting program can become the basis of a microprocessor-centered RTTY terminal unit. I am writing this also to show how easy it can be to replace hardware with software. Applications such as the one I will describe require only a fraction of the amount of memory that is needed to do calculations with a high-level language such as BASIC. And, for the experimenter, replacing gadgets with programs has another great advantage. No longer do you need to worry about the condition of your gear if a lengthy equipment modification doesn't work. Rewind your tape cassette and you can have the old version up and running in a few seconds.

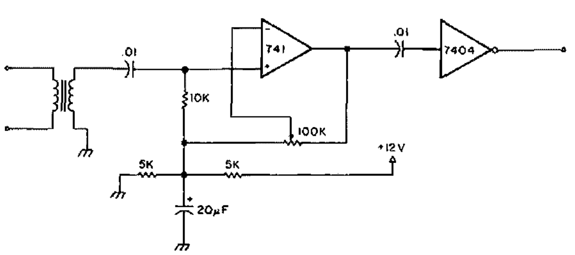


Fig. 1. Input interface. The pot is used to adjust the gain of the 741 amplifier until it drives the 7404 TTL inverter to the point of producing a clean square wave output of the same frequency as the input. 60- or 120-cycle hum is the villain that can make this difficult; the transformer may not always be necessary, but sometimes eliminating the common ground connection gets rid of hum.

Counting Frequencies With a Computer

The computer works with ones and zeros; counting is a very simple task for it. A little bit of external hardware help is needed, however, to get the signal from the outside world into the form the computer requires. Fig. 1 shows an adequate arrangement. An operational amplifier circuit boosts the input signal to a level adequate to drive a TTL inverter. The resulting square wave is applied to one bit of an input port of the computer. On most systems, the other seven bits can just be left floating, but, if you are picky, you can tie them to either ground or +5 volts. On my home-brew computer, I have a number of input and output ports that are implemented as single bits for applications like this. The transformer shown may not be necessary, but may help in keeping 60-cycle interference out of the system.

The easiest way to measure audio frequencies is to time the duration of a half cycle. Fig. 2 shows a flowchart, and Fig. 3 shows an 8080A program to do this. Two registers are used, one to hold the previous input, and one to count up the number of times the program loops between changes in the input. Suppose, at the starting time, the input signal from the inverter is in the 0 phase of the square wave. The unused seven bits will be read as ones, and 11111110 will be stored. Until the input changes to the 1 phase, the program will loop and the counter will count. Eventually, a time will come when the input is read as 11111111. When this happens, the count will be displayed and a new count started. If desired, a bit of programming could be done to calculate the frequency in decimal units from the binary representation of the duration of a half cycle, but, for many purposes, it is adequate to know what pattern on the LED display corresponds to a desired frequency.

For a typical 8080A system with a 500-ns clock, the instruction loop just

discussed will require 14.5 µsec. If you were trying to measure the tones from an AFSK generator, this counter would produce a count of 16 (00010000 in binary) for a 2125-Hz input or a count of 15 (00001111) for a 2295-Hz input. That might be good for some purposes, but it obviously is not very accurate. The way to make a timer more accurate is to time longer intervals. The counting time can be doubled by timing whole cycles of the input instead of half cycles. This also will eliminate inaccuracy due to asymmetry in the square wave input. For the 8080A program illustrated, this can be accomplished by changing the JZ (jump on zero) instruction to JNC (jump on no carry). Following a comparison operation, the zero flag is set when the numbers compared are equal, so in the original version of the program, the loop is broken whenever the input changes from 1 to 0 or from 0 to 1. The carry flag is set when the number in the accumulator register is less than the comparison number. Thus, by using the no-carry condition to stay in the loop, the timer ignores transitions from 0 to 1 and the count accumulates until a transition from 1 to 0 occurs.

A second way to increase accuracy is to put the basic program inside a larger loop that counts down a predetermined number of cycles of the input signal. Figs. 4 and 5 show the flowchart and program for this approach. The inner loop again takes 14.5 µsec, but now the JNC instruction is used to keep the timer going for the entire duration of an audio cycle. The outer loop causes the inner loop to be repeated as many times as the value initially loaded into register D calls for. With this approach, standard AFSK tones in the range of 2000 to 3000 Hz can be measured to the nearest 10 Hz or so. This will suffice for adjusting an AFSK generator or calibrating an oscillator to be used in adjusting a RTTY demodulator. More accuracy yet can be achieved by timing a larger number of cycles and accumulating the count in a 16-bit register pair. Still other software frills could turn the computer into a fancy frequency meter indeed, but that is not my present goal. Instead, I would like to show how the basic timing program can be used to build a radioteletype terminal unit with capabilities not usually found in the simpler analog TU circuits.

The Software Terminal Unit

My home-brew computer decodes audio signals from an audio cassette recorder by means of a simple cycle timer program which is stored in read-only memory. Compared to the problems of decoding over-the-air RTTY signals, it is trivial to decode a tape. A few preliminary experiments showed me that the simple frequency measuring routines could work on clear and strong signals, so I set out to define the additional requirements for RTTY.

Essential features for RTTY are some kind of filtering to minimize the effects of interferences and some kind of tuning indicator. Another feature, not necessary, but very desirable, is a squelch or mark-hold provision to keep the printer from running wild when a useful signal is not present. Finally, an easy way of throwing in a locally-generated line feed or carriage return can sometimes prevent loss of print. Doing all this in software is easy.

The flowchart of Fig. 6 shows how all these provisions are included. Entry and exit from the program are through a control section which allows a local ASCII keyboard to direct operations. Next, a cycle timer section determines the frequency of the incoming audio. Decision routines cause execution to branch, first to display the current state on a tuning indicator, and then to take appropriate action. A "noise counter" disables the printer whenever the signal-to-noise ratio becomes lower than the preprogrammed acceptable limit. A "signal counter" takes over the functions of a post-detection low-pass filter, and the processed data then drives the printer magnet through an output port and very simple interface circuitry.

The details can be seen in the program listing. In my system, a surplus 8-bit parallel-output ASCII keyboard has its data lines connected to one input port and its strobe line connected to another. The control section of the program first examines the strobe signal and skips to the frequency-measurement section if no key is depressed. If a key is pressed, a subroutine in my monitor program is called which converts the ASCII to Baudot and drives the printer. The subroutine checks for control characters and returns immediately when one is encountered. The TU program then checks for ↑B (control B) or ↑E characters, which cause exits to either a RTTY transmit routine or the control level of my monitor program. ↑T, ↑N, or ↑R characters are stored for later reference; they signify Tune (no printing), Normal (low tone is mark), and Reverse (high tone is mark).

The frequency measurement portion of the pro-

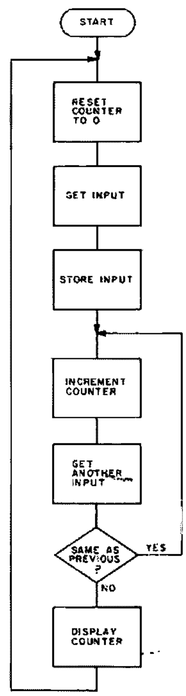


Fig. 2. Flowchart for frequency measurement by cycle timing. Note that this simple version times the duration of a half cycle of input.

```
START   MVI C 00      reset counter
        IN AUDIO      get input
        MOV B,A       store it
LOOP    INR C         increment counter
        IN AUDIO      get new input
        CMP B         compare with first input
        JZ LOOP       If same repeat cycle
        MOV A,C       otherwise display count
        OUT DISPLAY
        JMP START     and do it all again
```

Fig. 3. An 8080 program that times half cycles of audio according to the flowchart of Fig. 2. The DISPLAY output port can be a row of LEDs or 7-segment displays which show the count in octal or hexadecimal. The meaning of the count in real-time units will depend on the clock frequency of the processor.

gram works like the routines described in the first part of this article, with two refinements. It doesn't matter that a simple continuously-cycling routine gives a short count on its first cycle. For RTTY decoding, an accurate count is needed the first

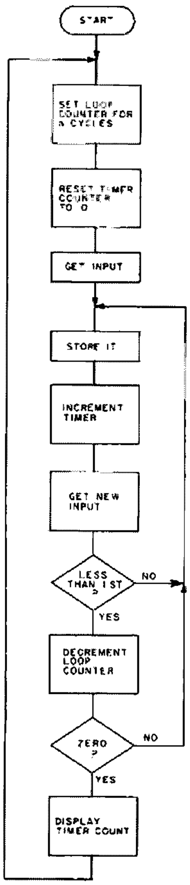


Fig. 4. Flowchart for an accurate frequency-measurement program that times the duration of n whole cycles of the input signal.

time. This problem is solved by an extra loop which causes the computer to wait for the cycle in progress to finish before the following five cycles of audio are timed. The other refinement is a more complicated nesting of the inner and outer loops which keeps the execution time constant regardless of which branch is followed. This is aided by inserting a "nonsense instruction" (MOV B,B) into one branch to compensate for the execution time of the DCR C instruction in the other branch.

All the information needed to accurately tune in a RTTY station and drive the printer is in the output of the frequency measurement section of the program. With analog circuitry, at this point one would use a comparator to decide whether a voltage was above or below a criterion level. Having a count, not a voltage, and having the power of the microprocessor makes possible a six-way decision. Try setting up comparators to do that at the output of a phase-locked loop! I use the various possible outcomes of this six-way decision to light up a row of LEDs on the front panel of my computer. As the receiver is tuned across a signal, the light appears to move from left to right as the audio tone goes from low to high. Fig. 7 illustrates the patterns

Constant	Locations In Assembled Listing
CRIT1	044A
CRIT2	044F
CRIT3	0454
CRIT4	0459
CRIT5	045E
KBDSTB	0401
KBD	0408
KBDW	04E1
PRINT	040A 04E8
MONITOR	0429
AUDIO	0430 0433 043A
PRINTER	0479 04CE 04DC
LEDDISP	0468 0480 0487 0499 04A0

Table 1. The above locations will probably have to be changed to make the TU program run on a different machine. The values for CRIT1, CRIT2, CRIT3, CRIT4, and CRIT5 will depend on the clock frequency of the computer being used. The other values listed are port numbers or, in the case of PRINT and MONITOR, routines in the author's ROM monitor.

observed. The effectiveness of the technique is due to the criteria for the comparisons having been chosen in such a way that a clear indication that the signal is not tuned in exactly on center is given before the error is great enough to cause inaccurate printing. With practice, it is also easy to spot shifts which are too wide, or stations transmitting "upside down."

The mark-hold and low-pass filtering techniques I use are also examples of simple software implementation of functions that would be relatively complex with analog circuits. Each of these features uses a counter. The mark-hold is controlled by the noise counter. This register is incremented when a tone too high or too low to be a valid RTTY signal is encountered. Valid signals decrement the same counter. Limits are placed on the maximum and minimum values the noise counter can hold, and, after each frequency measurement, the noise-counter value is compared with an intermediate criterion.

When the criterion is exceeded, operation of the printer is suppressed. With the values given in the listing, printing will proceed when a good signal is decoded one-third of the time. When the signal drops out, the printer is silenced almost immediately, but a fraction of a second of steady mark tone at the beginning of a transmission immediately enables the printer.

The low-pass filter also uses a counter, which I call the signal counter. Mark signals increment this counter and space signals decrement it. The counter is limited to a minimum value of zero and a maximum value of seven. A mark signal is sent to the printer when the value is four or higher; otherwise, a space signal is generated. Thus, at any time, the printer is given a signal corresponding to the majority of the eight previous samples of audio from the receiver. Without some

```
START  MVI D,n        set loop counter
       MVI C,O        reset timer counter
       IN AUDIO       get input
LOOP   MOV B,A        store it
       INR C          increment timer
       IN AUDIO       get new input
       CMP B          compare with first input
       JNC LOOP       if equal to or greater than first repeat cycle
       DCR D          otherwise decrement cycle counter
       JNZ LOOP       and continue timing another cycle
       MOV A,C        when done, retrieve the total count and show it
       OUT DISPLAY
       JMP START      and do it all again
```

Fig. 5. The 8080 program corresponding to the flowchart of Fig. 4. The count indicates the duration of n complete cycles of the audio input signal.

form of filtering of this sort, the information in 80% of the received signal is lost, since the printer itself samples only 20% of each bit.

The last part of the listing isn't really part of the RTTY receiving routine at all. This is a simple loop that enables me to use the ASCII keyboard for transmitting RTTY. It includes a test to recognize a ↑C character as a command to leave the transmit routine and return to the receive routine. It is not a misprint that the keyboard is called by a different port number here than that used in the control section of the program. I decode two different port numbers for my keyboard; the one used here initiates a WAIT state in the 8080A which is terminated by the falling edge of the keyboard strobe signal. This allows me to simplify the coding used for getting keyboard input in cases like this.

It would be cruel to present a program listing of this sort without pointing out the parts of the program that might need to be changed to make it run on another system. Table 1 lists the instructions which are unique to my own computer. For the most part, patching the program will require changing only I/O port assignments and relocating addresses, but it should be noted that a major and crucial difference between my computer and most others is the clock frequency. My junk-box crystal gives me a clock period of 694 ns instead of the usual 500 ns. The various criteria constants will need to be reevaluated to suit the timing of another system. This can be done experimentally by using a calibrated audio oscillator (calibrate it with the timer progam!) and trying different values for each criterion, using the tuning indicator to check results. For example, CRITERION3 should be a value that causes the low space and high mark lights to blink as the audio input is rocked around 2210 Hz.

Interfacing and Operation

A few pieces of hardware external to the computer are needed, of course. At the input, a circuit such as the one already described in Fig. 1 is needed to convert the receiver audio to digital levels. It will help if a bit of audio filtering precedes this. Fig. 8 shows a simple filter which gives good results when followed by the recommended 10k-Ohm load. The .05-uF capacitor should be chosen to give a peak at around 2200 Hz. The last external item

Program listing for RTTY TU.

```
TYPE RTTYTU.PRN
                ;
                ;
                ;
                ;                       DIGITAL RTTY TERMINAL UNIT
                ;
                ;THIS IS A PROGRAM TO DECODE AFSK SIGNALS AND DRIVE A BAUDOT PRINTER
                ;WRITTEN FOR MIAN'S 8080A SYSTEM WHICH USES A 694 NSEC CLOCK.  OTHER
                ;SYSTEMS WILL REQUIRE CHANGES OF THE TIMING BYTES.  THE PROGRAM
                ;IS BASED ON NOMINAL AUDIO FREQUENCIES OF 2125 HZ FOR MARK AND 2295
                ;HZ FOR SPACE.  FOR THIS 170 HZ SHIFT A MAXIMUM MISTUNE OF +/- 85 HZ IS
                ;PERMISSIBLE.  FREQUENCIES ABOVE 2380 HZ OR BELOW 2040 HZ ARE ACCORD-
                ;INGLY REJECTED AS INVALID.  OPERATION OF THE PRINTER IS SUPPRESSED BY
                ;OUTPUTTING A CONTINUOUS MARK LEVEL TO THE MAGNET DRIVER WHEN AN EXCESS-
                ;IVE PROPORTION OF INCOMING SIGNALS CORRESPOND TO INVALID TONES.  AS AN
                ;AID TO TUNING PROVISION IS MADE FOR DISPLAY OF THE APPROXIMATE FREQUENCY
                ;OF THE INCOMING TONE ON A ROW OF LEDS, SO TUNING BECOMES A MATTER OF
                ;KEEPING THE CENTER OF THE LED ROW ILLUMINATED.   DIGITAL PROCESSING
                ;ALSO SIMULATES THE EFFECT OF POST-DETECTION LOW PASS FILTERING OF THE
                ;DRIVING SIGNAL TO THE PRINTER MAGNET.
                ;THE FOLLOWING PROGRAM REQUIRES LESS THAN 256 BYTES OF MEMORY TO RUN,
                ;EXCEPT THAT SOME CALLS ARE MADE TO A PRINTER-DRIVER ROUTINE FOR THE
                ;PURPOSE OF ECHOING THE KEYBOARD THAT CONTROLS EXECUTION.  THIS IS
                ;NECESSARY ONLY FOR LOCAL OVERRIDE OF INCOMING SIGNALS SO EXTRA CARR-
                ;IAGE RETURNS OR LINE FEEDS MAY BE INSERTED.
                ;   WRITTEN 23 MARCH 1978-COPYRIGHT 1978 ALBERT S. WOODHULL
                ;
0400                            ORG 1024
0003 =          KBDSTB          EQU 3
0005 =          KBD             EQU 5
0020 =          PRINT           EQU 20H
0000 =          MONITOR         EQU 0
0001 =          AUDIO           EQU 1
007E =          CRIT1           EQU 7EH
0040 =          CRIT2           EQU 40H
0043 =          CRIT3           EQU 43H
0046 =          CRIT4           EQU 46H
0048 =          CRIT5           EQU 48H
0060 =          NOISEMAX        EQU 60H
0040 =          HOLDCRIT        EQU 40H
0011 =          PRINTER         EQU 11H
0000 =          LEDDISP         EQU 0           ;FRONT PANEL LEDS
0000 =          KBDW            EQU 0
                ;CONTROL ROUTINES TO SAMPLE KEYBOARD
                ;
0400 DB03       RECEIVE         IN KBDSTB       ;CHECK KEYBOARD STROBE
0402 E601                       ANI 1
0404 CA2B04                     JZ TIMER        ;SKIP TO TIMER IF KEYBOARD INACTIVE
0407 DB05                       IN KBD          ;LOOK AT ASCII KEYBOARD
0409 CD2000                     CALL PRINT      ;ECHO THE INPUT BY ROUTINE IN MONITOR
040C FE0E                       CPI 0EH         ;WAS IT ^N? (CONTROL N=NORMAL MODE)
040E CA1E04                     JZ STOW
0411 FE12                       CPI 12H         ;WAS IT ^R? (REVERSED MODE)
0413 CA1E04                     JZ STOW
0416 FE14                       CPI 14H         ;WAS IT ^T? (TUNE MODE, NO PRINTING)
041B CA1E04                     JZ STOW
041B C32104                     JMP SKIPSTOW
041E 32EE04     STOW            STA FORMAT
0421 FE02       SKIPSTOW        CPI 2   ;WAS IT ^B? (TRANSMIT MODE)
0423 CAE004                     JZ TRANSMIT
0426 FE05                       CPI 5           ;WAS IT ^E? (EXIT TO MONITOR)
0428 CA0000                     JZ MONITOR
                ;
                ;TIMER ROUTINES TO DETERMINE FREQUENCY OF INCOMING AUDIO SIGNAL
                ;
042B 0E05       TIMER           MVI C,5         ;PRELOAD CYCLE COUNTER
042D 1600                       MVI D,0         ;ZERO TIMER
042F DB01                       IN AUDIO        ;LOOK AT AUDIO INPUT
0431 5F         LOOP1           MOV E,A         ;STOW INPUT IN REGISTER E
0432 DB01                       IN AUDIO        ;GET ANOTHER SAMPLE OF AUDIO
0434 BB                         CMP E           ;SEE IF THERE WAS A CHANGE
0435 D23104                     JNC LOOP1       ;IF NOT KEEP LOOKING
                ;
0438 5F         LOOP2           MOV E,A         ;STOW LATEST INPUT
0439 DB01                       IN AUDIO        ; GET A NEW SAMPLE
043B 14                         INR D           ;INCREMENT THE TIMER
043C BB                         CMP E           ;LOOK FOR END OF AUDIO CYCLE
043D DA4404                     JC CYCLECNT     ;CARRY FLAG WILL BE SET BY CHANGE FROM 1 TO 0
0440 40                         MOV B,B         ;IF NO CHANGE KILL SOME TIME
0441 C33804                     JMP LOOP2       ;THEN LOOK AGAIN
                ;
0444 0D         CYCLECNT        DCR C           ;DECREMENT CYCLE COUNTER
0445 C23804                     JNZ LOOP2       ;AND KEEP ON TIMING UNTIL 5 CYCLES TIMED
                ;
                ;CRITERION ROUTINES DECIDE WHICH OF SIX POSSIBILITIES THE INCOMING AUDIO
                ;REPRESENTS: TOO HIGH, HIGH SPACE TONE, LOW SPACE TONE, HIGH MARK TONE,
                ;LOW MARK TONE, OR TOO LOW
                ;
0448 7A                         MOV A,D         ;GET COUNT FROM TIMER
0449 FE7E                       CPI CRIT1       ;WAS FREQUENCY ABOVE 2380 HZ?
044B DA6504                     JC INVHI        ;IF SO IT IS INVALID, TOO HIGH
044E FE40                       CPI CRIT2       ;WAS FREQUENCY ABOVE 2335 HZ?
0450 DA9604                     JC SPHI         ;HIGH, BUT IN RANGE VALID AS SPACE TONE
0453 FE43                       CPI CRIT3       ;WAS IT ABOVE 2210 HZ?
0455 DA9D04                     JC SPLO         ;LOW SPACE TONE, OR
0458 FE46                       CPI CRIT4       ;WAS IT ABOVE 2085 HZ?
045A DA8404                     JC MKHI         ;HIGH END OF MARK TONE RANGE
045D FE48                       CPI CRIT5       ;WAS IT ABOVE 2040 HZ?
045F DA7D04                     JC MKLO         ;LOW MARK TONE
```

```
                ;
                ;IF NO JUMP TAKEN FROM CRITERION ROUTINES THIS POINT IS REACHED WITH AN
                ;INVALID LOW TONE REPRESENTED BY THE DATA IN THE ACCUMULATOR
                ;
                ;FOLLOWING GIVES VISIBLE DISPLAY OF INVALID TONES AND CHECKS TO SEE IF
                ;PRINTER SHOULD BE DISABLED TO PREVENT GARBAGE PRINTING, THEN DOES SO IF
                ;REQUIRED
                ;                       MVI A,0C0H      ;PREPARE VISIBLE SIGNAL FOR TONE TOO LOW
0462 C36704                     JMP INVDISPLAY
0465 3E03       INVHI           MVI A,3H        ;PREPARE VISIBLE SIGNAL FOR TONE TOO HIGH
0467 D300       INVDISPLAY      OUT LEDDISP     ;SHOW IT ON FRONT PANEL LEDS
0469 24                         INR H           ;INCREMENT NOISE COUNTER
046A 7C                         MOV A,H
046B FE60                       CPI NOISEMAX    ;CHECK AGAINST MAX VALUE PERMITTED
046D DA7204                     JC SKIPRESET    ;IF OK SKIP RESET
0470 265F       RESET           MVI H,NOISEMAX-1
0472 FE40       SKIPRESET       CPI HOLDCRIT    ;ALSO COMPARE WITH MARKHOLD CRITERION
0474 DA0004                     JC RECEIVE      ;JUST IGNORE AND START OVER IF BELOW CRITERION
0477 AF                         XRA A           ;OTHERWISE SET ACCUMULATOR TO ZERO
0478 D311                       OUT PRINTER     ;AND OUTPUT TO PRINTER DRIVER A LOW LEVEL
047A C30004                     JMP RECEIVE     ;THEN START OVER
                ;
                ;WHEN VALID TONES RECEIVED EXECUTION TRANSFERS TO ONE OF THE
                ;FOLLOWING ROUTINES WHICH FIRST DISPLAY TONE RECEIVED THEN INCREMENT OR
                ;DECREMENT THE SIGCOUNTER.  THE SIGCOUNTER IS PREVENTED FROM OVERFLOWING
                ;OR UNDERFLOWING BEFORE THE NEW VALUE IS STORED.
                ;
047D 3E20       MKLO            MVI A,20H       ;DISPLAY LOW MARK SIGNAL
047F D300                       OUT LEDDISP     ;ON FRONT PANEL LEDS
0481 C38804                     JMP MARKCNT
0484 3E10       MKHI            MVI A,10H       ;DISPLAY HIGH MARK SIGNAL
0486 D300                       OUT LEDDISP     ;ON FRONT PANEL LEDS
0488 3AED04     MARKCNT         LDA SIGCNTR     ;GET THE SIGCOUNTER
048B 3C                         INR A           ;INCREMENT IT
048C FE08                       CPI 8H          ;BUT KEEP IT BELOW 8
048E DAA904                     JC CNTSTORE     ;PUT IT BACK IF NOT OVERFLOWED
0491 3E07                       MVI A,7H        ;OTHERWISE RESET IT
0493 C3A904                     JMP CNTSTORE    ;THEN PUT IT BACK
0496 3E04       SPHI            MVI A,4H        ;DISPLAY HIGH SPACE SIGNAL
0498 D300                       OUT LEDDISP
049A C3A104                     JMP SPACECNT
049D 3E08       SPLO            MVI A,8H        ;DISPLAY LOW SPACE SIGNAL
049F D300                       OUT LEDDISP
04A1 3AED04     SPACECNT        LDA SIGCNTR     ;GET THE SIGCOUNTER
04A4 3D                         DCR A           ;DECREMENT IT
04A5 F2A904                     JP CNTSTORE     ;SKIP NEXT IF VALUE ZERO OR HIGHER
04A8 AF                         XRA A           ;OTHERWISE RESET TO ZERO
04A9 32ED04     CNTSTORE        STA SIGCNTR     ;PUT THE UPDATED SIGCOUNTER BACK
                ;
                ;THE SIGCOUNTER MUST BE EQUAL TO OR GREATER THAN 4
                ;TO PRINT A MARK, LESS THAN 4 TO PRINT A SPACE.  THIS ACTS AS A LOW PASS
                ;FILTER, PREVENTING SUDDEN CHANGES OF THE DRIVE TO THE PRINTER
                ;
04AC FE04                       CPI 04H         ;COMPARE SIGCOUNTER WITH MK/SP CRITERION
04AE DAB504                     JC SPACE        ;IF LESS THAN 4 IT IS A SPACE
04B1 AF                         XRA A           ;OTHERWISE IT IS MARK, SET TO OUTPUT
04B2 C3B704                     JMP SPACESKIP   ;SO SKIP NEXT
04B5 3E01       SPACE           MVI A,1         ;SET TO OUTPUT SPACE
04B7 47         SPACESKIP       MOV B,A         ;BUT SET PRINTDRIVE DATA ASIDE FOR NOW
                ;
                ;BEFORE PRINTING WE CHECK FOR LOW VALUE OF NOISE COUNTER AND NORMAL OR
                ;REVERSED FORMAT
                ;
04B8 25                         DCR H           ;DECREMENT THE NOISE COUNTER
04B9 F2BE04                     JP CONT         ;IF ZERO OR ABOVE THEN CONTINUE
04BC 2600                       MVI H,0         ;OTHERWISE RESET NOISE COUNTER TO ZERO
04BE 7C         CONT            MOV A,H
04BF FE40                       CPI HOLDCRIT    ;COMPARE WITH MARKHOLD CRITERION
04C1 D2CC04                     JNC HOLD        ;IF ABOVE CRITERION GO TO HOLD
04C4 3AEE04                     LDA FORMAT      ;GET FORMAT INFORMATION
04C7 FE14                       CPI 14H         ;IF IT IS ^T WE ARE IN TUNE MODE
04C9 C2D204                     JNZ PRTDRIVE    ;IF NOT IN TUNE MODE GO ON
04CC AF         HOLD            XRA A           ;OTHERWISE OUTPUT LOW LEVEL TO SILENCE PRINTER
04CD D311                       OUT PRINTER
04CF C30004                     JMP RECEIVE     ;GO BACK FOR NEW START
04D2 FE12       PRTDRIVE        CPI 12H         ;SEE IF FORMAT IS REVERSED
04D4 C2DA04                     JNZ NORMAL      ;IF NOT GO TO NORMAL
04D7 78                         MOV A,B         ;GET PRINTER DRIVE DATA
04D8 2F                         CMA             ;COMPLEMENT IT FOR REVERSED MODE
04D9 47                         MOV B,A         ;PUT IT BACK
04DA 78         NORMAL          MOV A,B ;GET DATA
04DB D311                       OUT PRINTER     ;AND DRIVE PRINTER
04DD C30004                     JMP RECEIVE     ;THEN START OVER AGAIN
                ;
                ;TRANSMIT ROUTINE JUST ECHOES TO PRINTER, AN EXTERNAL SWITCH CAUSES
                ;DATA TO BE ROUTED TO THE FSK MODULATOR.  A CTRL C RETURNS TO
                ;RECEIVE MODE
                ;
04E0 DB00       TRANSMIT        IN KBDW         ;THIS ALTERNATE ADDRESS FOR KBD WAITS FOR DATA
04E2 FE03                       CPI 3H          ;CTL C IS SIGNAL FOR RETURN TO RECEIVE MODE
04E4 CA0004                     JZ RECEIVE
04E7 CD2000                     CALL PRINT      ;PRINT ROUTINE IN ROM CONVERTS ASCII TO BAUDOT
                                                ;AND DRIVES PRINTER
04EA C3E004                     JMP TRANSMIT    ;JUST DO THIS IN A LOOP
04ED            SIGCNTR         DS 1            ;STORAGE FOR SIGCOUNTER BYTE
04EE            FORMAT          DS 1            ;STORAGE FOR TUNE/NORMAL/REVERSE FORMAT BYTE
04EF                            END
A>
```

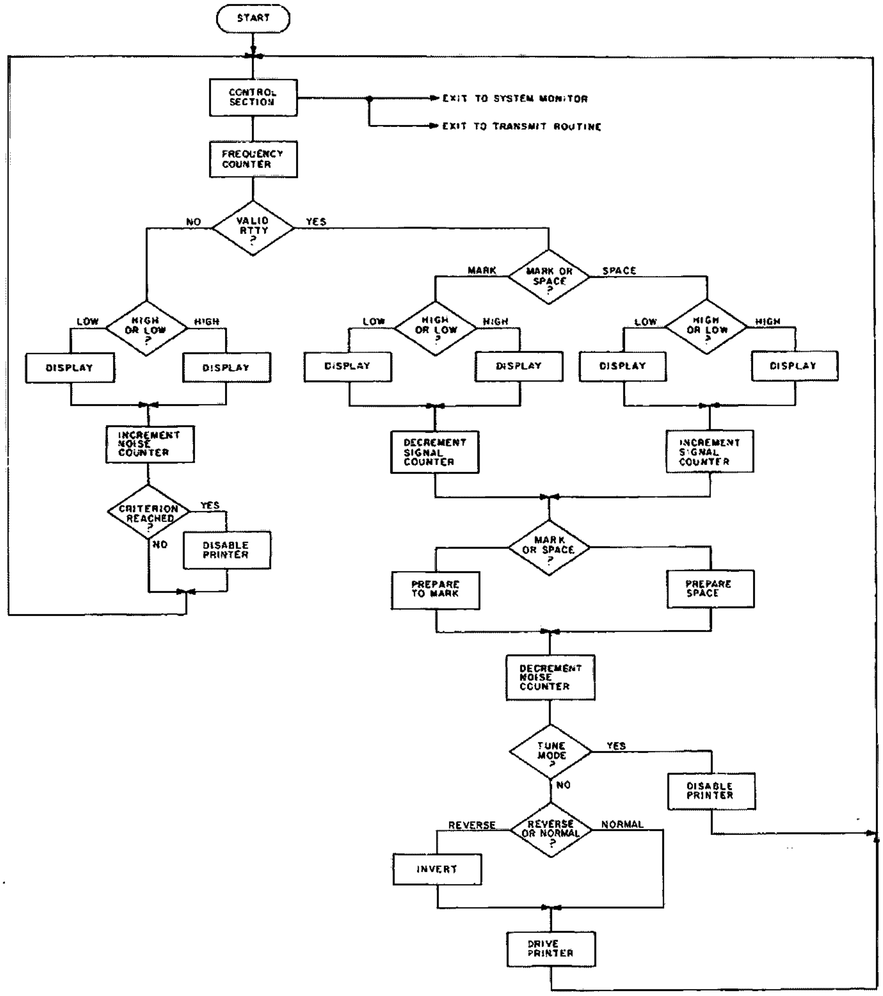


Fig. 6. Flowchart for complete TU program. Note the 6-way partition of the data for driving the tuning display. The noise counter squelches the printer when there is too much noise present. The signal counter acts as a post-detection low-pass filter.

needed is a driver for the teleprinter loop. Fig. 9 shows how I do it. A high-voltage transistor can be used for the switch if one is available. The piggyback circuit shown allows the use of relatively low-voltage "experimenter grab bag" power transistors to switch the high-voltage loop current.

For initial setup, an oscilloscope is convenient to allow determination of the proper audio level. I usually use a simple audio monitor connected right at the computer input port. With this arrangement, I can tell

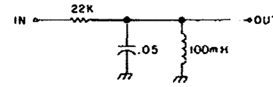


Fig. 8. A simple 2200-Hz filter. A lower-value resistor will widen the passband. Selecting capacitors from the junk box is the easiest way to tune the filter.

by ear when the audio level is adequate. Tuning is simply a matter of watching the LED display and making corrections when the low mark or high space lights begin to flash.

As I said at the start, one of the advantages of software is the ease of modification. Just sitting down to type this manuscript made me think of four or five changes, and I just had to try them before getting back to the typewriter. I'm sure anyone who tries this method of copying RTTY will come up with other changes. I intend to do some experimenting with different amounts of averaging in the signal counter and different criteria in the noise counter. It also would be possible to add more control signals to instantly modify the criteria and allow for different shifts. Enough information is extracted to allow the generation of control signals for afc. I would enjoy hearing from readers who undertake some of these improvements. ■

○ ○ ● ● ● ● ● ● ●
a. STEADY TONE, TOO LOW TO BE VALID MARK

● ● ○ ● ● ● ● ● ●
b. MARK TONE, TUNED A LITTLE LOW

● ● ● ○ ● ● ● ● ●
c. MARK TONE, TUNED CORRECTLY

● ● ● ○ ○ ● ● ● ●
d. RTTY SIGNAL, PROPERLY TUNED

● ● ○ ● ● ○ ● ● ●
e. RTTY SIGNAL, SHIFT A LITTLE WIDE

● ● ● ● ● ● ● ○ ○
f TONE TOO HIGH TO BE VALID SPACE

Fig. 7. Some of the possible combinations seen on the row of LEDs that serve as a tuning indicator. It is very easy to see which way the receiver dial should be tuned to maintain good copy. O = on; ● = off.

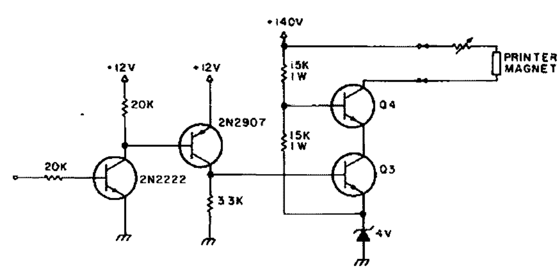


Fig. 9. A TTL-to-60-mA loop interface circuit. Q3 and Q4 could be replaced by a single high-voltage transistor. This piggyback circuit is a useful one for switching high voltages with low-voltage transistors. In my station, I use two unmarked TO-220-type power transistors from a "40 for $1.98" special pack.

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Baudot Hard Copy For Your SWTPC

—noisy, but cheap

Tie a 6800 to a five-level Teletype™.

Garry Caudell K4HBG
3125 Robin Lynn Drive
Ashland KY 41101

In an earlier article (March, 1978), I discussed the use of a simple search program. In this article, I'll explain hardware and software to tie an SWTPC 6800 to a Baudot Teletype™.

Everyone probably knows the disadvantages of the old Baudot machines, such as being slow, having a limited character set, etc. However, on the plus side, they are cheap and compatible with ham radio operation. If you want cheap (but slow) hard copy, or if you want to use the CRT terminal as a glass Teletype, keep reading.

The simplest way to get hard copy is to use the standard SWTPC MP-S board. All you need to build is the clock divider (see Fig. 2). Unfortunately, this board uses an ACIA (6850) chip, and there is no way to tell it that you don't need all eleven bits when you really need only seven (five data bits plus start and stop bits). If you are willing to slow down the already slow printer, it will think that the extra bits are just long stop bits. Trying to copy this way would not work on anything that was sent at near-synchronous speed. The program would need to be changed to accommodate an ACIA (see listing 2 in Fig. 4).

The circuit I used to interface my SWTPC 6800 computer to my Model 15 Teletype is an expansion of the circuit used by Mark J. Borgerson in his article in *73* (November, 1976). It has a PIA (6820) controlling a UART (S-1883). All connections into the PIA are identical to those used by the MP-L board.

The clock for the UART is derived from the 600-baud clock divided by 13. If you are using the 1.843-MHz crystal recommended by Motorola for the MC14411 baud generator chip, this comes out slightly high. If you are using the crystal which SWTPC rec-

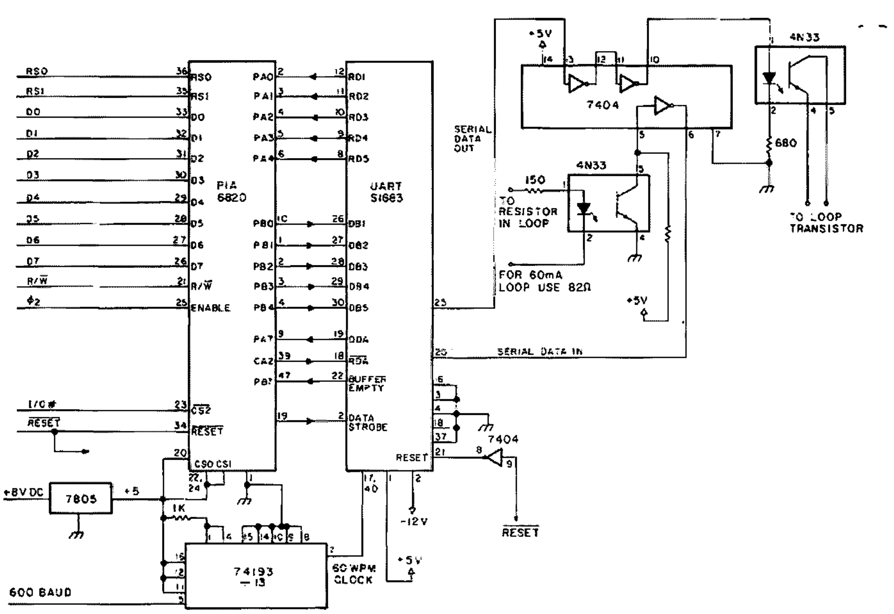


Fig. 1.

ommends, it will be slightly low. In either case, it is as close as the rest of the baud rates, if you follow SWTPC recommendations. (I don't know why SWTPC did this.) This circuit works well and gives one less variable, as compared to using a tunable oscillator (one less confusion factor when trying to get the thing working).

The A-side of the PIA ties to the receive data side of the UART, with bit 7 used for a data ready indication. CA2 is used to clear the UART.

The B-side of the PIA is used as an output to drive the UART, with bit 7 used as an input to poll the UART for a buffer empty signal. CB2 is used to strobe the UART to tell it when to transmit data.

I found it useful to connect the UART reset to the SWTPC reset (through a 7404 inverting gate). This may not be necessary, as most UART circuits do not require a reset, but simply ground this pin. I felt that if the UART did need a reset, this would be well worthwhile to include.

Data in and data out are buffered by the 7404 gates and by 4N33 optical couplers.

In my system, the output is in series with the base of my loop-keying transistor. This allows the printer to

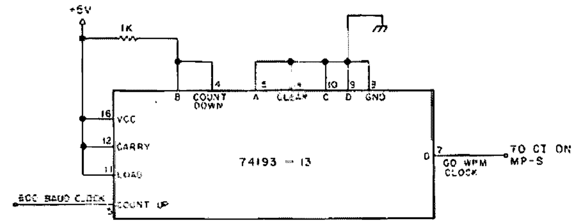


Fig. 2. Build this only if you are going to use the MP-S board. Don't jumper any baud rate on the board.

Fig. 3. Program listing 1.

```
                        NAM    OUTEEE
                ****************************************************
                *
                *      PROGRAM TO CONVERT ASCII TO BAUDO
                *
                *      G. D. CAUDELL
                *
                *      JULY 1977
                *
                ****************************************************
                        OPT    O
                        OPT    5
3F00                    ORG    $3F00
3F00 02         TABLE   FCB    $02,$03,$19,$0E,$09,$01,$0D,$1A
3F01 03
3F02 19
3F03 0E
3F04 09
3F05 01
3F06 0D
3F07 1A
3F08 14                 FCB    $14,$06,$0B,$0F,$12,$1C,$0C,$13
3F09 06
3F0A 0B
3F0B 0F
3F0C 12
3F0D 1C
3F0E 0C
3F0F 13
3F10 16                 FCB    $16,$17,$0A,$05,$10,$07,$1E,$13
3F11 17
3F12 0A
3F13 05
3F14 10
3F15 07
3F16 1E
3F17 13
3F18 1D                 FCB    $1D,$15,$11,$03,$02,$04,$16,$04
3F19 15
3F1A 11
3F1B 03
3F1C 02
3F1D 04
3F1E 16
3F1F 04
3F20 04                 FCB    $04,$2D,$31,$34,$29,$04,$3A,$2B
3F21 2D
3F22 31
3F23 34
3F24 29
3F25 04
3F26 3A
3F27 2B
3F28 2F                 FCB    $2F,$32,$2B,$1A,$2C,$23,$3C,$3D
3F2A 23
3F2B 1A
3F2C 2C
3F2D 23
3F2E 3C
3F2F 3D
3F30 36                 FCB    $36,$37,$33,$21,$2A,$39,$35,$27
3F31 37
3F32 33
3F33 21
3F34 2A
3F35 39
3F36 35
3F37 27
3F38 26                 FCB    $26,$38,$2E,$3E,$2F,$2E,$32,$39
3F39 38
3F3A 2E
3F3B 3E
3F3C 2F
3F3D 2E
3F3E 32
3F3F 39
3F40 86 FF      CINT    LDA A  #$FF       LOAD FLAG
3F42 B7 3F83            STA A  LAST+1     STORE FOR INIATE
3F45 39                 RTS
3F46 81 5E      OUTEEE  CMP A  #$5E       IS IT LOWER CASE
3F48 22 5F              BHI    EXIT       YES -- GET OUT
3F4A FF 3FA5            STX    SAVX+1     SAVE INDEX REGISTER
3F4D CE 3F00            LDX    #TABLE     POINT INDEX REG. AT START OF
3F50 84 7F              AND A  #$7F       GET 1D OF PARITY
3F52 E7 A8              STA B  XSAVB+1,X  SAVE B
3F54 6D 83              TST    XLAST+1,X  TEST CASE FLAG
```

```
3F56 2C 0C              BGE    CKCR       GO CHECK FOR CARRIAGE RETURN
3F58 C6 7F      INT     LDA B  #$7F
3F5A 8D 5B              BSR    XINT
3F5C C6 1F              LDA B  #$1F       LOAD BAUDOT LETTERS
3F5E E7 B5              STA B  XSEND+1,X  STORE B SO IT CAN BE SENT
3F60 6F 83              CLR    XLAST+1,X  CLEAR CASE FLAG (LAST+1)
3F62 8D 4A              BSR    BAUDO      GO SEND BAUDOT LETTERS
3F64 81 0D      CKCR    CMP A  #$0D       IS IT CARRIAGE RETURN
3F66 26 02              BNE    CKLF       GO CHECK LINE FEED
3F68 86 5B              LDA A  #$5B       POINT TO BAUDO CARRIAGE RETUR
3F6A 81 0A      CKLF    CMP A  #$0A       IS IT LINE FEED
3F6C 26 04              BNE    CKSP       GO CHECK FOR SPACE
3F6E 86 5C              LDA A  #$5C       POINT TO BAUDO LINE FEED
3F70 26 0A              BNE    CKSHF
3F72 81 20      CKSP    CMP A  #$20       IS IT SPACE
3F74 26 02              BNE    CKCNTRL
3F76 86 5D              LDA A  #$5D       POINT TO BAUDO SPACE
3F78 81 1F      CKCNTR  CMP A  #$1F       IS IT A CONTROL CHARACTER
3F7A 23 28              BLS    SAVX
3F7C 84 3F      CKSHF   AND A  #$3F       CONVERT TO SIX BIT ASCII
3F7E A7 A0              STA A  XLOOKUP+1,X  STORE IN LOOKUP+1
3F80 84 20              AND A  #$20
3F82 81 FF      LAST    CMP A  #$FF       COMPARE LAST
3F84 27 16              BEQ    ASEND      IF SHIFT IS OK GO SEND CHAR
3F86 23 0C              BLS    LTRS       GO TO LETTERS
3F88 C6 20      FIGS    LDA B  #$20       LOAD FIGS FLAG
3F8A E7 83              STA B  XLAST+1,X  STORE IN LAST+1
3F8C C6 1B              LDA B  #$1B       LOAD BAUDO LETTERS
3F8E E7 B6              STA B  XSEND+1,X  STORE IN SEND+1
3F90 8D 1C              BSR    BAUDO      GO SEND IT
3F92 20 08              BRA    ASEND
3F94 6F 83      LTRS    CLR    XLAST+1,X  LEAR CASE FLAG (LAST+1)
3F96 C6 1F              LDA B  #$1F       LOAD BAUDO LETTERS
3F98 E7 B6              STA B  XSEND+1,X  STORE IN SEND+1
3F9A 8D 12              BSR    BAUDO      GO SEND IT
3F9C 8D 0C      ASEND   BSR    LOOKUP
3F9E 20 04              BRA    SAVX
3FA0 E7 B6      BSEND   STA B  XSEND+1,X  STORE IN SEND+1
3FA2 8D 0A              BSR    BAUDO
3FA4 CE 0000    SAVX    LDX    #$0000
3FA7 C6 00      SAVB    LDA B  #$00       RESTORE B
3FA9 39         EXIT    RTS
3FAA E6 00      LOOKUP  LDA B  0,X        CONVERT CHARACTER TO BAUDO
3FAC E7 B6              STA B  XSEND+1,X  STORE IN SEND+1
3FAE F6 800E    BAUDO   LDA B  PIA
3FB1 C4 80              AND B  #$80       IS UART READY
3FB3 27 F9              BEQ    BAUDO      NO GO BACK AND WAIT
3FB5 C6 00      SEND    LDA B  #$00       LOAD BAUDO CHARACTER
3FB7 F7 800E    XINT    STA B  PIA        TICKLE THE UART
3FBA C6 34              LDA B  #$34       TO LET IT KNOW
3FBC F7 800F            STA B  PIA+1      TO DO SOMETHING
3FBF C6 3C              LDA B  #$3C
3FC1 F7 800F            STA B  PIA+1
3FC4 39                 RTS
     0082       XLAST   EQU    LAST-TABLE
     00B5       XSEND   EQU    SEND-TABLE
     00AA       XLOOKU  EQU    LOOKUP-TABLE
     00A7       XSAVP   EQU    SAVB-TABLE
     800E       PIA     EQU    $800E
                        END
TABLE   3F00
CINT    3F40
OUTEEE  3F46
INT     3F58
CKCR    3F64
CKLF    3F6A
CKSP    3F72
CKCNTR  3F78
CKSHF   3F7C
LAST    3F82
FIGS    3F88
LTRS    3F94
ASEND   3F9C
BSEND   3FA0
SAVX    3FA4
SAVB    3FA7
EXIT    3FA9
LOOKUP  3FAA
BAUDO   3FAE
SEND    3FB5
XINT    3FB7
XLAST   0082
XSEND   00B5
XLOOKU  00AA
XSAVB   00A7
PIA     800E

TOTAL ERRORS 00000
```

Fig. 4. Program listing 2. If you reassemble the entire program, NOPs (lines 1290-1295) can be omitted.

```
00100                      NAM     PATCH
01282                      OPT     L
01290 3F56 01        INT   NOP
01295 3F59 01              NOP
01300 3F5A 8D 61           BSR     XINT
01310 3F5C C6 1F           LDA B   #$1F      LOAD BAUDOT LETTERS
01320 3F5E E7 86           STA B   XSEND+1,X  STORE B SO IT CAN BE SENT
01330 3F60 6F 83           CLR     XLAST+1,X  CLEAR CASE FLAG  (LAST+1)
01340 3F62 8D 4A           BSR     BAUDO     GO SEND BAUDOT LETTERS


01722                      OPT     L
01723      800C      ACIA  EQU     $800C
01730 3FAE C6 02     BAUDO LDA B   #$02      LOAD TEST FLAG
01740 3FB0 F5 800C   BIT   BIT B   ACIA      IS ACIA READY
01750 3FB3 27 FB           BEQ     BIT       NO GO BACK
01760 3FB5 C6 00     SEND  LDA B   #$00      LOAD BAUDOT CHARACTER
01770 3FB7 CA E0           ORA B   #$E0      SET EXTRA BITS TO MARK
01780 3FB9 F7 800D         STA B   ACIA+1    SEND IT
01790 3FBC 39              RTS


01800 3FBD C6 03     XINT  LDA B   #$03
01810 3FBF F7 800C         STA B   ACIA
01820 3FC2 C6 55           LDA B   #$55
01830 3FC4 F7 800C         STA B   ACIA
01840 3FC7 39              RTS

TOTAL ERRORS 00000
```

operate either from my ST-5 or the computer, without doing any switching. Similarly, the input is a resistor in the loop which allows either the keyboard or the ST-5 input to the computer.

Construction

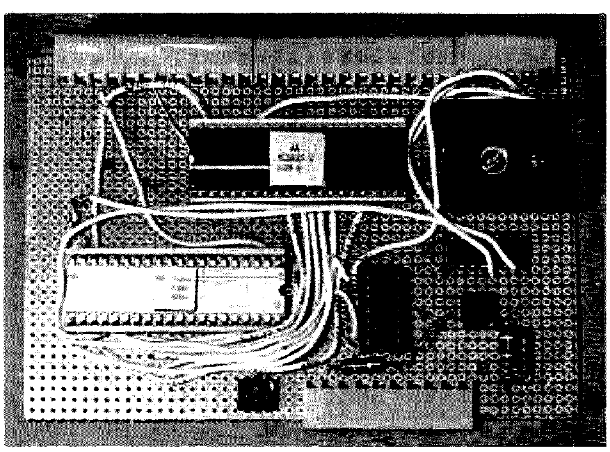
I am sorry to say that I do not have a nice printed circuit board to build this gadget on. Mine is hand-wired on a piece of vectorboard which is the same size as the SWTPC I/O boards and has the same plug arrangement. For no good reason, I put it on slot 3.

Program

The program to convert ASCII to Baudot (see listing 1) is noteworthy only because of the ease of relocating it. If you have a block-move program, only the memory locations in lines 1130, 1210, and 1220 have to be changed. From here on, relative or indexed addressing is used.

The first part of the program (1040-1110) consists of a lookup table to convert Baudot to ASCII. In the table, the conversion is accomplished by pointing the index register at the start of the table and using the ASCII character (6-bit form) as an offset. Line feed and carriage return are handled as exceptions. No other control characters are allowed (bell might have been useful).

Space is handled as an exception because some machines are set up for unshift on space. In the program, space is handled as a letters character only.



Home-brew I/O board.

The CINT (1120-1140) subroutine is used to restore the flag so that the PIA will be initiated after a reset.

OUTEEE (1150) is the point to branch to in order to output a character in "A" accumulator (just like MIKBUG). The first thing it does (lines 1150-1160) is reject any lowercase ASCII. Next, it stores the index register and points the index register to the start of the conversion table (lines 1210-1220).

In line 1230, the program makes sure that we are talking about 7-bit ASCII and then saves the "B" accumulator (line 1240).

The test in line 1260 is to see if the PIA has been initialized or not. It does this by checking to see what is stored in LAST+1 (line 1510). If it sees a negative value ($FF), it will go through the INT portion (1290-1340) which will initialize the PIA, clear the last flag, and put the printer in letters shift.

If it sees a nonnegative value, it will jump around this section. All this means that, if you have reset the computer, you need to restore the $FF in LAST+1. This is the purpose of the CINT routine.

Lines 1350-1470 check for carriage return, line feed, and space. If it finds them, it substitutes values for them so they can be printed. Line 1472 rejects all other control characters. Line 1480 converts the character to 6-bit ASCII, and then it is stored to be sent later (1490).

In 6-bit ASCII, if the character is less than hex 20, it is a letter of the alphabet, so we should be in letters shift.

If it is greater than hex 20, we should be in figures shift. Line 1500 reduces the character to either a hex 20 or a zero value. This is compared to the value in LAST+1 (line 1510) to determine if the printer is in the correct shift. If it is in the correct shift, the program jumps ahead to send the character; otherwise, the appropriate shift is sent (1550-1630).

ASEND (1640) branches to send the character then to SAVX (1680) to restore index register and "B" accumulator and return.

Lookup (1710) does the actual conversion and stores the Baudot character in SEND+1. In lines 1730-1750, the UART is tested to see if it is ready for a new character. 1760-1770 sends the character to the UART. 1780-1820 strobes the UART to tell it that the character can be sent.

Software to input a character is listed in the November article and will not be repeated here.

These two programs do not represent a complete system for RTTY operation, but rather a set of subroutines to be incorporated in such a system. A complete system would need a software FIFO and some form of sense switch operation, so you would automatically switch from the input program to the output program when your transmitter is keyed.

The program listed here can be used to give hard copy on your existing program.

The procedure for finding the correct places and the patching procedures were outlined in my earlier (March, 1978) article.

I would like to say that I am not sure how much of this is my own work and how much was Doug Schwab WA4ZV1's. Anyhow, thanks to Doug, and thanks to the repeater gang. ■

Reference

Mark J. Borgersen, "Baudot to ASCII," *73 Magazine*, November, 1976.

The 9-Element Duoband DX Attention-Getter

—when you call, they listen

From the folks who brought you the "Towerless 'Tower.' "

Robert H. Walker K4FK
400 Tivoli Ave.
Coral Gables FL 33143

Roy D. Mazzagatti N4OG
18551 S.W. 204th St.
Miami FL 33187

Photos by WA4KIL

Hy-Gain's "tiger on 20," the popular 204BA 4-element monoband yagi, exhibits the excellent performance which can be obtained from a relatively small close-spaced yagi array. For over a decade, the one at K4FK has been performing flawlessly and giving no maintenance problems. Originally, the antenna was up 77 feet on a Rohn tower. A move to a new QTH in 1971 limited us to mounting it on a telescoping TV mast at heights between 12 and 20 feet (see Walker and Mazzagatti, "The Towerless 'Tower,'" *73 Magazine*, June, 1978). Even at such low heights, the 204 has proven itself competitive in pileups.

With the recent upturn in the sunspot cycle, we decided to try interlacing a 15 meter yagi with the 204BA on the Hy-Gain boom. According to *The ARRL Antenna Book*, "It is generally accepted that interaction, if any, is very minimal between bands which are not harmonically related." Would this hold true in practice? Our empirical experimentation has essentially validated that quotation. The result has been a much more versatile antenna, with no degradation in 20 meter performance.

We began by constructing one 15 meter element and placing it near the boom. The swr on 20 meters immediately jumped to 1.7 to 1 from 1.3 to 1. Moving the 15 meter element along the boom and rotating it in and out of the plane of the 20 meter elements produced no further changes. As soon as the 15 meter element was placed within a yard of the boom, the swr climbed. We moved it further away, and the swr returned to normal. We tried the same experiment using a 10 meter ele-

Photo A. A most unorthodox 204BA. Nine elements and two gamma matches radically alter its appearance!

Photo B. A view of the "business end." The result is usually heard around the world.

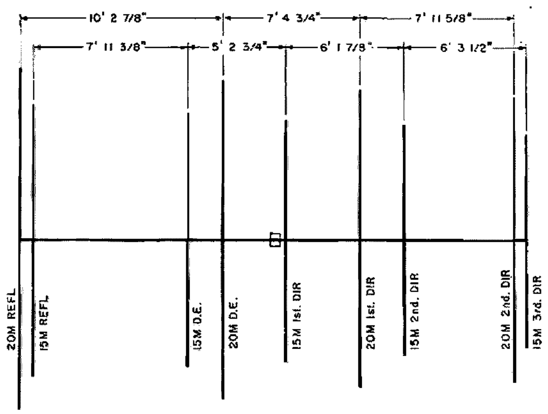


Fig. 1. Element spacing.

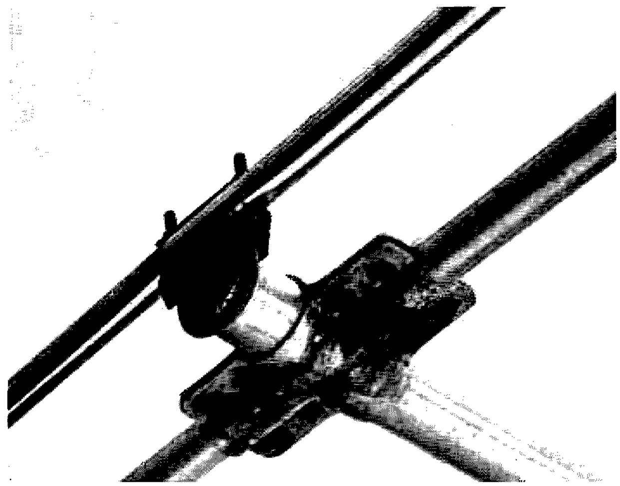


Photo C. Despite using just one muffler clamp per element, there has been no difficulty maintaining alignment.

ment, and, interestingly enough, this had no effect on the 20 meter swr. Bringing a Hy-Gain DB10-15A 3-element trap duobander close to the 204 produced a similar effect to that produced by the 15 meter element alone. Obviously, there was some interaction. Was it sufficient to reduce the 20 meter efficiency?

We tested for any 20m degradation by mounting three 15m elements on the boom and then using the beam normally on 20m over a period of several weeks. The additional elements did not increase the interaction over that introduced by the initial element, and we could detect no difference in the beam's 20 meter operation. If the 15 meter beam would function correctly, there appeared to be no reason why we couldn't interlace it with the 204BA. It would be desirable to provide an easily-adjusted matching system for each of the yagis, however.

One thing which we had noticed over the years of using the antenna at extremely low heights was how profoundly its capacitive coupling to the building was reflected in impedance excursions during rotation. Most annoying—rotate the array a few degrees, and then retouch the transmitter tuning. The better the antenna and feedline are matched, the less pronounced this effect becomes.

20 Meter Modifications

Hy-Gain's beta match is an inductive "hairpin" type of matching device. We decided to replace it with a more easily adjusted gamma match. Commercially manufactured coaxial capacitor-style gamma matches are much easier to install and maintain than are those which require a separate air variable capacitor in a waterproof enclosure. Viking Instruments* and Gotham Antennas** both market such a gamma match. We settled on the Gotham unit because it is a lower-Q device, which makes adjustment easier and less critical. Additionally, the Gotham gamma match is mechanically stronger and doesn't tend to fill with water and short out, as did two of our Viking matches.

The Hy-Gain driven element is split at the center for use with the beta match. We made it into a one-piece element by wrapping heavy-duty aluminum foil over the plastic center insulators and out over the element.

*Viking Instruments, 73 Ferry Rd., Chester CT 06412.

**Gotham Antennas, 2051 N.W. 2nd Ave., Miami FL 33127

An ohmmeter check showed that once the driven element halves were installed in the element-to-boom bracket, continuity was excellent. The aluminum foil should be covered with electrical tape and waterproofed by coating the tape with a sealant such as a popular uncured silicone rubber compound. For good measure, we attached a piece of coax braid between the two element halves as well.

Make sure you obtain good continuity between the driven element and the boom as well, if you plan to attach your feedline braid to the bracket which mounts the gamma match to the boom. Otherwise, attach the braid to the center of the driven element, not to its mounting bracket. It's also a good idea to run a bolt through the gamma tube itself for attaching the coax center conductor rather that relying on the U-bolt as the instructions suggest.

The length of the driven element wasn't altered from Hy-Gain's CW specification. The beta match, being an inductive device, probably requires a slight shortening of the driven element. Our method of making the driven element into an electrically one-piece element effectively lengthens it slightly. Therefore, resonance does not noticeably change. One additional benefit occurs as a result of this conversion. The 204BA will now display better bandwidth characteristics across the entire 20 meter band.

15 Meter Construction

Fig. 1 shows the spacing of both sets of elements along the boom. We had originally constructed the antenna with the 20 meter reflector mounted at one end of the boom, and the remainder of the elements spaced according to Hy-Gain's instructions. This left 2 inches of boom unused beyond the 20 meter second director. We chose to mount the 15 meter third director in this area to maximize its spacing. If you don't have room to do this on your particular 204BA, you can move that director inside of the 20 meter second director

Element	Length
Reflector	23' 5-1/2"
Driven Element	22' 6-1/2"
1st Director	21' 6-1/2"
2nd Director	21' 1-3/8"
3rd Director	20' 8-1/4"

Fig. 2. 15 meter element lengths.

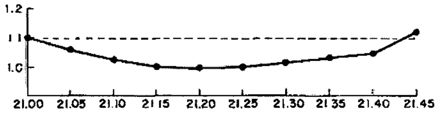


Fig. 3. Swr curve across the 15 meter band.

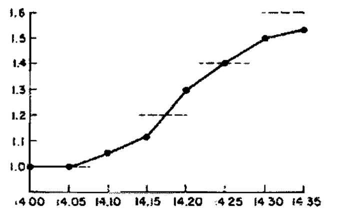


Fig. 4. Swr curve across the 20 meter band.

without affecting performance.

The boom of our 1968 vintage 204BA measures 26 feet, 2 inches. We needed to use it all if we were to mount 5 elements. Also, we had to locate some of the 15 meter elements very close to existing 20 meter elements. For these reasons, we dispensed with the usual aluminum element-to-boom mounting plates such as those used by W8ZCQ in his article, "Working 15m with a 20m Beam," *73 Magazine*, June, 1978.

Photo C shows how a single 2-inch muffler clamp can be used to mount each element. If you can't get muffler clamps with a long U-bolt, you may have to use hardware-store U-bolts with the saddles from your muffler clamps. The U-bolt must be long enough to come up through the element. We have had no trouble with elements slipping or otherwise coming out of alignment, and the array has withstood winds gusting to 56 mph.

Each 15 meter element is constructed of two 12-foot lengths of 3005 aluminum tubing. Make the center of each element from a single 1-inch diameter run. Cut a single run of 7/8-inch tubing into two 6-foot lengths. These are inserted into the ends of the center section. The ends of the center section should be Xed with a hacksaw so that hose clamps can pull it down snugly over the end sections. Our 1-inch tubing has a wall thickness of .041 inches, while our 7/8-inch tubing has a wall thickness of .035 inches. This combination produces a nicely telescoping assembly.

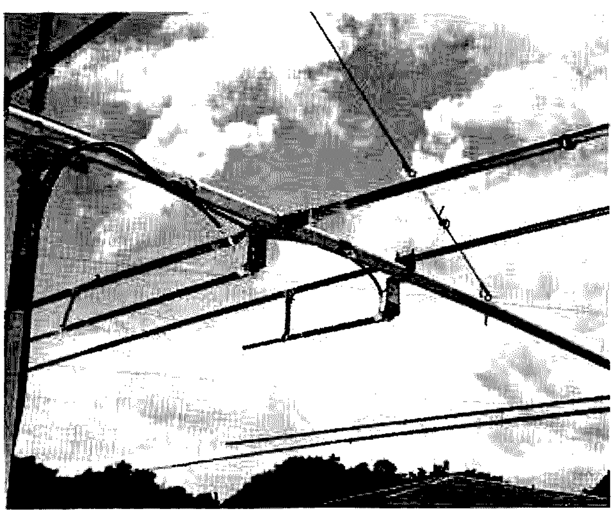


Photo D. White material on the gamma matches and over the electrical tape is GE Silicone Seal.™ It also protects the aluminum foil on the 20 meter driven element.

Adjustment

The gamma matches are adjusted in the normal manner, 20 meters first, and then 15. A good starting point for the shorting strap is a distance of 10 percent of the total length of the driven element, out from the center of the driven element. Preset in this fashion, both sections displayed an swr of less than 1.8 to 1 prior to any additional adjustment. Slide the coaxial capacitor part of the gamma match in and out until lowest swr is obtained. Then move the shorting strap a half inch and readjust the coaxial capacitor. By alternating these adjustments, you should easily find a combination which yields an swr of 1.2 to 1, or less.

It is ideal, of course, to adjust the gamma matches with the antenna in its final operating position. Most of us cannot accomplish this. We have found that the swr changes only slightly once the antenna is installed if it has been carefully adjusted either on top of a ladder or pointed vertically into the air with its reflector resting on the ground.

Performance

Figs. 3 and 4 show the swr curves on the 15 and 20 meter bands, respectively. It is quite permissible (although purists may disagree) to use the gamma matches to "fudge" the resonant frequencies a bit, if desired. Our matches were adjusted for lowest swr at 21.125 and 14.025 MHz. The 20 meter performance remains, as far as we can observe, absolutely unchanged except for the previously mentioned improvement in bandwidth. We have no way to measure the forward gain on 15 meters. However, "if you point it at 'em and give 'em a call . . . you usually get a reply." The front-to-back ratio on 15 meters runs about 20 to 25 dB and the front-to-side is just about 40 dB.

Some Thoughts

We were so pleased with this project that we decided to try to add 10 meters as well. Predictably, the interaction was so bad that we had to forego our attempts to triband the 204BA. The 10 meter elements didn't affect the performance on either 15 or 20 meters. We were just unable to make the 10 meter section perform as a beam. One set of adjustments gave us a slight bit of gain—off the reflector! Another set provided an omnidirectional pattern with signal levels about three S-units under a dipole. In no case did it make any difference whether the 10 meter elements were insulated from the boom or not. We would very much like to hear from anyone who successfully adds both 10 and 15 meter elements to a 204BA. That would surely be a most impressive tribander!

Parts Availability

In cooperation with Gotham Antennas, we are offering a complete kit to interlace five 15 meter elements with an existing 204BA. Elements, hardware, both gamma matches, and instructions are included. Please send an SASE for details.■

Bibliography

1. *The ARRL Antenna Book*, 1974 edition.
2. McCoy, Lewis G., "Why a Beam Antenna?", *QST*, January, 1972.
3. Orr, William I., *Beam Antenna Handbook*, 1976 edition.
4. Umberger, Dan, "Working 15m with a 20m Beam," *73 Magazine*, June, 1978.

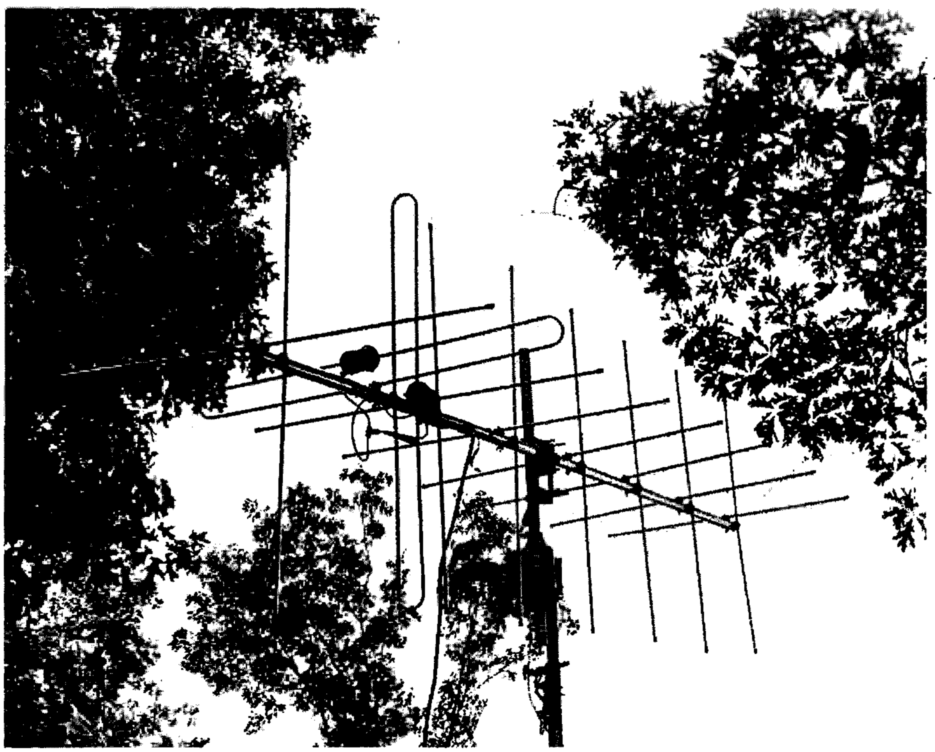
Here's a "Twist"

—an OSCAR antenna with a difference

Introducing the 8XY/2M.

Dave Ingram K4TWJ
Eastwood Village No. 1201 S.
Rt. 11, Box 499
Birmingham AL 35210

If you are one of the many amateurs who has experienced communication via our OSCAR orbital satellites, you know the challenge and enjoyment of satellite operations. The various aspects of OSCAR communications have something to catch nearly everyone's fancy: convenient operating times, orbital calculations and tracking systems, duplex style operating, unobtrusive antenna setups, low TVI levels, etc. Amateurs with limited time available to enjoy on-the-air operations truly appreciate the pinpoint-accurate communication times synonymous with satellite passes. What else could one ask?



The Spectrum International 8XY/2M OSCAR antenna is mounted on a 30-foot push-up mast which is tilted 30 degrees. This "skyward tilt" bypasses elevation rotor needs.

As with any station setup, the antenna system plays a major role in its performance. Quite simply, it's what's "up top" that counts! A poor skywire can undermine the most elaborate amateur setup, while an efficient antenna can make a mediocre setup perform like a million dollars. OSCAR setups are no exception to this rule. If you plan to fully enjoy OSCAR, you'll definitely benefit from using an antenna designed for satellite operations. Such an antenna is the 8XY/2M 8-element, 2-meter "Twist" antenna distributed by Spectrum International.

I found that assembling the 8XY/2M antenna was a refreshing change from the usual time-consuming task of rigging clamps and measuring element mounting locations. This gem went through smoothly in an hour's time, with heavy-duty bolts and wing nuts making hand-assembly a snap. Not a single tool was required until transmission lines were connected to

the driven elements. Each element of the S.I. "Twist" is ¼-inch aluminum tubing which is precut and capped with color-coded tips to aid assembly. The boom is also predrilled and color-coded to ensure quick, foolproof assembly. *All* hardware for the antenna is *preassembled*, and an extra element-mount is included in case one becomes lost or broken. The massive boom-to-mast clamp could support a triband beam. Very nice! I must admit that this was the first time I've enjoyed (sort of) constructing an antenna.

The 8XY/2M antenna can be fed four different ways to obtain either vertical, horizontal, right-hand circular, or left-hand circular signal polarization. A ready-to-install phasing harness for circular polarization is available from Spectrum International, or you can fabricate your own harness from details supplied in various antenna books. Since I didn't care to kill time building a harness, I used the S.I. unit—and I'm glad I did.

If a fixed polarization is desired, the harness can be mounted at the antenna proper. If various polarizations are desired (for operating various modes of OSCAR), two transmission lines can be run from the antenna's driven elements and the phasing harness placed at the operating position. A coax switch can then be used to select the required polarization.

My Spectrum 8XY/2M antenna replaced a 2-month-old, 3-element array previously used for satellite work, and a significant signal improvement was realized. Suddenly, I was able to easily access the satellite and "stay into" the transponder for a longer period of time during each pass. I also noticed that my signal wasn't as prone to the heavy fades which were apparently due to polarization shifts during passes. This gain alone was worth the change to Spectrum's 8XY/2M antenna, as it allowed me to successfully operate slow scan TV via satellite.

When OSCAR 8 was placed in orbit, I decided to remove a few director elements from the 8XY/2M to reduce my erp to this new "bird." This antenna change worked very well, but a couple of days later, OSCAR 8 lost sensitivity and I had to replace the removed elements. Hopefully this satellite problem is merely an overloading situation which will soon be rectified.

I truly feel that the 8XY/2M antenna was a prime factor in my operations of successfully transmitting the first SSTV pictures via OSCAR 8 during orbit 102. Since I have only one small TV rotor to use with the 8XY/2M, I bent the rotor-to-boom mast approximately thirty degrees. This tilt allows the antenna to "look skyward," and bypass elevation rotor requirements.

In conclusion, I think amateur satellite communication and Spectrum's 8XY/2M are an ideal combination which all amateurs would thoroughly enjoy experiencing. There's no better way of renewing one's interest in amateur radio than by trying a new aspect of communication.

The 8XY/2M antenna is available from Spectrum International, Inc., P.O. Box 1084, Concord MA 01742. This 16-element array (8 elements vertical, 8 elements horizontal) is in the $45 to $50 price class. ■

A Fortified 2m Whip

—won't bend in the breeze

Donald A. Habeck W9AMM
5973 Sugarbush Lane
Greendale WI 53129

Are you in need of a good 2 meter mobile antenna? How about an antenna for your base station? Or, do you just plain have the feeling that your station has become too commercialized and that a portion of your setup should be home-brewed? Then, why not try this antenna project? In actual checks, it was found to compare favorably with the commercially-made antennas tested. Whether you decide to use the antenna for mobile or base station operation, you'll be pleasantly surprised with its performance. The antenna is easy to construct and tune, and, best of all, it's inexpensive.

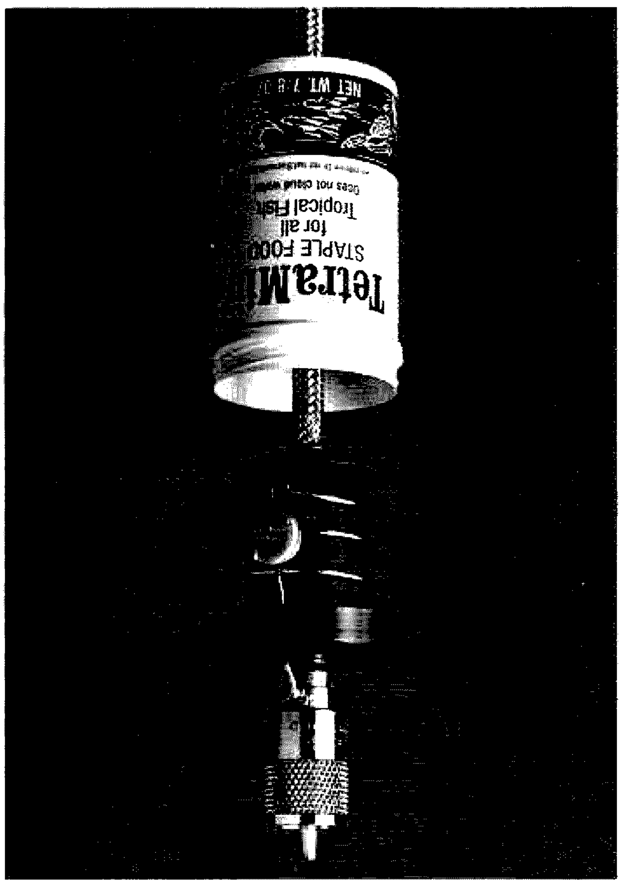


Photo A. The coil protective cover has been removed in this picture to show details of the base coil.

Design

One unique feature of this antenna is the construction of the whip. It consists of a 1/4"-diameter fiberglass rod with a shield of copper braid. This design was selected because it provided rigidity to minimize deflection during high winds or mobile operation. Research has shown that deflection of the flimsy-type whip causes degradation of the vertically polarized signal. In some instances, the efficiency of a 5/8-wave antenna actually becomes less effective than a 1/4-wave antenna.

The fiberglass rod is from the pennant-topped-type whip that is made for mounting on bicycles. Many retail stores have given away these whips as promotional items. They also are readily available from department stores and bicycle shops for approximately $1.25.

The impedance matching coil is 3 turns of no. 14 tinned copper wire wound on a wood thread spool from your XYL's sewing basket. It is tapped 1-1/8 turns from the ground end. A small ceramic trimmer capacitor across the coil provides a precise match in conjunction with the base coil tap. The impedance matching circuit is protected from the weather by enclosing it in an empty plastic container. Fish food had come in the container we used.

Construction and Assembly

Since no tricky construction or special tools are needed, no problems should be encountered. The fiberglass rod is prepared by drilling the 1/16"-diameter hole from the bottom as indicated in the diagram. Another 1/16"-diameter hole is drilled on the side of the rod at point A. This should be drilled at a slight angle towards the bottom to make the routing of the coil tap wire easier. The depth of this hole is only to the extent of meeting with the hole previously drilled from the bottom. When drilling these holes in the fiberglass rod, it is important to use a sharp drill and not allow the drill to heat up. It is best to cut the whip to proper length after the coil form is secured in place.

Prepare the coil form and other parts as indicated. Check that the hole in the spool is of the proper

diameter to permit the spool to slide on the rod. The notches filed into the coil form prevent the coil from slipping. The hole for the coil tap is displaced 1/8 of a turn from the alignment of the bottom notch.

After the coil form is prepared, feed the 20-AWG tap wire through the tap-wire hole and out the bottom of the spool. Slide the form over the fiberglass rod and carefully route the tap wire through the drilled hole at point A and downward through the rod, out the bottom. Allow sufficient length for the tap wire to be soldered later in the PL-259 connector. Apply epoxy glue to the appropriate rod area, slide the coil form into its proper position on the rod, and take up any slack in the top wire. The final position of the coil form should be such that the tap-wire holes in the spool and the rod line up with each other and the rod extends sufficiently below the bottom of the spool to accept the UG-176 adapter. To hold the tap wire securely in position, apply a small amount of epoxy to the tap-wire opening in the spool and at the bottom of the whip.

Two holes must be drilled in the cover of the coil protector. A 1/4" hole in the center will permit it to be slipped over the bottom of the whip. With the cover in position on the whip, use the notch of the coil form for determining the position of the second hole. This is a 1/8" hole and should be drilled in the correct position to allow the ground end of the coil wire to pass through the cover and be soldered to the PL-259 connector. After both holes are drilled in the cover, epoxy the cover (threads towards the coil form) to the bottom of the wood spool. Position the feedthrough hole in the cover so that the tap occurs at 1-1/8 of a turn when the coil is added.

With epoxy applied to the bottom of the fiberglass rod, slide the UG-176 reducer onto the rod and up against the container cover. Check that none of the other parts has slipped from its proper position. At this point of construction, it is best to allow the epoxy to harden before proceeding.

After the epoxy hardens, the UG-176 reducer can be screwed into the PL-259 and the tap wire soldered in the center pin. Measure 42½ inches from the top of the coil form and cut the whip to length.

The next step is to slide the copper braid shield over the fiberglass rod. Tinned braid is recommended. However, if this is not readily available, the shield from RG-8/U coax cable will work fine. If the braided shield is too snug to readily slip over the rod, the diameter of the shield can be enlarged by squashing the braid together a little bit at a time. If the diameter of the shield has to be enlarged to any extent, be sure to allow for the shrinkage in length that will occur. The braided shield is slipped over the full length of the rod down to the coil form. The shield can be snugged to the rod by running your hand tightly along the braid.

One end of the coil is secured by routing a 24" piece of 14-AWG wire through the hole in the cover and soldering it to the side of the PL-259 connector. With the one end secured, the 3-turn coil can then be easily wound on the form and soldered to the whip shield. Solder the tap wire 1-1/8 turns from the coil bottom (ground) and the trimmer capacitor across the entire coil. Cut off the braid shield so that it extends 3/8" above the top of the rod; twist and

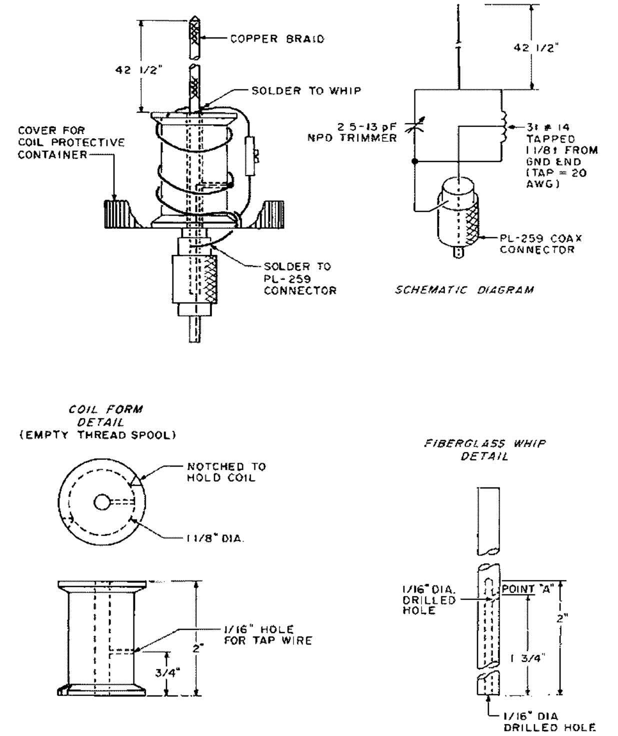


Fig. 1. A rigid 2 meter antenna for base or mobile operation.

solder. To protect the whip from the weather, shrink tubing, plastic electrical tape, or a protective spray can be used.

Mounting

For base station operation, I used a simple L-shaped aluminum bracket with an SO-239 connector, RG-58 coax, and four 19¼" ground radials. This arrangement is secured with U-bolts to the mast above a triband beam. For mobile operation, the bracket design is dependent on the type of car and individual desires. For my mobile operation, I mounted a simple bracket and connector arrangement directly to the luggage rack.

Tuning

The easiest method to tune the antenna is with a field-strength meter at a distance of approximately 2 to 3 feet. With the antenna connected and the transmitter keyed on an unused simplex channel, adjust the trimmer capacitor with a non-metallic screwdriver for a peak field-strength indication. The vswr will be minimum at this point. Numerous antennas have been built, and, on all occasions, vswrs of less than 1.2 to 1 were obtained. The antenna, of course, should be situated away from all objects and as high off the ground as practical during tuning procedures.

With a 5/16"-diameter hole drilled in the bottom of the plastic container to accommodate the whip, slide the container over the whip and screw it into its cover. If the container affects the tuning of the antenna, drill a hole in its side and retune the antenna with the container in position. With RTV, seal the top opening of the container, but not the bottom. The hole in the cover will help prevent any moisture from accumulating.

Do you want to generate conversation? Just mention on your local repeater the fact that you're using a home-brew antenna.■

Ageless Wonder: the Collinear Beam

—sure beats a dipole

Good results for a few dollars.

C. Stewart Gillmor W1FK
Spencer Road
Higganum CT 06441

Ever since the ready availability of aluminum tubing after the second World War, yagi beams have been popular with hams. More recently, quads have joined as popular antennas for the HF bands. These parasitic array antennas have a number of attractive features, including high gain, unidirectional radiation, and rotatability. Realization of their full potential, however, requires relatively expensive support equipment, including tower and rotor.

I have enjoyed using collinear wire beams, which give reasonably narrow bidirectional radiation patterns. These arrays are composed of elements arranged in a straight line. Each element is connected to the next by a phasing stub so that all elements operate in phase. The collinear antenna is often used at VHF and UHF in vertical orientation, but at HF it is only practical to erect horizontal collinear antennas. Collinear antennas have long been used in military applications, or in any situation where need exists for a rugged, directive HF antenna which can quickly be erected and which can deliver good performance. Especially for the Novice or for the ham on a budget, the collinear should be considered because it is easy to construct and it is inexpensive.

Many antenna texts discuss collinear antennas, but few provide complete design information. Particularly omitted is information on impedances. Collinear antennas may use elements of varying electrical length, but most common is the one-half wavelength element. Collinears may have as many as 6 elements. Because of mutual coupling and increasingly uneven current distribution obtained as one adds elements, most hams have built collinears with 2 or 3 elements. Highest gain is obtained if the antenna elements are spaced with 0.4 or 0.5 wavelengths of space between the ends of the elements, but this introduces construction problems. Less gain but much simpler design results from separating the elements only by use of an insulator.

I give design criteria below for 3-element 20 meter and 5-element 15 meter collinears, each of which requires less space to erect than an 80 meter dipole. I also give data on impedance characteristics at and near resonance to aid in selecting a suitable feedline. Many collinears are fed between the ends of the elements, where a very high impedance exists. In the antennas described below, feed occurs in the center of an element at a relatively low impedance, high current point. This permits a good match to 300- or 600-Ohm balanced lines. If one prefers, a 4:1, 6:1, or 9:1 ratio balun may be inserted so that the antennas may be fed directly with coax. My collinears are fed with balanced line, and a balun is introduced just outside the shack.

I was not able to find information on the impedances met when feeding collinears at current points, so I performed measurements on 3- and 5-element collinears suspended ¾ to 1 wavelength above ground. The impedances were measured on my Boonton 250-A "RX" meter. The impedance at resonance of the 3-element centerfed antenna was found to be 372 Ohms resistive; the 5-element antenna showed an impedance at resonance of 600 Ohms. Each of these antennas operates across an entire ham band with vswr of less than 1.5:1 (±1% of design frequency), using no matching device except a

Frequency	Dimensions			½-wavelength in feedline	
				coax V = 0.66	twinlead V = 0.82
	A	B	C		
21.2 MHz	11' 4"	22' 7½"	9' 6"	15' 4"	19' 0"
14.15 MHz	16' 6½"	33' 1"	14' 3"	22' 11½"	28' 6"

Table 1. Dimensions as measured for 15 and 20 meter collinears. A = halves of center element; B = outer elements; C = matching stubs.

properly chosen balun. The transmission line is chosen to be an integral number of half wavelengths. Of course, a balanced line tuner may be employed and the balun omitted. One can also tap up and down the transmission line for impedance matching purposes if this method is desired.

It is worth pointing out that the velocity of propagation of electromagnetic waves along transmission lines varies with the dielectric material used in constructing the line or cable. This velocity factor (V) must be included in calculating electrical wavelength in various types of lines. For example, open-wire line can be assumed to have a velocity factor of nearly 1.0 (or perhaps more exactly, 0.95 to 0.975). Thus, a wavelength in free space is nearly the same as one measured along open-wire line. The coax cable usually used by hams has a V of 0.66, and most 300-Ohm polyethylene balanced line ("twinlead") has a V of 0.82. This means, for example, that a wave of 15 meters length in free space has a physical length in coax of about (0.66 × 15m) = 10 meters and a physical length in 300-Ohm twinlead of about (0.82 × 15m) = 12.3 meters. In the designs below, I use 300-Ohm twinlead for the ¼-wave matching sections.

The 3-element collinear achieves a gain of about 3.3 decibels over a simple half-wave dipole and has a beamwidth to the half-power points (where the field strength voltage drops to 0.707 of its maximum value) in the horizontal plane of about ±18°. This is for a horizontally oriented antenna, of course, and the radiation is greatest at right angles to the axis of the array. The 5-element antenna achieves a gain of about 5.3 decibels and a beamwidth of about ±10° or so. Each antenna's horizontal radiation pattern is bidirectional with minor side lobes. I have designated the centerfed element halves as "A" in the drawing (Fig. 1) and in Table 1, the pairs of outer elements as "B", and the matching sections as "C", for the case of the 3- or 5-element centerfed collinear.

Construction Hints

All half-wave elements should be of equal length in a given antenna. One can erect the centerfed element and adjust it to exact resonance, if desired, then add the stubs and outer elements. Velocity factor V was found to be 0.95 for the 3-element collinear. The 5-element collinear resonated slightly higher than the calculated frequency; evidently a V of 0.95 overcorrects for end effects. I found V here to equal 0.975, and I give the actual determined dimensions for each antenna in Table 1.

I used home-brew nylon insulators which are 2 to 3 inches long and cut out of scrap. They are light and tough. One could also use Plexiglas™ or some other material or commercially-made ceramic insulators.

The phasing sections could be of open-wire line (remember, then, V would be about 0.95), but I chose 300-Ohm twinlead because the stubs tend to blow around in high winds and ladder line might twist up and short. (Also, I had a few scrap pieces of 300-Ohm twinlead in the shack.)

The antenna elements themselves I made of odds and ends of #16 and #14 hard-drawn copper wire, but almost anything will do here.

Care should be taken to fasten the phasing stubs to the insulators so that they do not fatigue and break off. Solder the stubs closed at the ends. I suspended the collinears high in some maple trees using clothesline pulleys and ¼-inch nylon line. One has been up for two winters and has survived numerous ice storms and high winds. You might wish to silicone or wax the twinlead to minimize swr changes during rainstorms. I'm not fussy about these antennas, except that I make sure that I never erect an antenna near, over, or under a power line.

In Table 1, I have given actual dimensions for center frequencies of 14.15 MHz for the 3-element and 21.2 MHz for the 5-element antenna. I use these collinears for working into Europe with my Triton IV. The 15 meter collinear would make a dandy antenna for Novice DXing. If one has the space for an 80 meter dipole, then 2 or 3 hours invested in construction and erection of a multi-element collinear will probably result in surprise and pleasure that such a simple antenna brings such good results for only a few dollars. ■

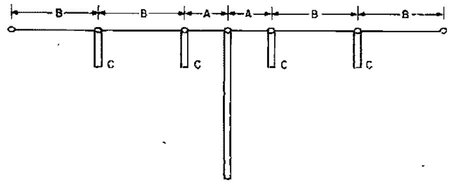


Fig. 1. Centerfed multi-element collinear wire beam. A = ¼ wavelength (ft.) = 246 (0.95)/f_{MHz}; B = ½ wavelength (ft.) = 492 (0.95)/f_{MHz}; C = ¼ wavelength (ft.) = 246 (0.82)/f_{MHz}.

Three Baluns for a Buck

—go find yourself a junked TV

Better than mail-order.

Editor's note: This article was written while the author was in Iran. He has since returned to the United States.

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Activating an HF radio station in areas of the world where hamming is not too common calls for a certain amount of improvisation. This is particularly true if station logistics have not been carefully planned prior to leaving home base.

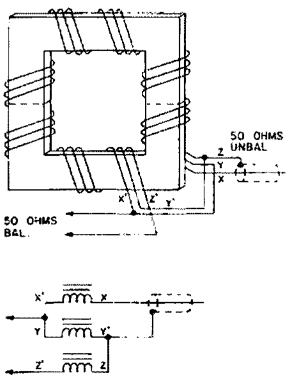

Fig. 1.

Material Selection and Preparation

The problem facing this station was that of acquiring a balun for a three-band dipole and then a three-element beam. Experiments with a homemade balun in the US using the ferrite core of a defunct TV flyback transformer had been quite successful on 80 and 40 meters. It was decided, therefore, to see if the same approach would do for 20, 15, and 10. It figured that a core material able to handle the TV horizontal retrace without significant loss should be fairly good for HF radio transmission. Actual measurements through the finished balun at 28 MHz and lower frequencies show less than a ½-dB attenuation.

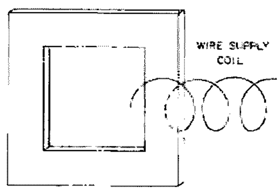

Fig. 2.

Initial Construction

Actual construction was started in the following fashion. A burned-out flyback was obtained from a TV service shop, and all of the windings, plus sealing compounds, were removed. After disassembly, two C-shaped core halves remained. These are normally mated at their highly polished surfaces and clamped together to form a solid O-shaped rectangle. To avoid any shorted turn effects from the clamping arrangement, and to make unobstructed space for windings around the full core circumference, the two core halves are held together with an epoxy compound. A very thin film of steel-filled epoxy is used for this purpose—hopefully this minimizes discontinuities in the magnetic circuitry of the core.

Some further core preparation is still needed before putting windings in place. This includes removal of any sharp edges with a fine file or abrasive cloth (to avoid scratching the enameled wire). The last step of preparation is to place two layers of plastic or glass tape over the core—this gives a very smooth surface for the winding process.

The actual winding calls for considerable care if a low swr is to be realized. Considerable experimentation took place to get best results—and two precautions turned out to be important in getting good balance and low loss: sym-

metrical placement of the turns and uniform "turn shape." The results of this care are uniformly distributed capacity within and between turns and equal inductance for each of the three trifilar windings.

The way the tight and uniform turns are achieved is to employ a modification of the "bobbin" technique (see Fig. 2) used on commercially-wound toroids. For this application, start with a single piece of about no. 20 gauge wire approximately 18 inches long. Thread the wire repeatedly through the core center until eight turns are in place. Distribute the turns evenly and clip all but about two inches on each end of the winding. Remove this temporary winding, straighten it, and measure its length. This will be the length of the permanent windings. Cut three lengths of no. 14 Formvar or similarly insulated copper wire and wind each one around a D-cell battery or similarly sized form to create the "wire supply coil" for the finished balun.

Next, take one of these coils and "screw" it onto the TV transformer core. Do this by spreading the turns and placing an end through the center hole, rotating the coil until it is all on the core. Straighten one end of the coil so that the 2" excess extends out from the core, then press tightly against the core this first turn of the "wire supply coil." Use your thumb to force each turn of the balun into shape against the core. Form each turn diagonally so that two turns are placed on each side. (Depending on where you wish to make your connection to the antenna and transmission line, you may start and finish at a corner or a side.)

Repeat the process for each of the next two windings. To keep the turns tight so that their final spacing can be evenly positioned, temporarily twist the two ends of each coil together. This will prevent any unwinding. Place a few drops of 5-minute epoxy glue at the point where windings start. When the windings are firmly set and evenly spaced, wire and solder them as shown in the diagram of Fig. 1. Be especially careful to make the connections between the windings symmetrical (to ensure equal inductance and coupling). Failure to do this will create a poor swr and increase loss. (An associate of mine has run tests on several commercial baluns and found that inattention to this matter accounts for fairly wide variations in performance, particularly at the higher frequencies.)

You are now ready to attach the leads on the balun which connect it to the feedline and antenna. Mount a coax fitting at one corner, and for the feedline, and the flexible leads (short lengths of coax outer conductor braid) for the dipole connection.

Final Adjustments

With a short length of coax, connect the balun through an swr bridge to a transmitter with variable output carrier. Connect the flexible leads to a dummy load, being careful to keep them straight, symmetrical, and evenly spaced. (Pieces of RG-58 outer covering can be used to protect the leads from the weather and to avoid shorts during the tests.) Next, set the rf source on 28 MHz and apply enough power to get a good reading on the swr meter in the forward direction. (Run the power high enough to ensure that the transmitter output "looks like" its transmission-line drive impedance—with some solid-state rigs, this may vary at very low power settings.)

Switch the swr meter to reverse and observe the reflected power level—it should read 1:1.2 or less. If it's higher, remove the rf power and try evening up any irregularities in the windings or significant spaces between adjacent wires in the individual turns. With careful dressing of the turns and connecting leads, this kind of performance can be realized.

The transformer (balun) is now ready for final assembly and mounting. Numerous schemes are appropriate. For my application, no enclosure was used, but just encapsulation in epoxy with a piece of vinyl tubing threaded through the center to tie the unit to the beam boom. (This was because an earlier model placed in a metal can arced to ground from a nearby lightning strike.) An appropriate form to contain the epoxy while it sets was made from the sides of a polyethylene detergent bottle. This material can be "welded" using a soldering iron to melt and join edges of individual pieces to form the desired shape of container.

Incidentally, the 30¢ cost refers to the wire—it has to be purchased locally. The epoxy is, of course, optional and is an added expense. The TV transformer core was a gift from a friendly Iranian TV repairman—a similar acquisition is no doubt possible anywhere.

The balun has worked fine and is superior to a mail-order kit which has been rebuilt numerous times but which has never given a satisfactory 10 meter swr when connected to a very load-match-sensitive Atlas 210X. ■

So You Want to Raise a Tower

—do it safely, do it right

A simple guide to an important subject.

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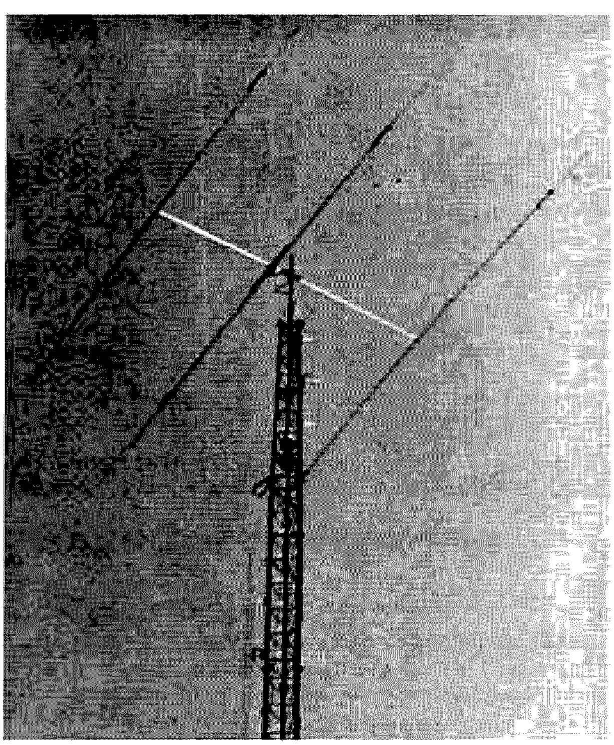


Photo A.

Sooner or later every ham has the desire to put up a tower. The intent of this article is to save you from some of the problems you can have by improper installation of your tower. These problems can result in loss of your tower and antennas, loss of your ham shack (a falling tower can do a great deal of remodeling to your shack), and last, but not least, loss of your or someone else's life. The first two losses can be corrected; the third can't!

First off, let's establish some basics. There are only two *safe* ways to erect a tower: with a crane or with a gin-pole. If you have the money, the first is the easiest. The second method is the one used by those of us who have more time than money.

Assuming that you have decided on the second method, you will have to do some tower climbing. There is one very important principle involved in tower climbing. Simply stated, it is: "If you are unable to strap a safety belt on the tower, let loose with both hands and lean back comfortably for a short nap, then keep both your feet on the ground."

If your legs are shaking, your hands are white from hanging on, and all you can think of is "I'm going to die," then you have no business on a tower!

Try the technique that I use. Tell yourself that once you have climbed more than ten feet, you probably will be killed if you fall. If you don't like this approach, you should get someone else to do the climbing.

Once you have doubled your life insurance—or found some tower rigger to do the climbing—you now have to decide where to put it. The ideal place is right next to the window in your shack, but this doesn't always turn out to be possible. Considerations governing tower location are as follows:

1) The guy-line anchors should be kept within your property boundaries, if at

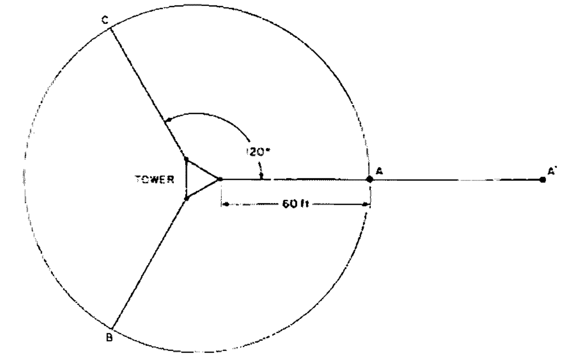


Fig. 1. Diagram for 60' tower and guys.

all possible.

2) The anchors should be at a distance of at least two-thirds of the tower height away from the base of the tower, and, preferably, a distance equal to the tower height. Example: A 60' tower should have guy supports at a distance of 40' to 60' from the base. Three guy lines are generally used.

3) The guy-line anchors should be at 120° spacing from each other. If available, a surveyor's transit should be used to site their locations. Fig. 1 demonstrates this. Note that it is not necessary to have all the anchors in a circle (i.e., equal distance from the base). This is shown by point A' of Fig. 1. Every effort should be made to keep the anchors as close to 120° apart as possible. The more you deviate from this, the more vulnerable is the tower to twisting torque.

4) Guy lines should not be obstructed by power lines, trees, or parts of any building.

5) Be sure your community has no restrictions on tower erection; obtain a building permit if one is required.

6) Make sure there are no buried water, gas, or power lines in the areas where you plan to dig your base- and guy-anchor holes. Call the utility companies; they will locate them for you free of charge.

7) If at all possible, attach the tower to your house or shack. In most cases, this will classify it so that your home-owner's insurance will cover it. Check with your agent to see if this applies to your policy, and, if it does not, ask him about a separate liability policy. In most areas, a tower is considered an attractive nuisance for juveniles, and if a child is hurt on your tower, you are at fault even though it is on private property. If your tower falls on a neighbor's house, more than "Gee, I'm sorry about that!" is usually required to fix the damage.

8) Determine that the ground where your base and anchors will be is solid enough to hold them in place. Freshly-excavated ground should be avoided. (Quicksand, mud, and earthquake faults also should be avoided.)

Now that we have the basics out of the way, let's get started on putting this thing up. The tower foundation and the guying are the two most important parts of your whole installation. Don't take short cuts in either of these areas. A few bucks saved on cheap concrete or junky guy lines could cost you thousands of dollars in the long run.

The type of ground (clay, sand, soft dirt, or whatever) and the height of the tower will determine how much concrete you need for the base and guy-line anchors. A very good place to get this information is in the Rohn tower catalog. You can probably obtain a copy of it from Rohn or your Rohn dealer. This will give you a lot of valuable information on how and where to guy your tower and how big to make your holes for concrete. Under no circumstances should the base or anchors contain less than ¼ yard of concrete.

Photo B. The base plate is anchored to the tower foundation with one bolt.

The specific information in this article is pertinent to most towers, but it is specifically related to the Rohn 25G tower. This is one of the most popular ham towers and the one with which I have the most experience.

In Photo B, you can see what I prefer for the tower base. Note that the concrete sticks up above ground level. This is accomplished by making a frame out of 2 × 4s, with the 4" side vertical. There are a number of reasons for doing this: looks, maintainability (grass trimming), and, most important, leveling. If your base plate isn't level, it will be nearly impossible to level the tower.

Speaking of the base plate, it is a good investment to make. At $40 to $45 per section, it is a very expensive practice to bury part of the tower in concrete. With my system, should you decide to move, the base plate can be taken with you. (Most people would rather not take a yard of concrete with them to get the tower section cemented in it.)

You will notice that the base plate is held in place by one 5/8" x 18" galvanized bolt in the center. If you are unable to find one at your hardware store, try your local power company. These bolts are used quite extensively for power-pole hardware.

After you have poured the concrete in your base hole and tamped the air out of it, the bolt is inserted. Don't wait too long to put the bolt in or your concrete won't hold it too well. If you are a pessimist, a 3" flat washer welded to the end of the bolt before putting it in the concrete will add holding power.

Do not attempt to put the base plate in place until after the concrete has set. Also, be careful not to bump your cement form when pouring the concrete.

Two-inch pump rods were installed to stop cars from running into the tower.

Once the base has cured (at least a week, and preferably longer), the

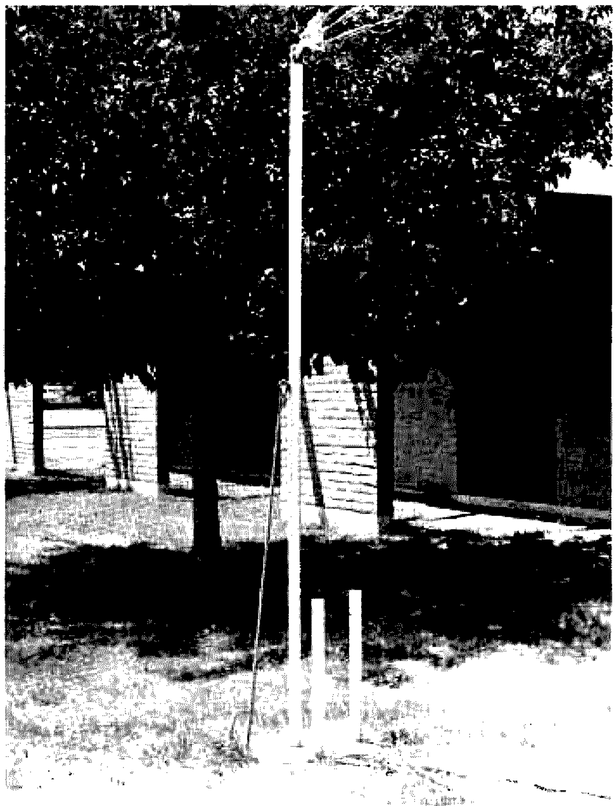


Photo C. Two types of guy-line supports are shown here.

Photo D. Guy lines are attached to equalizer plates, one of which is welded to the pump rod.

tower can be bolted to the base and set in place. Generally, the first two sections can be bolted together and set on the base without too much trouble.

Next, let's look at the guy-line supports. Photo C shows two types of guy-line supports. At the bottom of the picture is a Rohn guy anchor. This piece is cemented into the ground with just a few inches of shaft and the eye sticking out above the ground. (See your Rohn catalog for recommended installation of this device.)

Also in the picture is a pole with the lines attached to it. In this case, a 2″-diameter solid-steel pipe (a well pump rod) is used. If you check with a local pump repair company, you will find that pieces of rod that have been removed from wells are available for a couple of bucks each. Don't take your Volkswagen over to load up three lengths of this pipe, however. A 10′ piece of pump rod weighs over 300 pounds!

If you are unable to find the pump rod, a piece of 3″ or 4″ pipe will do equally well, with the pipes filled with concrete for extra strength, if desired.

The use of the pole has several advantages over the use of the guy anchor. The main advantage is that the lines are above ground so that people won't trip on them or hang themselves on them.

The hole for the anchor was 2′ × 2′ × 2½′ deep. This left 7½′ of pipe above ground, and, in most cases, this is plenty. If a driveway is crossed, you may need to go higher than that. If so, I recommend you use concrete-filled 4″ pipe rather than a pump rod. In any case, to make sure that they don't move, the pipes should be placed in the hole before pouring the concrete. The pipe also can be guyed with wire or rope attached to stakes in the ground.

Before calling your Redi-Mix company for a load of concrete, be sure that you have everything prepared. If the driver stands around while you put the pipe in the ground and guy it, you'll find that your bill will have a substantial charge for "stand-by" on it.

Photo D shows a close-up of how the guy lines are attached to the pipe. The piece of metal welded to the pipe is one of the equalizer plates in the Rohn EP-2534-3 package. When ordering, get 5 EP-2534-3 packages. There are 2 plates and hardware in each kit. Three sets will be used as standard equalizer plates, three of the remaining four plates will be welded to the pipes and the last plate always can be used as a paper weight.

Unless you are an extremely good welder, you should have the plates put on at your local welding shop. Tell the welder you want a *very* strong weld, to hold guy wires which will hold up a tower.

A few more points and tips: (1) All of the hardware shown comes with the equalizer plates, but, when ordering, be sure you get the correct plate for the number of guys that you will have. An EP-2534-3 is for two or three guys. An EP-2534-5 is for four or five guys. (2) When you set the guy-line pipe in the ground, be sure that the equalizer plate is facing toward the tower. It is very hard to rotate the pipe once the concrete has set. (3) If you want a little extra safety, you can weld a 12″ × 12″ plate to the bottom of the pump rod to make it harder to pull out of the concrete.

Once you have the base and guy supports poured in concrete, the next thing is to sit back and take a well-deserved break while the concrete cures. This will give you time to catch up on your reading of those back issues of *73*. After a couple of days, you can sand the rust off your guy pipes and spray them with Rust-o-leum, or some other rust-inhibiting paint. The silver paint seems to last the best of the colors I've tried.

Now that you are well rested and raring to go, we will start putting the tower up. We previously men-

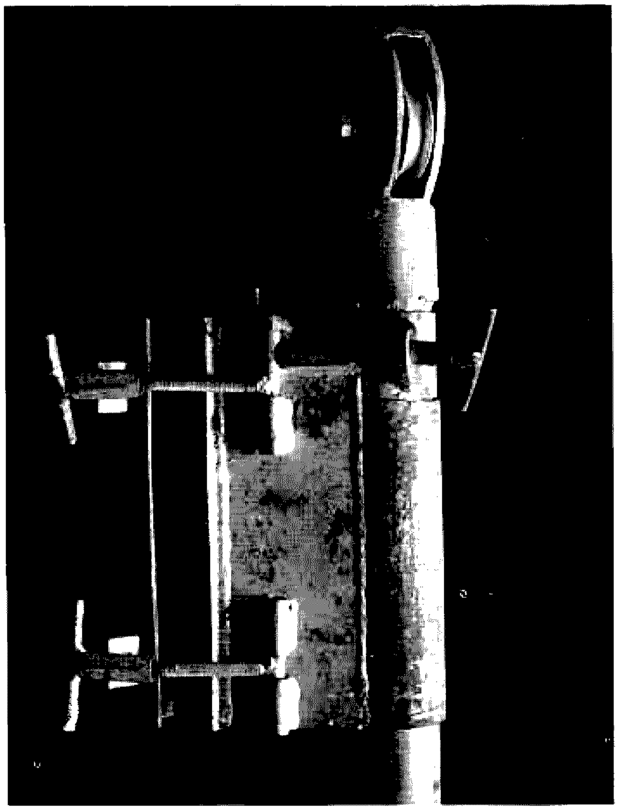


Photo E. This is what a gin-pole looks like.

Photo F. Clearing excess galvanizing from the tower legs will make joining easier.

tioned the gin-pole. Photo E shows a picture of the gin-pole, for those of you who don't know what one is. It consists of an aluminum pipe about 13′ long, a clamping device, and a pulley at the top of the pole. (If you know someone who works at a radio shop, you may be able to borrow their gin-pole.)

While you are out scrounging around, you also will need a *good* safety belt (not a World War I surplus job). Remember, your life literally depends on the belt. If it goes, you go; if your belt breaks, you will be in for a big letdown. Another need is good rope. You will need a piece as long as twice the height of the tower, plus about 30′.

Before you get gung-ho to start putting up the tower, take a few minutes to inspect the tower sections. If any of the mating ends appear to be at all bent, check to be sure that they will mate with another section of tower. If severe damage is evident, turn in a claim to the trucking company and request replacements. While you're checking out the tower, locate the mounting hardware. You will find a plug in one of the lower legs of the tower. Pry it out, tilt the leg, and catch the nuts and bolts as they slide out. There should be two sizes of nuts and bolts, and three of each size. Be sure to count all the hardware to make sure you're not short, and then place it in the pouch of your safety belt.

Two other things can be done to make the tower sections easier to put together. The first is to take a 1½″ piece of rod a foot or so long and grind a blunt point on it. Very gently drive this into the female (lower part of tower) ends of the tower sections. (Don't get carried away or you will split the tower legs open.) Photo F shows this being done. The second is to drive a drift punch through each of the bolt holes in the tower. Drive the punch in from both sides of the holes. The reason for these steps is to clear out any excess galvanizing that may be clogging the holes. (All Rohn towers are hot-dipped galvanized after they are assembled.) Under no circumstances should you use a drill to ream out the holes.

You now are ready to start putting up the tower sections. If you are doing the climbing, be sure that your ground man is reliable. Your life literally rests in his hands. If *you* say "whoa" and *he* "let's go," you have a big problem.

The man on the tower *always* calls the shots—he is the boss. If you can get hold of a pair of walkie-talkies, it will save you from laryngitis from yelling to each other. And let your ground man do as much of the physical work as possible.

The number one rule is safety. Tower work is no place to be horsing around. Before you take one foot off the ground, make the following point emphatically clear to everyone: If anything breaks, comes loose, or drops, don't try to stop it or catch it. Should anything go wrong, get your butt out of the way. A piece of mangled-up tower can easily be replaced. A mangled body is not so easily replaced.

The man on the tower should have the following equipment with him before he starts climbing: (1) Safety belt, boots, and gloves. (2) Two wrenches for *each* of the two bolt sizes on the tower. (A ratchet and socket help a lot.) (3) A drift punch and hammer. These are used to help align the bolt holes. (4) All of the nuts and bolts for all of the tower sections. (5) A small pulley which can be used to raise the gin-pole from one section of the tower to the next. (6) A work platform, if used.

Item six is not a requirement, but it can make the tower work a lot easier and save a lot of wear and tear on your feet and back. (See Photo G.) Once again, I wish to emphasize that very important point: If you can't relax while doing tower work, *stay on the ground*. There is no way

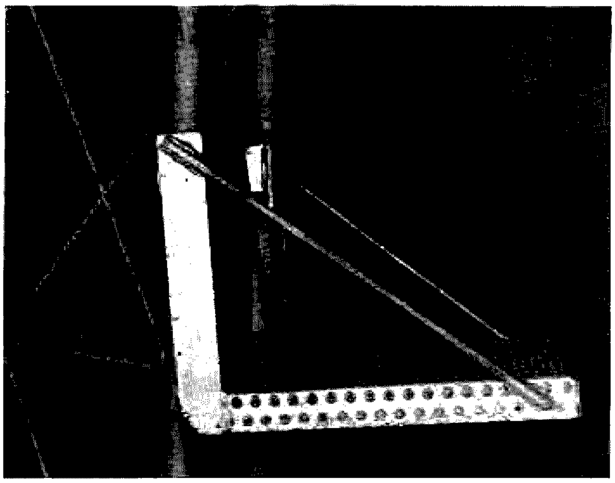


Photo G. A work platform can make tower erection much easier.

that you can hold on with one hand and work with the other. Tower work requires both hands and all of your attention.

Your first job is to place the gin-pole at the top of the first section. Carry the pole up the tower with the pole in the lowered position, or use the small pulley. Once you have it in place on the tower, you can raise the pole. Be sure to place the clamp on a tower leg so that sections can be pulled up without obstructions being in the way.

The clamp should be positioned so that it faces away from the tower. The pulley should be rotated so that it faces toward the inside of the tower. Do not use pliers to tighten any of the clamp screws on the gin-pole; hand-tight is sufficient on all three screws. Photo H shows a picture of the gin-pole clamped in place on the tower.

While you are mounting the gin-pole, your ground man should be tying the rope to the next section of the tower. The rope should be tied approximately two-thirds of the way up the section. If it is tied too high, you will have trouble placing the sections in place. Photo I shows how I tie the rope on. You will notice that this is a slip knot. Many people have looked at this and said, "It won't work." I have used this knot to send up over 500′ of tower sections and never has it come loose.

Once you have the third section of tower in place, the first set of guy lines should be attached. I personally recommend that if you put up thirty feet or more of tower, it should be guyed. The Rohn catalog gives recommended guying heights for various tower heights. While you are working on the third section of tower, have your ground man getting the guy lines ready. Each line should be prepared as shown in Photo J *before* it is sent up to you. The loop should be about three inches long, and two cable clamps (minimum) should be used at each loop.

When you have the gin-pole ready (you can do this before moving the pole if you want), have the loop sent up to you on the gin-pole line. Each line should be taken to the turnbuckle it attaches to and measured to length before cutting. The turnbuckles should be screwed to the maximum *out* position before measuring. *Do not* try to pull the guy line tight when you are measuring it, but leave plenty of slack. The lines can't be tightened until all three lines are attached.

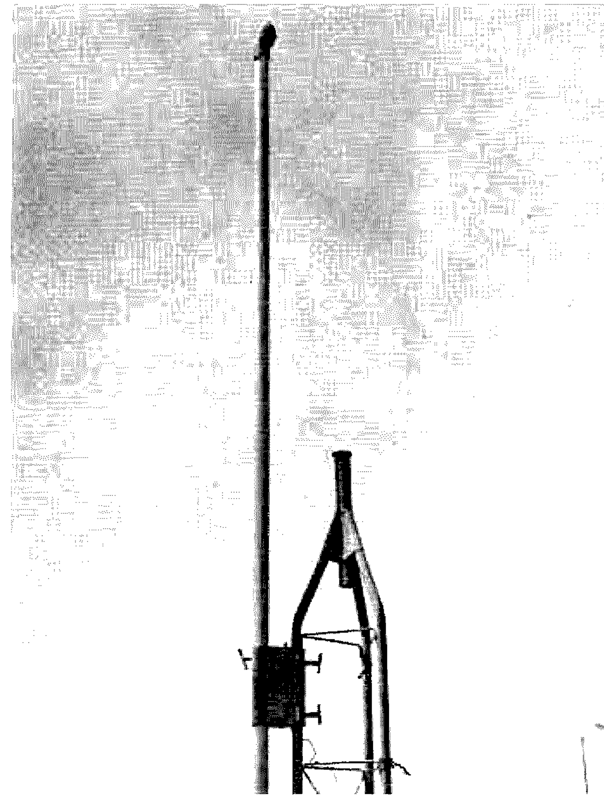


Photo H. The gin-pole is clamped in place at the top of the tower.

Leave a couple of feet extra so that the cable clamps can be fastened. When you cut the guy cable, be sure to tape both sides of the cut with electrical tape before you cut it. A small pair of bolt cutters does a good job of cutting the cable.

After the first line is attached, have the second one prepared and sent up. After all three guys are attached, the tower man should come down, because the next job is easiest when done by all hands—preferably with four men. Have one man on each of the guy lines, and the fourth man at the tower, with a two-foot or longer level. It is best to use a ladder, so that the level can be placed on the middle of the second section or higher (15′ from the ground).

The level man should not stand on or hold onto the tower when he is leveling it. Each turnbuckle should be tightened until the tower is level. Take at least two perpendicular readings (90° from each other) on each leg to ensure that the tower is level. The first set of guys is very important. If the tower is not properly leveled at this point, you may never get it straight.

If you turn the turnbuckle all the way in and still need more tightening, then back it all the way out, loosen the cable clamps, pull the cable until it is tight, re-clamp, and start tightening the turnbuckle again. When properly tightened, the guy lines still should have a fair amount of slack. You should be able to shake the cable and have a small amount of ripple in it.

If the cables are too

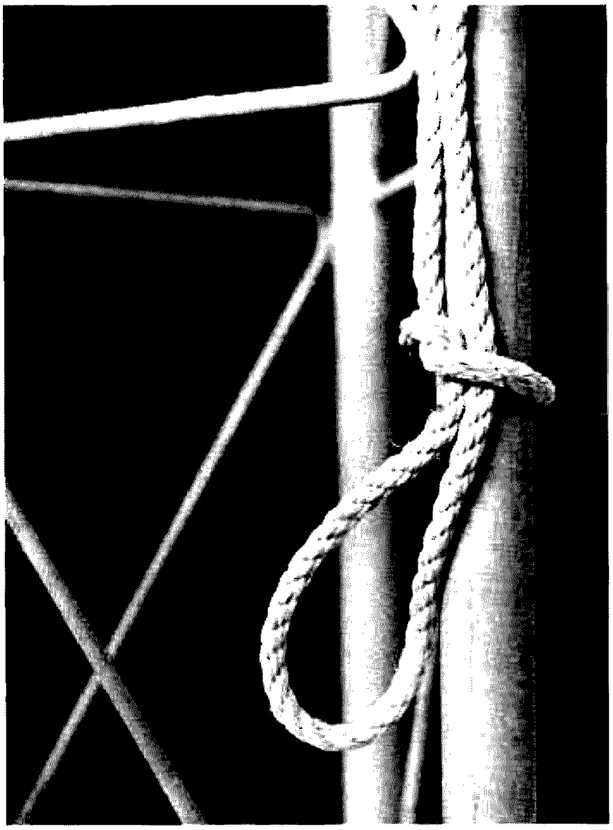


Photo I. A good knot to use when lifting tower sections.

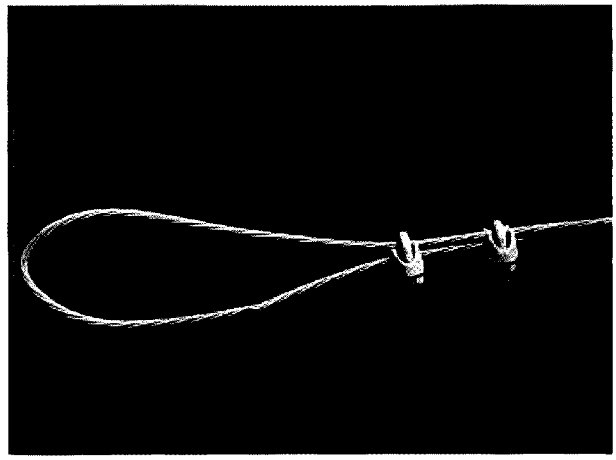


Photo J. The three-inch loop should be prepared before the guy line is lifted up to the tower.

tight, you stand a good chance of losing your tower. The theory is that of the reed in the wind. A reed will bend in the wind and not be broken, but a rigid plant will snap off because it is unable to give. A properly-guyed tower will have a small amount of sway to it. And remember that if you put up your tower in winter, you will need *less* slack than you would in the summer!

Continue to put additional sections of tower and guy lines on until the tower is completed. Additional sections of tower are leveled in the same manner. The only exception is that, rather than using a level, the level man should look up each leg of the tower. A section that is not level will stand out very noticeably. If you're not sure, have several people sight up the tower and level until the general consensus is that it is straight.

When all sections of tower have been installed and leveled, the turnbuckles should be safety-wired. This prevents movement of the lines from working the turnbuckles loose. The method I prefer to use is the "figure-8" safety wiring. This can be seen in Photo K.

Another feature you may want to add to your tower is a skirt on the bottom section. Remember, your tower is classified as an "attractive nuisance." The skirting I used can be seen in Photo L. The best way to make this is to take a section of tower to a local air conditioning contractor and ask him to make you a piece of metal 8' long to cover the tower. You can have him attach it to the tower, or do it yourself. The best way to attach it is to use pop rivets. Be sure to leave space at the top and bottom of the section so that the mounting bolts can be installed.

The only remaining part of the job is the antenna and feedline installation. Since there are so many types of antennas and mountings, I will not attempt to go into installation of them. If you intend to use a rotor, contact your Rohn dealer. He probably can fix you up with a rotor mount and thrust bearings that are made for the tower.

Two words of caution on feedlines: (1) There seems to be quite a bit of unjacketed Heliax® available that has been removed from commercial service. If you run across any of it, take it if it is given to you, proceed to your nearest scrap metal yard, and sell it for the value of the copper. Under no conditions do you want to use it on your tower. When you place two dissimilar metals together and place them in an electromagnetic field, you have created a fantastic TVI generator. This is the reason that it was removed from commercial service. And (2), watch for kinks in the outer shield. If it is kinked, there is a 98% chance that the cable is ruined. If you need a good attenuator, it is fine. However, most people find it to no advantage to have a 3-dB attenuator in their feedline.

If you are planning to buy a complete tower, you can buy a package that has the tower, guy lines, turnbuckles, equalizer plates, and cable clamps. This could save you some time and money. Check with your Rohn dealer about the package tower before you buy all the pieces individually.

Be sure that the tower you buy will handle the wind loading and weight for the antenna system that you plan to use. If you plan to use the pump-rod guying technique, be sure to order two extra equalizing plate kits. Also, check to see that there is sufficient guy line to meet your guying needs. The packages are set up for the ideal guying, but there is a very good chance that your installation will need more cable.

I hope that this article has given you some insight into the proper methods of erecting a tower. I claim neither to have covered every possible condition you may encounter nor that this is the only way to put up a tower. All I can say is that these are some of the most acceptable methods I've tried in 15

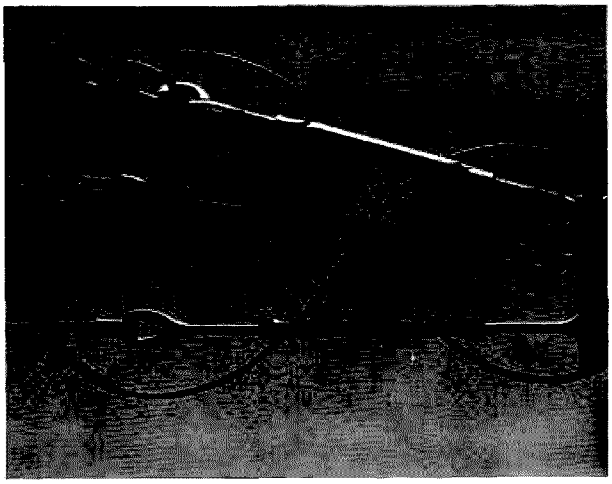


Photo K. A "figure-8" safety wiring for turnbuckles.

years of putting up ham and commercial towers.

If you have any suggestions or questions, I will be glad to respond to them. If you wish and expect a reply, send an SASE. Good luck, and remember the final words of Harry Splash, the tower rigger: "I knew that I should have replaced that worn strap on my safety belt!"

Note: Thanks to Deborah Coyle for proofreading and typing this article, and to Sue (WB7CXE's YL) for help with the photo work. ■

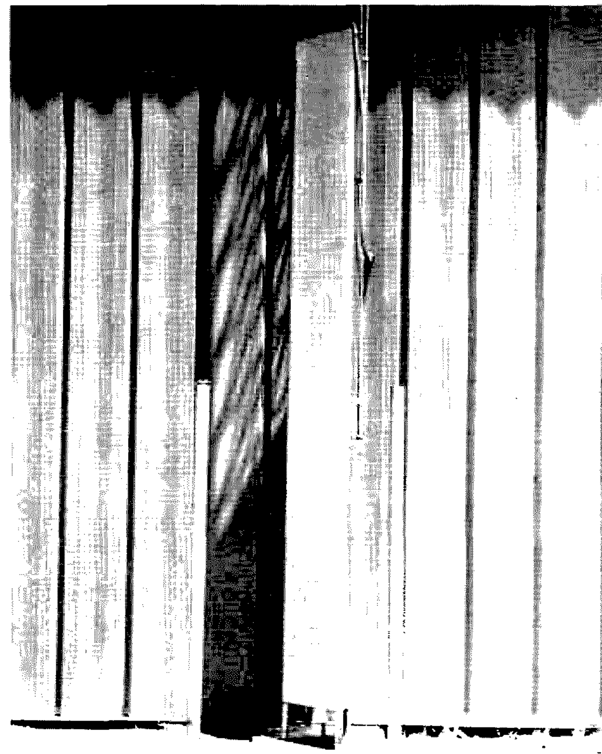


Photo L. A skirting at the bottom of the tower lessens the "attractiveness" of your "attractive nuisance."

✓ Reader Service—see page 211

The Revolutionary Organic Antenna

—product of NASA research

Arm yourself!

Author's Note: To prevent possible adverse heating effects in the arm tissue, it is important that power input to antenna described in this article be limited to 10 mW.

James C. Gaddie
Russell T. Wolfram
(SRI International)
Ames Research Center
Moffet Field CA 94035

A human arm may be made to act as an antenna for a communications system. It has been done by using an energy coupler made of two strips of copper foil fastened to a strap and wrapped around the wrist. Apparently, the wrist strap can efficiently transfer radio-frequency energy to or from the arm.

Reprinted from NASA Tech Briefs, Summer, 1978.

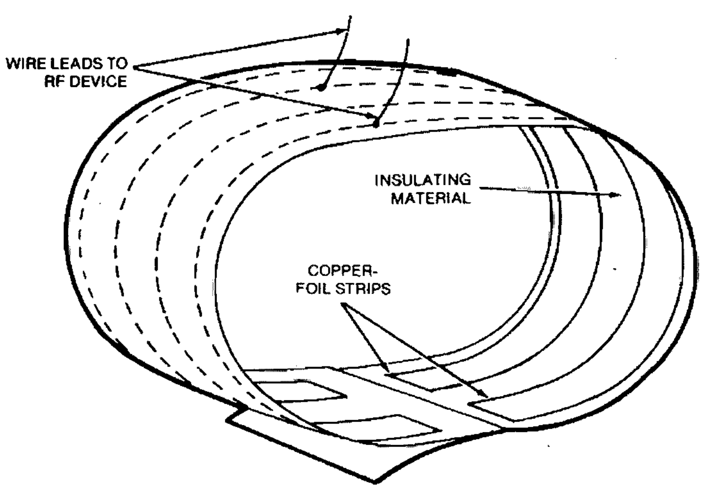


Fig. 1. Wrist-strap coupler of radio-frequency energy consists of two strips of copper fastened to an insulating material. Wires at the midpoints of the strips lead to the radio-frequency device that can act as a transmitter or receiver.

A prototype of the antenna coupler was built and found suitable for both sending and receiving very-high-frequency signals. The goal of the developers is to build a body-worn communications system for the deaf blind, and it was with this purpose in mind that the prototype unit was built and tested. Other potential applications for the compact coupler include body-worn two-way local communications systems for police and as part of a portable personal communications system that could communicate via satellite.

The copper-foil strips of the wrist-strap coupler shown in Fig. 1 are rectangular, 5 in. (13 cm) long and ½ in. (1.3 cm) wide. They are placed 7/16 in. (1.1 cm) apart and are fastened to the underside of a wrist strap made of an electrically insulating material. A thin insulating

strip is also placed over the straps as a protective cover. Such an insulator can be added to the wrist strap because the copper strips need not be in direct contact with the skin for the rf signals to be coupled to or from the arm.

For connecting the coupler to a transceiver, or receive- or transmit-only unit, a small wire is attached to the edge of each copper strip at a point equidistant from the ends of the strip. Each wire is then routed through a hole in the insulating material to the upper surface of the strap. In addition, a fastener must be attached to the strap so that it can be pulled snugly against the wrist.

Radio-frequency energy couples to or from the arm through the electrical capacity between the arm and the copper strips. Electrical impedance charac-

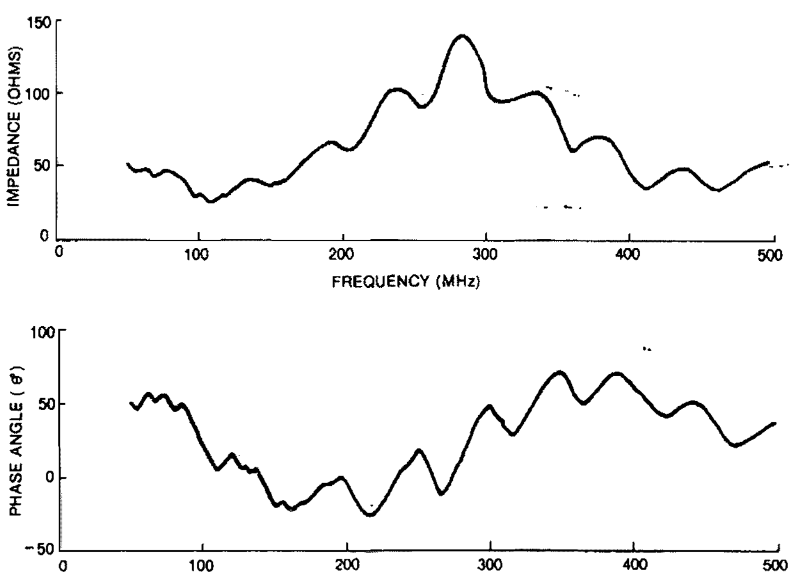


Fig. 2. Electrical impedance characteristics of the wrist-strap antenna coupler were measured with a General Radio 1710 rf network analyzer. Varying the widths of the copper strips will produce somewhat different characteristics.

teristics of the antenna are shown in Fig. 2. The radiated field strength, with the strap driven by a 170-MHz, 10-mW transmitter, was found to be slightly greater than that from a well-designed loop antenna built with a 16- by 11- by 3-mm ferrite core and driven by the same transmitter.■

DDRR Dipole for VHF

—experiment!

Seeking selectivity.

Dave Atkins W6VX
130 N. Westgate Ave.
Los Angeles CA 90049

Selectivity in an antenna is becoming increasingly important as the bands compress under the load of more and more stations. Reception is where this is most desirable. Front-end overload, we have learned, will cause big problems to a communications circuit when off-channel signals are strong. Directional-type antennas, of course, are the answer unless we need to cover everything around us. The DDRR, or directly driven ring radiator, developed by its inventor, J.M. Boyer (with patents assigned to Northrop), has high selectivity. Because of this, it also is a low-noise device. This makes two good reasons for its superior performance. (*73 Magazine* for August and September, 1976, goes into detail of its design and advantage. There have been many other articles written about it over the years.) Two drawbacks are noted when the chips are down. One is the size of the ground plane for the monopole design; the other is the cost of the conductor material for low-frequency use. Tuning can be another problem where its use for high-power transmission is contemplated. Very high voltage and current are the prices of the trade-off for high selectivity.

What Is It?

Boyer suggests the DDRR dipole in his September (part two) article. This version does without the big ground plane, as would any dipole. So here we have a quarter-wave open transmission line formed into a shape which "leaks" and radiates rf. I first built one of these for ten meters and made it so it operated on its highest frequency (no added capacitance) and at a fixed frequency. A/B checks with the spaced rings mounted vertically compared very well with those of a horizontal folded dipole at the same height and with the same orientation. Pretty good for an antenna on ten meters which is 30 cm "long" and 84 cm in diameter (see *73*, April, 1965, "Double Hula," Peter Lovelock).

The Two Meter DDRR Dipole

To make the two meter model, I dug out an old ¼-inch tubing coil from a long-forgotten final and annealed it in the fireplace, then cleaned and polished the surface after stretching it between a car bumper and a stout post. 33 inches comes to a half wave. This is then folded on a one-inch-diameter rod or mandrel at exact center. The quarter-wave line is formed on a can to make a circular double ring or transmission line of about 5 inches diameter. This will resonate above the 148 MHz end of the band. I made a simple tuning arrangement of a 4-inch piece of #20 (0.8 mm) Teflon™-covered flexible wire. This is formed into a U to slide into the open ends of the line. When

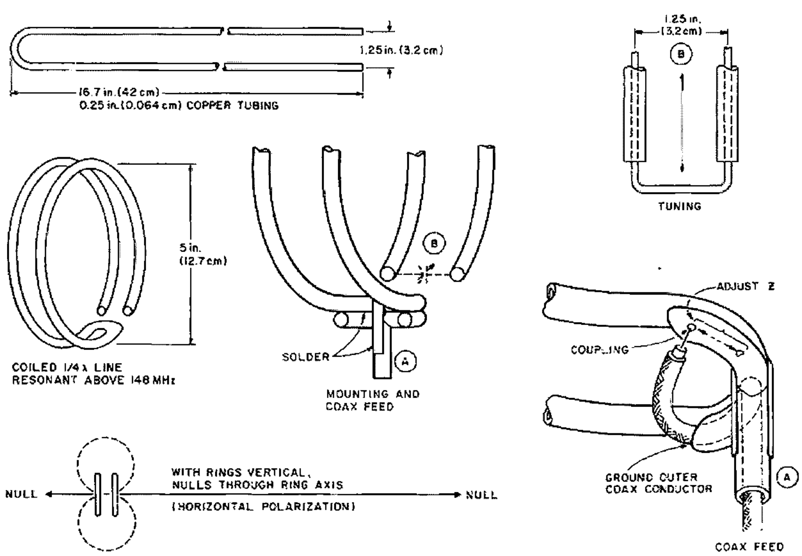


Fig. 1. Two meter DDRR dipole.

pushed in, the frequency should more than cover the 2 meter band. See detail B in Fig. 1.

A length of small-diameter coax may be coupled tightly to the closed end of the open line. Mine was fed through a separate matching U-shape of the same tubing soldered to the closed end of the line. A good match was obtained by varying the size of the link (see drawing). A 50-Ohm match comes at an area of less than that formed by the 180 degree half turn at the closed end of the line. The ¼-inch line thus formed needs no insulators for support.

Mounting of the completed antenna may be done in several ways. Mine was to make a pedestal a few inches long and to feed the coax through. This was mounted breadboard fashion on a piece of hardwood. A BNC coax connector was fastened to this piece. A tuning arrangement was made to slide the Teflon tuning U in or out to cover the band of interest. The selectivity curve was measured using a signal generator, a counter, and an FM receiver. The antenna frequency was left fixed and the receiver and generator were moved together across the antenna frequency.

While vertical polarization is the way most of our present two meter signals leave the antenna, things happen that make the polarization somewhat different at the receiving end. By orienting the receiving antenna, it is often possible to null out an interfering signal. By going a step further, I made the mounting adjustable in azimuth and elevation. This also can be done in various ways—mine is a breadboard way to test the idea. Aiming it works well and can reduce multipath *and* QRM.

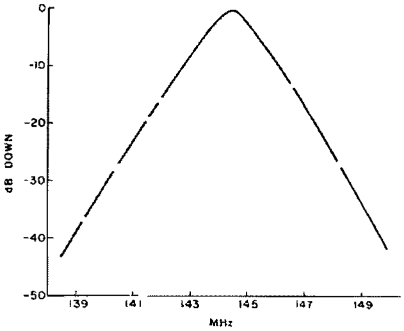


Fig. 2. Two meter DDRR dipole antenna selectivity.

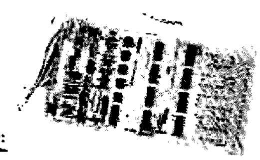
Conclusions

While the amount of selectivity afforded by the DDRR will not come up to that of a multipole filter, it is worthwhile in that it is ahead of the front end—aiding in the signal-to-noise problem. An undesired signal off to one side is noise, too.

Do not try transmitting with the device with the tuning method described except with very low power. It will not pass the smoke test.

Broadband antennas are very convenient (discones, rhombics, and tribanders), but who needs all these unwanted signals going up and down the feedline? Phased DDRR elements could improve selectivity as well as gain.

A selective antenna should make a big difference to you. ■



Reader Service—see page 211

Social Events

Listings in this column are provided free of charge on a space-available basis. The following information should be included in every announcement: sponsor, event, date, time, place, city, state, admission charge (if any), features, talk-in frequencies, and the name of whom to contact for further information. Announcements must be received two months prior to the month in which the event takes place.

LOUISVILLE KY
JUN 29-JUL 1

The Louisville Area Computer Club will hold its 4th annual Computerfest™ 1979 from June 29 through July 1, 1979, at the Bluegrass Convention Center, Louisville, Kentucky. Activities include a flea market, seminars, and exposition, as well as activities for the entire family. Seminar and exposition admission is $4.00. Pre-registered Ramada Inn guests ($29.00, single; $34.00, double) receive free admission. For advance mail information, write Computerfest '79, Louisville Area Computer Club, PO Box 70355, Louisville KY 40270, or phone Tom Eubank, Chairman, at (502)-895-1230.

BATESVILLE AR
JUN 30-JUL 1

The Arkansas Army MARS meeting will be held on June 30-July 1, 1979, at the Independence County Fairgrounds, Batesville, Arkansas. There will be a fish fry on Saturday and a pancake breakfast on Sunday. Camping and motel rooms will be available. For further information, contact Robert Glines WB5KUI/ADN2MH, Box 97, Floral AR 72534, or phone (501)-345-2880.

BELLEFONTAINE OH
JUL 1

The Champaign Logan Amateur Radio Club, Inc., will hold its annual hamfest on Sunday, July 1, 1979, at the Logan County Fairgrounds, South Main Street and Lake Avenue, Bellefontaine, Ohio. There will be free admission and door prizes. Trunk and table sales are $1.00, and there will also be a bid table. Talk-in on 146.52. For more information, contact John L. Wentz W8HFK, Box 102, West Liberty OH 43357, or Frank Knull W8JS, 402 Lafayette Ave., Urbana OH 43078.

DUNKIRK NY
JUL 1

The Northwestern New York Repeater Association and the Northern Chautauqua Amateur Radio Club will hold their Lake Erie International Hamfest on Sunday, July 1, 1979, at the fairgrounds in Dunkirk, New York. A large flea market area and plenty of free parking will be provided. Tickets are $4.00 at the gate or $3.00 in advance. RV hookups are available. For information on advance sales or for a map showing easy directions from I-90, write to Dick Brinkerhoff WB2HEF, 123 5th St., Dunkirk NY 14048.

HARRISBURG PA
JUL 4

The Harrisburg RAC will hold its annual Firecracker Hamfest on Wednesday, July 4, 1979, at the Shellsville VFW picnic grounds, I-81 north, Exit #27 or #28, Racetrack Exit, Harrisburg, Pennsylvania. Look for the large balloon. Admission is $3.00, with no charge for tailgating. Tables will be available in the pavilion. Talk-in on .52/.52.

WELLINGTON OH
JUL 7

The Northern Ohio Amateur Radio Society will hold its second annual NOARSFEST on Saturday, July 7, 1979, at the Lorain County Fairgrounds, one mile west of Rte. 58 on Rte. 18, Wellington, Ohio. Admission tickets are $1.50 in advance and $2.00 at the gate and are good for all prize drawings. Children under 12 are admitted free. Gates open for the sellers and dealers at 6:00 am and to the public from 7:00 am to 5:00 pm. Indoor dealer tables are $4.00 each by advance registration. Drawing-only tickets are available by mail or at the gate for $1.00 each. Flea market spaces are $1.00 each. There will be over 100 prizes, including a Den-Tron HF-200 transceiver, a Ten-Tec 509, a DenTron GLA-1000, a Wilson Mark II, and an Optoelectronics counter. There will be plenty of food and free parking. Featured will be a large indoor exhibit hall for dealers and a huge blacktopped midway for flea market and trunk sales. There will be free camping outside the gates on Friday night, but no hookups. For advance registration, information, or tickets, write NOARSFEST, PO Box 354, Lorain OH 44052.

INDIANAPOLIS IN
JUL 8

The Indianapolis Amateur Radio Association will sponsor the Indianapolis Hamfest on Sunday, July 8, 1979, at the Marion County Fairgrounds, on the southeast corner of Indianapolis at the intersection of Interstates 74 and 465, Indianapolis, Indiana. There will be commercial exhibitors and dealer displays for a fee of $30.00 per booth. The commercial building will be open from 12:00 noon until 9:00 pm on Saturday and will reopen at 7:00 am on Sunday. Camper hookup facilities are available on the fairgrounds for overnight parking if you arrive on Saturday. A food and drink vendor will have a setup outside, while a professional caterer will have facilities inside. For more information, write to the Indianapolis Hamfest, PO Box 1002, Indianapolis IN 46206.

OAK CREEK WI
JUL 14

The South Milwaukee Amateur Radio Club will hold its annual Swapfest '79 on Saturday, July 14, 1979, at American Legion Post #434, 9327 S. Shepard Avenue, Oak Creek, Wisconsin. Admission is $2.00 and includes a happy hour with free beverages. Prizes include a $100 first prize, a $50 second prize, and a variety of other prizes. Activities will begin at 7:00 am and continue until 5:00 pm. Parking, a picnic area, hot and cold sandwiches, and liquid refreshments will be available on the grounds. Overnight camping is also available. Talk-in on 146.94. More details, including a map, may be obtained from the South Milwaukee Amateur Radio Club, Inc., Robert Kastelic WB9TIK, Secretary, PO Box 102, South Milwaukee WI 53172.

BEAVER PA
JUL 15

The Beaver Valley Amateur Radio Association will hold its 2nd annual hamfest on Sunday, July 15, 1979, from 9:00 am to 5:00 pm at Brady's Run Park on Rte. 51 west from Beaver, Pennsylvania. Shelters 12 and 17 will be used. There will be free space for vendors. Tickets are $3.00. Talk-in on .52 and directions on 146.25/.85. For information, write WB3FKE, 3414 47th Street, New Brighton PA 15066.

TERRE HAUTE IN
JUL 15

The 33rd annual WVARA Hamfest will be held on July 15, 1979, at the Vigo County Fairgrounds, one mile south of I-70 on US 41, Terre Haute, Indiana. Overnight camping will be available. There will be a free flea market, a covered flea market at $2.00 for a 12' x 12' space with some tables and ac available, XYL bingo, food, refreshments, and valuable prizes. Advance ticket sales are $1.50 or 4 for $5.00. Tickets at the gate are $2.00 or 3 for $5.00, with children under 12 free. Talk-in on .25/.85 and .52. For tickets and information, send an SASE to WVARA Hamfest, PO Box 81, Terre Haute IN 47808.

ALLENTOWN PA
JUL 15

The Delaware-Lehigh ARC, Inc., the BGYE, Inc., and the Lehigh Valley ARC, Inc., will hold their Tri-Club Hamfest on July 15, 1979, from 8:00 am to 4:00 pm at the Allentown Police Academy pistol range on Lehigh Parkway South at Allentown, Pennsylvania. Admission is $2.00 for lookers and $4.00 for sellers. Talk-in on .34/.94 and .52.

WILKES-BARRE PA
JUL 15

The Broadcasters Amateur Radio Club will hold its 2nd annual hamfest on July 15, 1979, from 9:00 am to 4:00 pm at Pocono Downs Racetrack, Rte. 315, four miles north of Wilkes-Barre, Pennsylvania. Setup begins at 8:00 am. Admission is $2.50, with no additional fee for sellers. XYLs and children are free. The event is all indoors. Talk-in on 147.66/.06 or 146.52. For more information, write John Soha W3KU, 62 S. Franklin Street, Wilkes-Barre PA 18707, or phone (717)-823-3101.

CANTON OH
JUL 15

The fifth annual Hall of Fame Hamfest will be held on Sunday, July 15, 1979, at Stark County Fairgrounds, Canton, Ohio. Tickets are $2.50 in advance and $3.00 at the gate. Mobile check-in on .19/.79 or .52/.52. For information, contact Max Lebold WA8SHP, 10877 Hazelview Ave., Alliance OH 44601.

GUANAJUATO MEX
JUL 19-21

The first annual ARARM-LMRE will be held in Guanajuato, Mexico, from July 19-21, 1979. Guanajuato is located 230 miles north of Mexico City. Registration will be US $13.00. A package will be available for US $40.00 and will include 2 banquets, 1 dinner dance, sight-seeing, theater, and gifts. Drawings will be held, with a grand prize being an SSTV setup. A total of 500 prizes will be given away. The US $40.00 includes registration. Hotels are available with prices ranging from US $10.00 and up for a double room. English-speaking guides are available from the University of Guanajuato. Talk-in on 147.63/.03, 146.10/.70, and 149.22/.82. HF/SSB frequencies will also be operating, and we

Continued on page 182

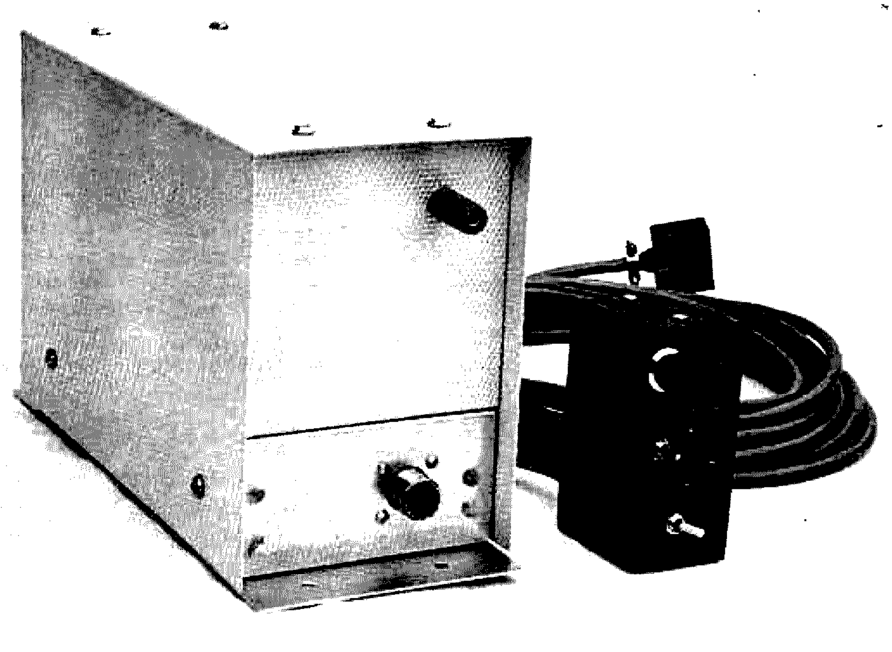
Tennamatic: An Auto-Tuning Mobile Antenna System

—works all of 40 and 75

Farewell to fading.

B. F. Brown W6TWW
1241 Arroyo Seco Dr.
Campbell CA 95008

Would you like to operate your mobile station over the entire 40 and 75 meter phone bands with a vswr not exceeding 1.15 to 1? With a Tennamatic, you can convert a high-Q narrow-bandwidth mobile antenna into a wide-bandwidth system. This means that you can use transceivers having solid-state finals and obtain full output power on any frequency in the 40 or 75 meter phone bands without any manual tuning operations. All you have to do is select frequency, start talking, and the Tennamatic will tune your mobile antenna system to resonance automatically, ensuring maximum field strength. Of course, if your transceiver has tubes in the final, you will still have to retune it when you QSY. Specifications for the Tennamatic are listed in Table 1.



The neat packaging of the Tennamatic can be duplicated easily. The control head, tuner cover, and end pieces are 0.040-inch soft aluminum cut in a paper cutter and folded in a vise using wood blocks. The chassis is described in the text.

History

About two years ago, I met Don Johnson W6AAQ, and I adopted his "big DK" mobile antenna system. He subsequently described it in his October, 1976, *73 Magazine* article entitled "Build a Weird 2 Band Mobile Antenna." His antenna neatly solved the problem of needing to change antenna loading coils when band-hopping between 40 and 75 meters. It also proved to be an exceptionally efficient radiator compared to the commercials, but it was still limited to only a few kHz of usable bandwidth on each band, and I wanted full band coverage.

To obtain full band coverage, I added a motor-driven roller inductor at

the base of the antenna and a control switch at the driver's seat, allowing me to QSY the antenna resonant frequency. This worked beautifully for about six months until I ran off a freeway one day while watching a field strength meter as I was peaking the antenna. Luckily, no damage was done, but the experience convinced me that for safety's sake I had to get out of the loop. This conclusion required me to design a servo system.

Design Requirements

I decided that the tuner would be required to tune automatically over all of the 40 and 75 meter phone bands and use easily-obtainable parts. The parts count was to be minimized to keep reliability high, complications associated with limit switches were to be avoided, and the power handling capability had to be at least 350 Watts PEP. It had to be easy to duplicate, present a pleasing appearance, and the control head had to be capable of being mounted on the side of an Atlas and be visually compatible. Last of all, the servo system had to be uniquely simple, have a 3- or 4-kHz deadband so it would not hunt or jitter around in the voice pass band, provide constant motor torque while tuning, and operate reliably over a plus ten-to-fifteen-volt supply voltage range.

The System

These design requirements led to a system consisting of two units. One unit is a control head and the other is the tuning unit. The tuning unit contains a phase detector and a servo system which drives a permanent-magnet dc gear motor. The motor turns a roller inductor taken from a surplus T21/ARC-5 or T22/ARC-5 command transmitter. The tuning unit also contains a toroidal impedance-matching transformer which ensures a good impedance match between the antenna and coaxial line. The control head has directional indicators, an automatic/manual operation switch, an automatic/manual indicator, a manual slewing switch, and an impedance-match selector switch. The units are shown in the photographs.

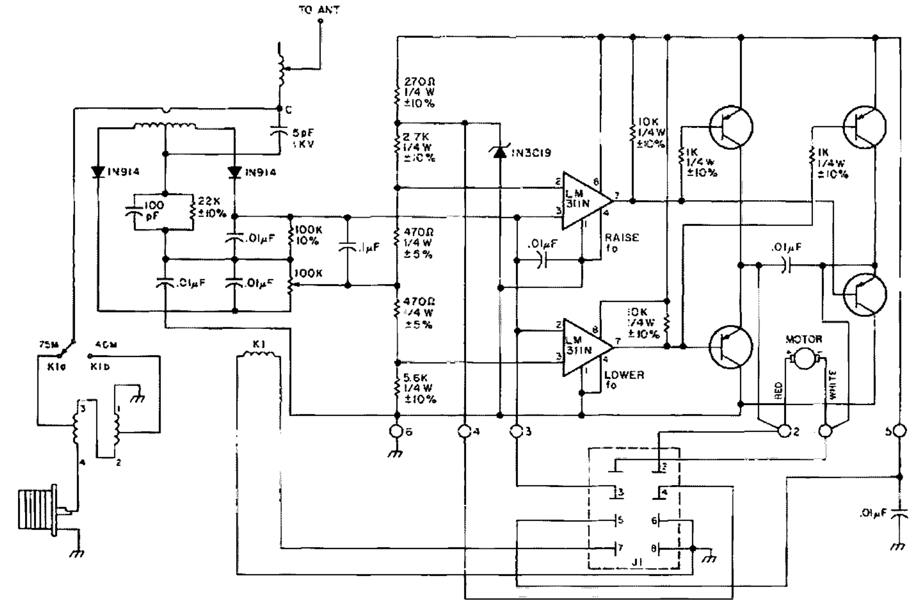
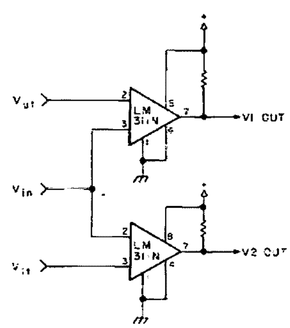


Fig. 1. Tuning unit schematic. The output transistors and motor are discussed in the text. The jack is a male chassis-type Jones plug.

The Circuit

The circuit which I designed is depicted in Fig. 1. To understand its operation, it is best to start with an explanation of the servo system and work backwards toward the input. The system that I selected is known as a "bang bang" servo system in aerospace circles. It is either off or on in one direction of rotation or the other and provides full motor torque when on. Fig. 2 is a simplified diagram of the servo. It uses two LM311N voltage comparator integrated circuits connected as a window comparator. The circuit states listed in Fig. 2 simply say that if the input voltage (V_{in}) is a positive voltage between the upper and lower threshold voltages, the outputs of both comparators will be at supply voltage. If V_{in} either exceeds the upper threshold voltage or is less positive than the lower threshold voltage, one or the other comparator's output will be low. The low-state output is about one-half volt positive.

Referring back to Fig. 1, it will be seen that the comparator outputs are connected to diagonally-opposite transistors. When a comparator switches on and its output goes low, it turns on the associated transistors, resulting in one side of the motor being clamped to ground while the other side is clamped to the positive supply, turning the motor on. The upper comparator drives the motor in the direction which reduces inductance, raising the antenna system resonant frequency. The lower comparator drives the motor in the opposite direction, increasing inductance and lowering the antenna system resonant frequency.



Circuit states

$V_{in} < V_{ut}$: V1 out is high
$V_{in} > V_{lt}$: V2 out is high
$V_{in} > V_{ut}$: V1 out is low
$V_{in} < V_{lt}$: V2 out is low

Fig. 2. Window comparator servo simplified diagram.

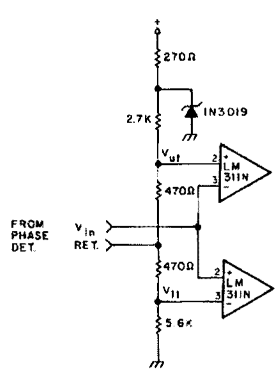


Fig. 3. Window comparator regulated-voltage divider.

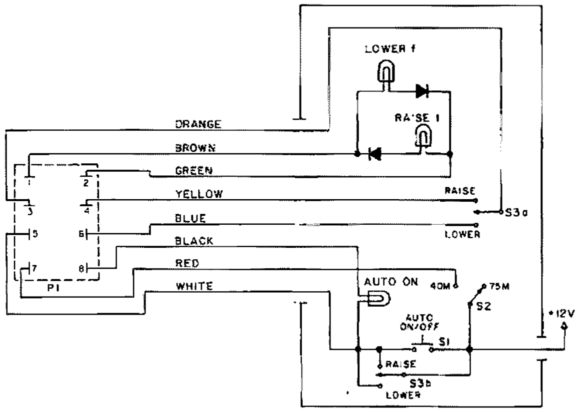


Fig. 4. The control head assembly connects to the Jones-type plug, P1, through 20 feet of TV rotator cable. The diodes are Radio Shack part number 276-1101.

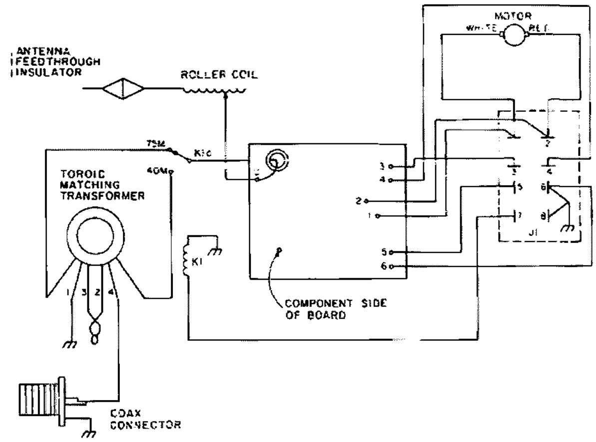


Fig. 5. Tuner unit wiring diagram.

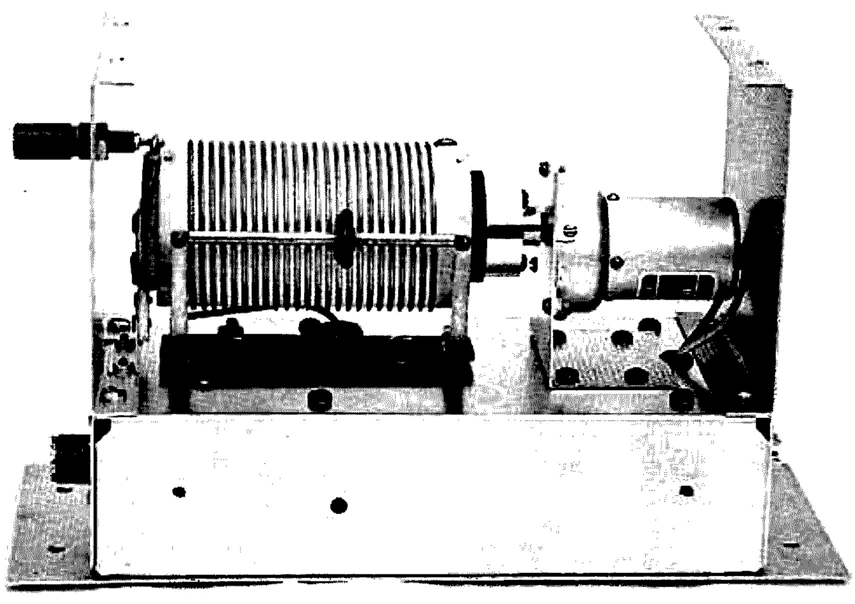
Fig. 3 shows the input circuit to the voltage comparators. The comparators must operate with their inputs positive with respect to ground, making it necessary to reference the phase detector to a point above ground. This reference point is the junction of the two 470-Ohm resistors. The output of the phase detector is connected to V_{in} and will be a voltage which will swing positive or negative with respect to the reference point, causing the comparator inputs to swing above V_{ut} or below V_{lt}, depending upon the off frequency condition existing at the time. The voltage divider is zener regulated to hold the switching thresholds constant. The voltage drops across the two 470-Ohm resistors set the width of the deadband to 3 kHz on 75 meters and 4 kHz on 40 meters.

The phase detector compares the phase relationship between the current flowing in the antenna circuit and the voltage from the antenna circuit to ground. When the input frequency is higher than the antenna system resonant frequency, the phase detector produces a dc output voltage across the two 100k load resistors which is positive with respect to the slider on the trimpot. Conversely, if the input frequency is lower than the antenna system resonant frequency, the output dc voltage is negative.

The trimpot is adjusted in operation to cause the phase detector to find exact resonance. It compensates for the inductive reactance inserted by the toroidal antenna impedance-matching transformer. The reduced output from the low side of the phase detector caused by the trimpot results in need for incremental downward QSY on 75 meters with pauses to allow the servo system to catch up. Even so, a QSY from 4000 kHz to 3800 kHz takes less than 30 seconds.

The impedance-matching transformer is necessary with the DK antenna because of its low input impedance at resonance. The taps are set at the 10-Ohm point for 40 meters and at the 14-Ohm point for 75 meters. These low input impedance values are excellent indicators of the low-loss characteristics and high performance of the antenna. Relay K1, a Potter and Brumfield KT11D 12 V dc 5-Ampere contact relay, selects the appropriate tap and is controlled by a manual switch on the control head.

Fig. 4 depicts the schematic of the control head. All of the switches, diodes, and 12 V dc indicator lamps are from Radio Shack. Switch S1 provides for switching the tuner into the automatic or manual mode and is a push-on/push-off switch. S3 provides capability to



Mounting details of the roller inductor, gear motor, and shaft coupler illustrate the mechanical simplicity of the unit.

manually slew the tuner up or down in frequency. It is a DPDT center-off-type switch. I have found that I use it rarely in operation, but it is nice to have in case you need it. It is needed during the installation adjustments. S2 operates the antenna-matching transformer tap-selector relay. No power on/off switch is provided, as power is taken directly from the transceiver. This prevents inadvertently leaving power on the tuner unless, of course, you forget to turn the transceiver off when you leave the car.

Construction

The photographs of the tuner reveal how simple the unit is to duplicate. It is built on a standard 2" × 4" × 8" aluminum chassis, and the motor bracket, end panels, cover, and bottom plate are easily constructed in the home workshop. Several W6s have built the tuner and made Plexiglas™ covers so that they can see the roller coil go into operation when they QSY. The layout I selected results in minimum antenna-circuit wire length and should be duplicated as closely as possible.

Don't get innovative by trying to reduce conductors in the control cable. You can quickly get into trouble because the voltage comparators are sensitive to rf and to ground loops and will go "ape" if you unknowingly build in a ground loop as a result of a circuitry change. Also, keep some spacing between the control cable and the coaxial line, as rf pickup in the control cable can lead to erratic operation. The wiring diagram is shown in Fig. 5. The only precaution here is to note the direction of the antenna wire as it goes through the hole in the toroidal phase-sensing transformer. If it goes through from the wrong side of the printed circuit board, the tuner will drive away from resonance.

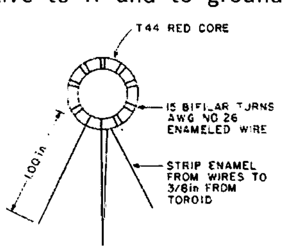


Fig. 7. Phase-detector transformer details. Note: Cut two wires 12" long and wind in parallel for bifilar winding. Connect the opposite ends together as shown for center tap.

Antenna-Matching Transformer

A T-106 red toroidal core, obtained from either G.R. Whitehouse or Amidon Associates, both of which advertise in several amateur magazines, is the heart of the transformer. Fig. 6 provides all necessary details for construction. The sleeve for securing the taps is a model airplane copper gas line obtained from a hobby shop and cut to length with a hacksaw. Should you desire to use an antenna other than the big DK, you must determine the antenna input impedance in Ohms at resonance with an antenna noise bridge and then determine the correct tap position from Table 2. If you don't use the DK, you will still have to change loading coils when changing bands.

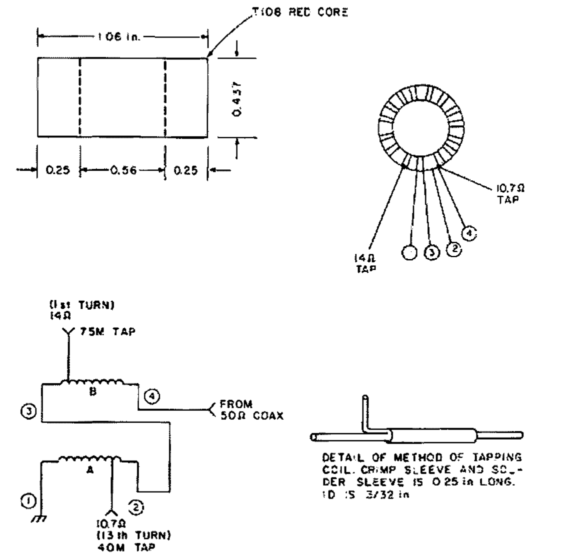
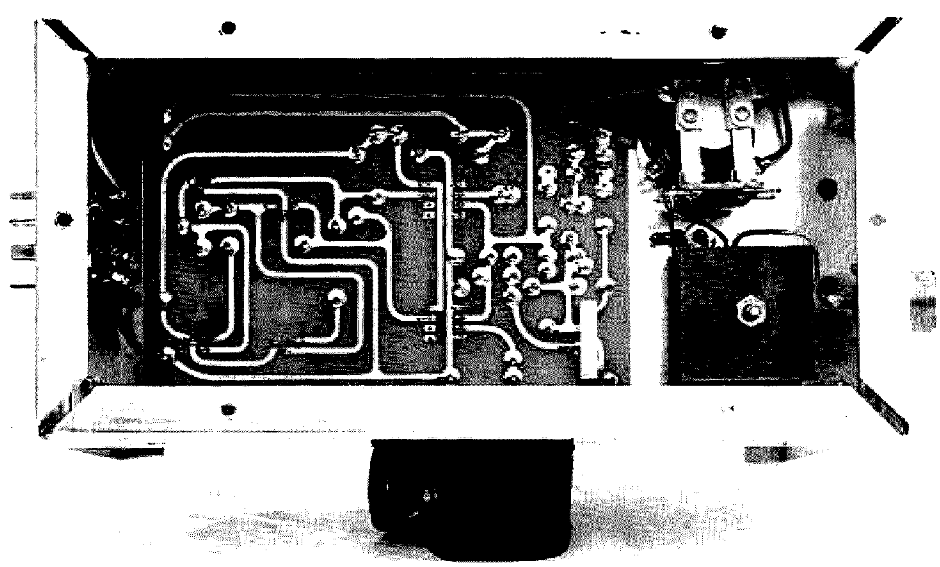


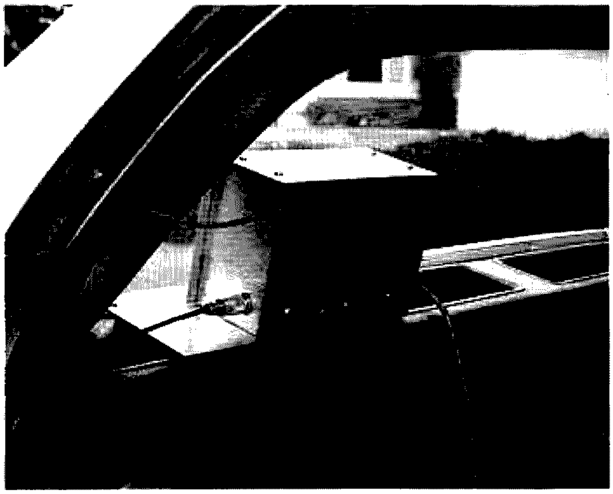
Fig. 6. Toroidal impedance-matching transformer details. Notes: Cut two wires 24" long and wind in parallel for a bifilar winding. Each winding is to have 14 turns. Taps and wires 1 and 4 are to be 2" long. Wires 2 and 3 are to be twisted and soldered and not to exceed ½" long. All wire should be AWG #18 enamel. Dip it in General Cement Red Glypt and hang up to dry before use.

Phase-Detector Transformer

Construction details of this transformer are depicted in Fig. 7. When winding the transformer, be sure that the wires remain parallel to each other without any crossovers. Also, count each pass through the hole as a turn.



The under chassis view further illustrates the mechanical as well as the electrical simplicity of the unit. The toroidal antenna impedance-matching transformer is hidden by the masonite clamping pieces. The prop under the chassis is a photographic lens case.



This neat installation of the tuning unit in the left rear window of my station wagon permits a short lead-in from the ball mount outside.

Remember that it is impossible to wind a half turn on a toroid. This transformer need not be dipped in General Cement Red Glypt, although you may do so if you wish.

Gear Motor

The gear motor which I used and recommend is a Magna-Torc™ permanent-magnet 24 V dc motor with a type B gear reduction unit. Operated in the Tennamatic, this motor will turn the roller inductor at approximately one revolution per second. The motor is manufactured by the Hansen Manufacturing Co., Princeton, Indiana 47670. It may also be obtained from Hartfield, Kennan, and Freytag, PO Box 328, Fremont CA 94536. The motor is expensive at about $21.50 per copy; however, it is the smallest and neatest solution to the drive-motor problem and well worth it.

Others who have built this tuner have found various surplus motors or used window crank-up motors obtained from auto wrecking yards. These high-current motors are quite bulky, do not allow neat packaging of the system, and also require the addition of relays to the output of the tuner, since the transistors can not drive them directly. These surplus motors do have the advantage of being cheap, however.

Shaft Coupler

The shaft coupler mates the gear motor drive shaft to the thumbwheel on the end of the roller inductor. It is made of aluminum turned out on a lathe and is simply bolted with three 6-32 machine screws to the thumbwheel. Fig. 8 provides the dimensional details. One of the photographs shows how it looks when the motor and roller coil are coupled together.

Frequency range:	75m—200 kHz 40m—300 kHz
*Slewing rate:	75m—6 kHz/sec. 40m—40 kHz/sec.
Minimum Δf:	75m—requires 3 kHz QSY to activate tuner 40m—requires 4 kHz QSY to activate tuner
Maximum Δf:	75m—50 kHz (QSY of 200 kHz in four increments of 50 kHz requires less than 30 seconds.) 40m—200 kHz (QSY of 200 kHz requires less than 5 seconds.)
Vswr:	typically 1.15 to 1 or better after tuning completed
Modes:	automatic/manual
Input voltage:	10 to 15 V dc, negative ground
Input current:	420 mA at 13.8 V dc while tuning; 125 mA at 13.8 V dc after tuning completed
Power rating:	350 Watts PEP

*Table 1. Tennamatic specifications. *Full carrier inserted. On SSB, the slewing rate is slightly slower due to speech pauses.*

Printed Circuit Board

Fig. 9 depicts the printed circuit board. Be sure that you watch the polarity of the phase-detector diodes when you insert them. Also, it is a very good idea to use integrated circuit sockets instead of soldering the integrated circuits directly into the board. The four output transistors can be Poly Paks green-body PNP power-tab transistors, part number 92CU2227, or Radio Shack PNP power-tab transistors, part number 276-1641. Both types are rated at 35 Watts with suitable heat sinking. Heat sinking is not required in this application.

If you use the Poly Paks transistors, bend the tabs at right angles to the body of the transistors to ensure that they clear other components mounted on the board. Make the bend about a quarter inch from the body of the transistor. Test them carefully for leakage before you solder them because I have found that about 25% of them are too leaky to work properly in this circuit. They will cause the directional indicator lights to light even when the system is at resonance. I've had no trouble with Radio Shack transistors.

The photograph of the underside of the chassis shows the printed circuit board as installed in the tuner. The trimpot was mounted on the foil side of the board because, when three-quarter-inch stand-

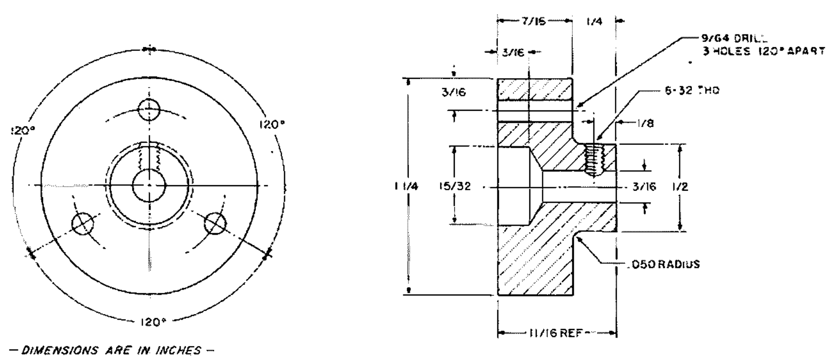


Fig. 8. Shaft coupler.

offs for supporting the board are used, the screwdriver access hole in the side of the chassis falls midway in the side.

I have a few extra printed circuit boards available at $5.00 each for those who prefer not to make their own.

Installation

Mount the tuning unit as close as possible to the base of your antenna. Connect the base of the antenna to the tuning unit with insulated AWG #12 or #14 wire. Do not under any circumstances use coax to connect the antenna to the tuner! Make sure that you ground the tuning unit to the car body by means of sheet metal screws or a short bonding strap. Use 50-Ohm coaxial cable to connect the tuning unit to your transceiver. RG-58A/U is satisfactory, and the length is not critical.

One photograph shows how I mounted the tuner in my station wagon. After mounting the control head to the transceiver (I used Velcro® fastening tape), connect the control head power lead to the transceiver so that the transceiver power switch will control application of power to your Tennamatic.

DK Antenna Adjustment

After installation of your Tennamatic, your DK antenna (or other antenna) must be retuned to be resonant on approximately 4025 and 7325 kHz. For this adjustment, the roller inductor must be slewed to minimum inductance using the manual slewing switch. Next, you must determine the antenna resonant frequency on both 75 and 40 meters using your vswr bridge or field-strength meter. Resonance will be lower than it was before the Tennamatic was installed. Don't overlook changing the impedance-matching tap when you change bands looking for resonance.

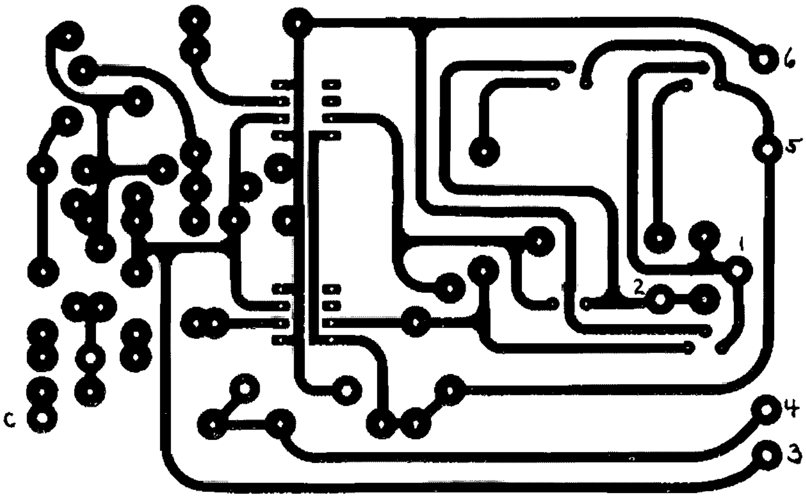


Fig. 9(a). PC board.

Now that you know where the antenna system resonances are, you can proceed to raise them by removing turns from the loading coil, shortening the whips, or by a combination of both methods. If the two resonances are as low as 3900 kHz and 7150 kHz approximately, you may find it better to remove a turn or two from the bottom of the loading coil and one or more turns from the top of the loading coil in order to minimize the amount that must be trimmed off the whips. Remove turns only one at a time. Be sure to check the resonant frequency on each band after each adjustment because they interact, and it is essential that you do not go too far. By the time resonance is approaching the upper band edge on 75 and 40 meters, you should have determined the number of kHz per inch of frequency change you get with each inch cut off. The kHz-per-inch figure will be different for each whip. After reaching 3995 kHz and 7295 kHz, cut off an additional increment from each whip determined by dividing 30 kHz by the number of kHz per inch for each band. This will complete the antenna tuning procedure.

Tuner Trimpot Adjustment

This adjustment is made to cause the tuner to tune for maximum field strength (coincident with minimum vswr). When adjusted on 40 meters, it will also be correct on 75 meters. Adjust as follows:

1. Make sure your vehicle is at least fifteen feet away from other vehicles, trees, buildings, or metallic objects.
2. Turn the trimpot fully counterclockwise, and

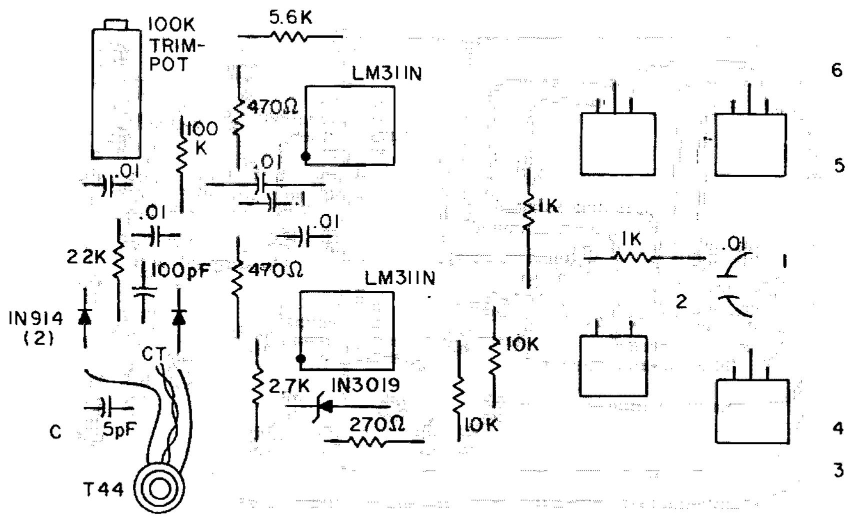


Fig. 9(b). Component locations viewed through the foil side of the board. When installing the LM311N integrated circuits, line up the dot on the IC with the dot shown on the outline of the board. The T-44 phase-sensing transformer may be glued to the board. The four output transistors are mounted against the board.

Antenna input impedance	Winding A turn number	Winding B turn number
3.13	7	
4.08	8	
5.17	9	
6.38	10	
7.72	11	
9.18	12	
10.78	13	
12.5	14	
14.34		1
16.33		2
18.43		3
20.66		4
23.02		5
25.51		6
28.13		7
30.87		8
33.74		9
36.73		10
39.86		11

Table 2. Transformer taps required for various antenna input impedances to match 50-Ohm coaxial line.

then preset it six turns clockwise.

3.Turn on your transceiver. Place it in the tune mode with carrier inserted on the 40 meter band.

4. While watching a field-strength meter or vswr indicator, tweak the trimpot until you observe maximum field strength or minimum vswr. The Tennamatic must be in the automatic mode for this adjustment. Your unit is now ready to operate.

Operating Results

With a year and a half of operating experience, the Tennamatic has demonstrated that high-Q mobile antennas are extremely sensitive to the environment around them. For example, a dense fog will lower the antenna system resonant frequency on 75 meters by as much as 25 kHz, but the Tennamatic will compensate by rolling the inductor to less inductance. I leave it in the automatic mode at all times while driving, and, as long as I am talking, it will compensate quickly for the detuning caused by passing trucks, cars, trees, freeway overpasses, bridges, and residential power line drops as you drive under them. The result is that most of the characteristic mobile fade, which I now realize is due to antenna detuning, is eliminated. The result is such a strong steady mobile signal that I frequently have to convince my contact that I am really mobile!

There is one thing that the Tennamatic cannot compensate for. That is another 75 or 40 meter mobile parked up to twenty feet away. The mutual coupling between antennas, reflected signal, and phase shifts cause it to go "ape." So, if you build one, don't proudly try to demonstrate it when parked near another mobile.

Acknowledgement

I would like to acknowledge with my thanks the numerous suggestions made by Don Johnson W6AAQ as this project proceeded through the breadboard, prototype, final design, and evaluation phases. I also wish to express my grateful appreciation for the photography provided by Jerry Fulstone WA6EJV. ■

William Epperhart, Jr. WB2DTY
7 Sampson Street
Oyster Bay NY 11771

Add Solid-State Braking to the T²X

—a worthwhile improvement

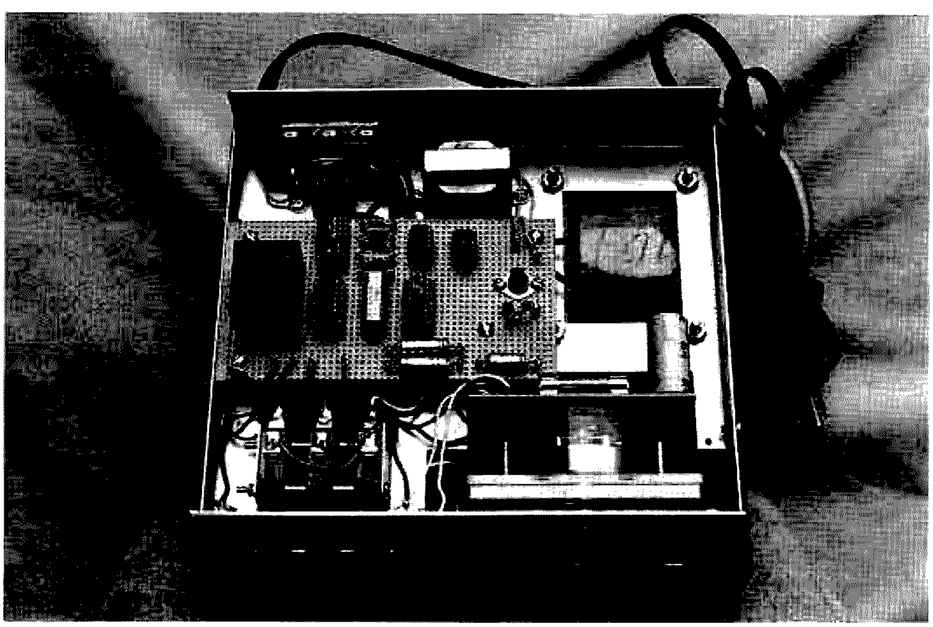
Tame your Tailtwister.

The T²X "Tailtwister" rotor by CDE is quite a piece of machinery. It's a heavy-duty rotor capable of turning an antenna system with 26 square feet of wind load, has a coast-down pre-brake action, and has a wedge brake system that keeps the rotor from slipping when not in use. As an added safety feature, power is not delivered to the directional controls until the wedge brake has been released.

In order to get the rotor to turn, you must press the brake release switch on the control unit, holding it down while pressing either the clockwise or counterclockwise direction switch. Once the antenna reaches its destination, the direction switch must be released first, followed by the brake release switch after the antenna has coasted to a stop. If you should let go of the brake release switch before releasing the direction switch, or if both switches are released simultaneously, the wedge brake will immediately engage, bringing the system to an abrupt stop, placing undue strain on the rotor, mast, antenna system, and the tower itself.

Holding onto the brake release switch until the rotor has had plenty of time to coast to a stop is much easier in theory than in actual practice. What this means is that sooner or later you could have troubles, unless you can guarantee that the wedge brake won't be constantly slamming into the gears of a moving rotor.

One solution to this problem is to electronically delay the engagement of the wedge brake for a small period of time after the rotor has stopped turning. The circuit I designed to accomplish this consists of four ICs, one optoisolator, a small power supply, and a solid state relay. All the parts, with the exception of the power transformer, filter capacitor, and bridge rectifier, are mounted on a 5¼" x 2¾" perfboard using standard wire-wrapping techniques. The entire circuit fits in the rotor control unit, and no modifications to either the rotor or the outside appearance of the control unit are required.



The power to the rotor's brake solenoid and directional circuitry is switched by a Grayhill Solid State Relay, which takes the place of the brake release switch in the original schematic—see Figs. 1(a) and 1(b). The SSR is ideal for this application for a number of reasons:

1. Its zero voltage turn-on and zero current turn-off characteristics plus its 3000-volt-per-microsecond transient protection allow it to switch a 110-V-ac inductive load at 4 Amps without the contact arcing found in a mechanical relay.
2. It will switch with 5 V dc of control voltage and draw less than 5 mA of current, making it compatible with TTL.
3. It physically separates

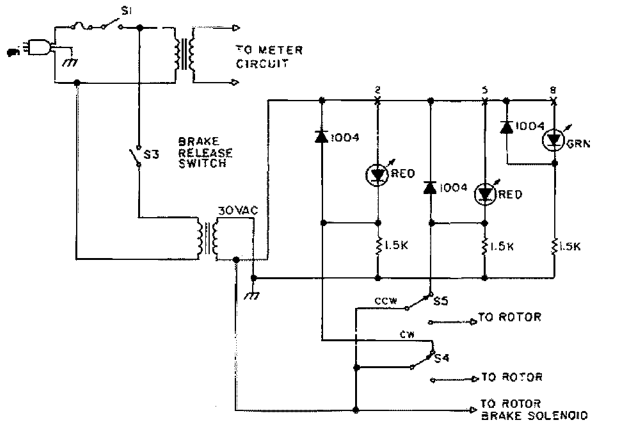


Fig. 1(a). Detail of control unit (original version). All resistors ¼ Watt. "X" denotes wiring connection to the control unit PC board.

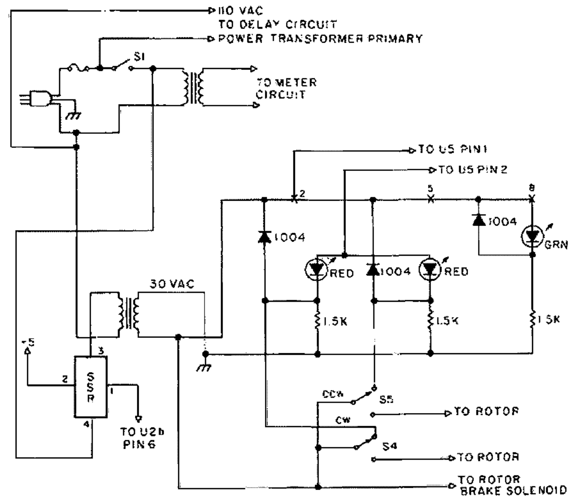


Fig. 1(b). Detail of control unit (modified version). All resistors ¼ Watt. "X" denotes wiring connection to the control unit PC board.

the digital control circuitry from the load by means of optoisolation, protecting the logic from any spikes that might be generated by the brake solenoid.

4. Its small size (1 cubic inch) enables it to be mounted directly on the perfboard, producing a very compact modification in the rotor control unit.

The rest of the circuitry on the perfboard (Fig. 2) determines the amount of time the SSR will remain energized. When the brake release switch (S_3) on the front panel is closed, the reset (pin 4) on the NE555 timer goes low, as does pin 6 on the 7409, turning on the SSR, releasing the wedge brake, and applying power to the rotor's directional controls. When the switch is released, the 74121 (which is triggered on the negative-going edge of its input pulse) applies a one-shot to the NE555, which in turn goes high at its output. This keeps pin 6 of the 7409 low, allowing the SSR to remain energized for approximately five more seconds. The five-second delay is determined by the RC combination of the 3.3-megohm resistor and the 1-uF capacitor on the NE555 and can be lengthened or shortened by increasing or decreasing the values of these components.

The input to the digitial circuitry is physically separated from the rotor's direction control voltage by an optoisolator (U_5) whose diode is wired in series with the LED directional indicators on the control unit—see Fig. 1(b). By the way, the optoisolator drops the total current in each directional LED by only 1 mA and therefore does not affect the original brightness of the indicators. If either one of the rotor's directional controls is pressed while the wedge brake is released, current will flow through the diode of the optoisolator. This causes the output of the optoisolator to go low (Fig. 2), resetting the NE555 and keeping the SSR energized. Releasing the directional switch triggers the 74121 which pulses the NE555 and holds the SSR on for another five seconds. As a result, it is no longer necessary to hold down the brake release switch once the circuit has been energized. The wedge brake will not engage unless all three front panel switches have remained open for five seconds. Closing any one of the switches during the five-second delay resets the timer and repeats the cycle upon release of the switch.

In building this circuit, I used a 1k resistor network in place of mounting separate pull-up resistors, but there is room to mount the ¼-Watt resistors separately on the perfboard if you don't have a network handy. It should be noted also that I have connected the primary of the digital logic power supply transformer—Fig. 1(b)—before the rotor control unit "Off/On Switch" (S_1) so that power is supplied to the ICs continuously. Although you might prefer to make the connection after the switch, this will tend to energize the brake solenoid as soon as power is applied to the box. Powering the ICs constantly (the digital logic draws considerably less than 100 mA) not only prevents this,

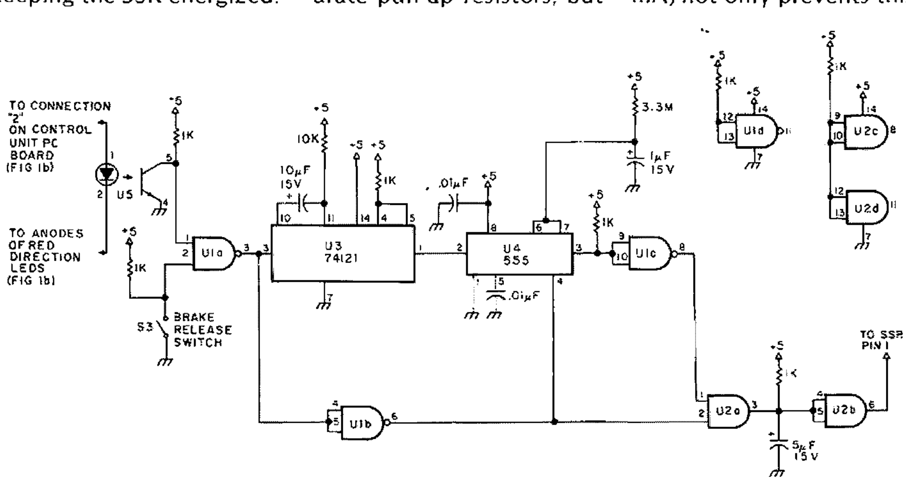


Fig. 2. Delay circuit. All resistors ¼ Watt. All capacitors measured in uF.

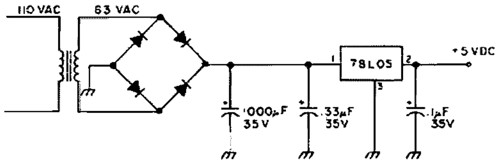


Fig. 3. Power supply.

but also is better for the ICs in the long run since they are not subjected to surges that accompany the application of voltage to the unit.

When connecting the wire-wrap wire to the SSR "control" pins, use the wire-wrap tool to make the connection, but make sure you solder the wire to the pins. Normally, solder is not necessary with the wire-wrapping technique, but the pins on the relay are round as opposed to the square wire-wrap pins, so solder should be used to ensure a solid connection.

Since all of the circuitry, with the exception of the power transformer, bridge rectifier, and 1000-uF filter capacitor (Fig. 3), is built on the perfboard, the digital logic can be checked for any wiring errors before connecting it to, or mounting it in, the rotor control unit. The 78L05 voltage regulator will handle up to 35 volts on its input (although it runs much cooler with the 6.3-volt supply used in this project) so you can temporarily power the perfboard with the output of a standard 12-V-dc supply. Attach a logic probe or voltmeter to pin 6 of the 7409 (since the 7409 has an open collector output, pin 6 must be connected to pin 1 of the SSR and pin 2 on the SSR must be connected to +5 V dc in order to get the proper readings). You should get a high-level logic state on the probe or a little under 5 volts on the voltmeter. Grounding pin 1 or pin 2 on the 7400 should change the reading to a low-level logic state (under 1 volt on the voltmeter). When you remove the ground, the reading should stay low for about 5½ seconds before returning to its original state.

If the circuit checks out correctly, disconnect the leads on the brake release switch (S_3) and solder them to the "load" pins on the SSR. Now you can mount the board on the bottom side of the control unit's chassis and hook up the power supply as shown in the schematics in Figs. 1(b) and 3. Connect a lead from one contact on the brake release switch to pin 2 of the 7400 and a lead from the other contact to ground. Unsolder the leads from connection points 2 and 5 on the control unit's printed circuit board (the board is numbered) and connect them both to pin 2 (the cathode) on the optoisolator (U_5). Connect a lead from pin 1 on the optoisolator (U_5) to connection point 2 on the printed-circuit board. Connection point 5 is not used. This completes the modification of the rotor control unit.

Although I made this modification on the Tailtwister rotor, the schematic for the control unit is very similar to the schematic of the Ham II and Ham III rotors. I have not modified these rotors, but this circuit should work with them and is worth checking into. The only real difference between the Ham II/Ham III schematics and the Tailtwister schematic is that the Tailtwister has the three front panel LEDs (two red ones for direction indication and one green one for an indication that the wedge brake has been released). These could be added quite simply if desired—see Figs. 1(a) and 1(b)—using three 1.5k ¼-Watt resistors and three HEP1004 (1N34A-type) diodes. Although the direction indicators are not really necessary, the brake release LED does indicate the status of the wedge brake and I would recommend that you install it if you plan to use the brake delay circuit. It should be a simple matter to mount the extra components on the perfboard.

In all, the addition of an electronic brake delav circuit makes a good rotor better and may save you from the headache of rotor troubles at a later date. ■

Parts List

ICs

1 SN7400 (U_1)
1 SN7409 (U_2)
1 SN74121 (U_3)
1 NE555 (U_4)
1 IL 1 or equiv. optoisolator (U_5)
1 uA78L05 5-volt voltage regulator

Resistors

7 1k, ¼-Watt, 10%
1 10k, ¼-Watt, 10%
1 3.3 megohm, ¼-Watt, 10%

Capacitors

1 1000 uF, 35 volts
1 10 uF, 15 volts
1 5 uF, 15 volts
1 1 uF, 15 volts
1 .33 uF, 35 volts
1 .1 uF, 35 volts
2 .01-uF disc ceramic

Miscellaneous

1 Power transformer, 6.3 V at 300 mA (Radio Shack 273-1384)
1 Bridge rectifier (Radio Shack 276-1151 or equiv.)
1 SSR Grayhill Inc., 561 Hillgrove Ave. La Grange IL 60525, Part no. 70S2-04-B-04-F ($21.00)

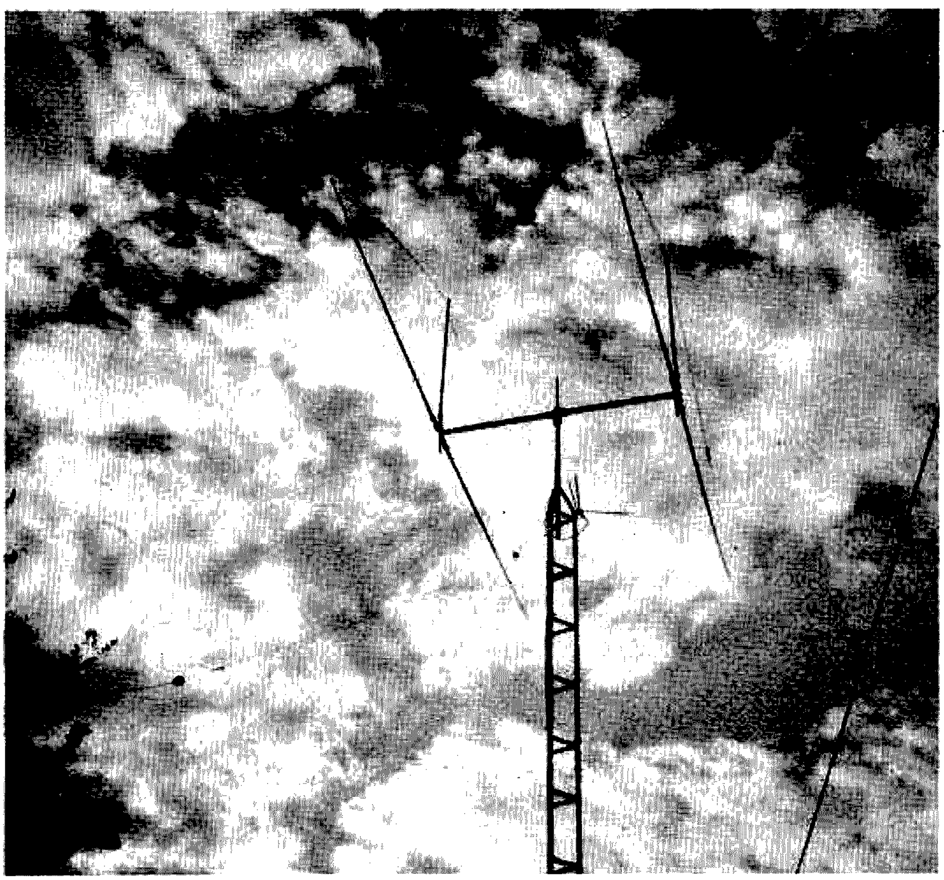
Sockets

2 8-pin wire-wrap sockets
3 14-pin wire-wrap sockets
1 Transistor socket for voltage regulator (Radio Shack 276-548)

Reader Service—see page 211

Compact Beams for 20 or 15
—build these when your quad bites the dust

Light, neat, rugged.



Jerrold A. Swank W8HXR
657 Willabar Drive
Washington Court House
OH 43160

My tower is just 11 feet from my neighbor's property line. The further I stay away from his television antenna, the better, lest I cause him TVI. I, therefore, have long wanted a 20 meter beam that, while a monobander, would not have a spread so long as to go outside my yard.

I do not like the regular 20 meter quad, as it is too big and floppy and somewhat unsightly, besides being easily damaged by the wind. I did not want to buy a triband beam, since I cannot operate 15 or 10 meters. I have only a three-band rig.

At one time, I had a 15 meter quad up for a couple

of years, and it worked fine, but since I cannot now work 15, I wanted to make a 20 meter beam out of my quad.

Everyone told me that this plan would not work, including one nationally-known antenna expert on quads. They said that bending back the ends of the elements would make it act like a transmission line.

I could have used loading coils, but most of all I did not want to have to buy an expensive beam. I had my quad put away and also had some parts of quad arms from another quad which I had once cut from 20 to 15 in my DX days. It was heavier, but a fellow ham had cut it down to 6½ feet to make a CB quad. Three of the arms had been broken when it fell while being taken down after he became a ham.

I decided to telescope one arm into a larger arm, and found that this would give me 11 feet per arm. I put epoxy on the smaller arms, or spreaders, and put them together. I was thus able to make four good arms and still have two usable short spreaders 6¼ feet long, by inserting aluminum tubing in one of the best broken arms. The 15 meter spreaders were still a full 8 feet long.

The reason I am telling you all of this is to make you think about ways of getting material for your beam. It would be possible to use bamboo or even wooden arms. If the arms are not hollow, you could tape the wire to the wooden arms. I actually tried this at first with the arms I am using, and then decided to see if the proximity of the aluminum spider would change the tuning of the beam elements. I found that it made no difference, so I removed the taped wires and fed the wires through the center of the fiberglass tubing.

I might mention a few booby traps I found as I went along. The first was that the stored tubing had been stopped up by insects and egg sacs. I used a 5/8 λ two meter mobile whip with the ball removed to poke out some of the debris. I then put my mouth to the small end, holding fingers over the hole which had been cut for wire in the old quad, and blew.

This worked with one arm, but not with two others. I tried poking wire through, but the wire was not stiff enough. I finally banged the large end on the concrete floor of my patio, and finally 8 cocoons fell out. I know now that I should have cleaned out the 15 meter quad arms before putting the two arms together. It would have been easier to handle them.

I then tried to push some #14 stranded wire through, but it kept catching on the end of the smaller inside arm. I took some #18 tinned wire and poked it through from the small end of the tubing, and it didn't buckle as it did when trying to force it the other way. I ran it through, twisted the end to the #14 Belden 8000, and pulled it back through.

I put a length of nylon tubing over the wire to keep it from being shorted to the bolts which held the clamps on the fiberglass arms.

I had cut the wire by formula to 16½ feet for the 14,200 MHz. I thus had 5½ feet left after reaching the end of the 11-foot arm. This I had to bend back. I put one of the short arms into the spider after placing the other 11-foot arm in the clamps. This I used in the upper arm of the spider. The lower arm of the spider was not used.

I could have left the upper arm unused and put the 6½-foot arm in the downward position. This I

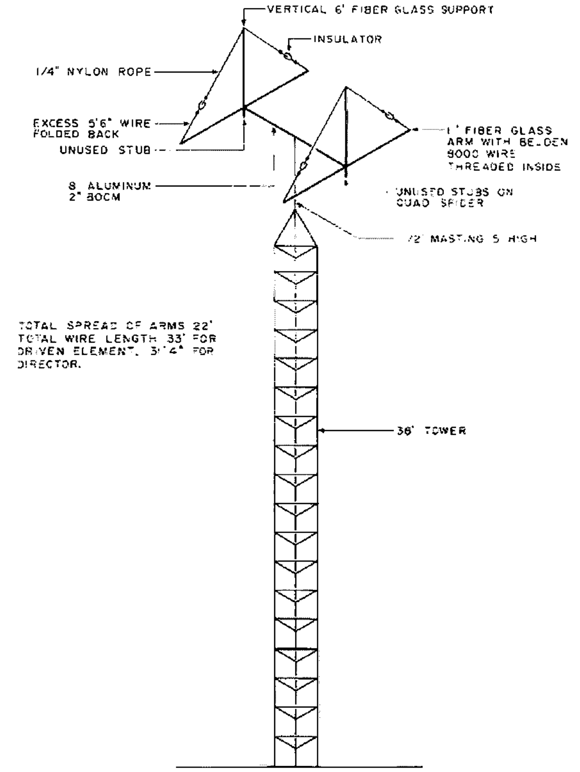


Fig. 1. Small light 20 meter beam.

decided against for two reasons. It would have brought the 5½ feet of excess wire back toward the metal tower, and by using the upward position, it furnished a support for the ends of the 11-foot arms. They did not sag, but I felt that they would be subject to more wind vibration if turned down.

I pounded a 3-foot length of 1½-inch pipe into the ground and placed the 8-foot boom with the attached spiders and center T-fixture in the pipe. This gave me a position for attaching the arms and stringing the ¼-inch nylon rope supports. The patio was too short, and the egg crate roof was so low that I could never have gotten the completed beam out. Even in the yard I was short of space, but I managed, even with shrubs and trees.

I drilled a ¼-inch hole in the tops of the vertical arms and threaded ¼-inch nylon rope through. I pulled enough through to reach the ends of the wire, and then tied a knot each side of the vertical arms to keep the rope from slipping. I used a 6-inch length of 7/8-inch PVC pipe with holes drilled in the ends for insulators. I probably did not need the insulators with about 7 feet of nylon rope and a fiberglass support, but habit made me use them. I would probably not use them again, so I suggest you don't bother.

I fastened a Kirk balun to the lower quad spider arm, and it made a fine installation. However, after spending several hours trying to figure out why the swr was about 10:1, I opened up the balun and found that one of the wires, after 20 years of use, had finally broken. I just put it up without a balun. I think a balun might have helped in some ways, but it seems to work well, anyway. I had used a hose clamp to attach the balun to the arm, and it was a neat job. If you use a balun, try this.

I used 31 feet, 4 inches for the director, which is 95%

of the 33-foot length of the driven element. I used a director instead of a reflector because it requires less boom length for the same gain and needed less extra wire pulled back toward the support. There was about 4 feet, 8 inches to pull back on each end.

I checked the swr on the ground, and it was 2½:1 from about 14.200 MHz to 14.350 MHz, except that it dropped to 2:1 in the area of 14.250 MHz. I figured that this would improve when it was up in the air, and it did. At the height of 43 feet, it dropped to 1.5:1 at 14.250 MHz and 2:1 at 14.350 and 14.200 MHz.

I have no rotator yet, so I

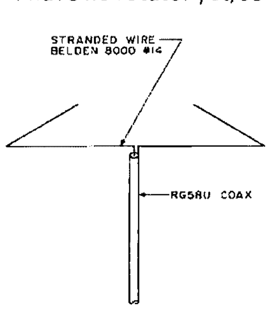


Fig. 2. Schematic of one element.

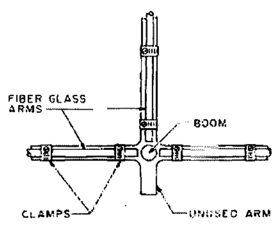


Fig. 3. Closeup of spider.

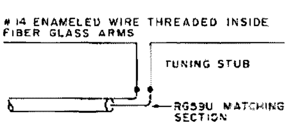


Fig. 4. Schematic of 15 meter driven element.

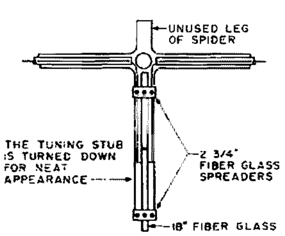


Fig. 5. Closeup of spider.

wanted to face the beam SW. It needed to be attached to a mast to raise it about 5 feet above the 38-foot tower. I had 8 feet of 1½-inch heavy wall aluminum tubing, and I inserted a similar length of 1¼-inch steel tubing inside to make a stiff mast. I drilled a hole and inserted a metal screw to hold the tubing together.

I had planned that we drill the mast for the T-fixture when it was up in the air, but my friend, Bill Burns WA8IEJ, who was going to raise it for me, wanted to drill it on the ground. I think he regretted it when he carried it to the tower. I had told him the beam weight was about 12 pounds, I thought. I had easily carried it on the ground.

While he was carrying it up in one arm and climbing with the other, he stopped to rest a couple of times, and he said it was more like 25 pounds with the attached masting. I recommend that you wait until it is on the tower and drill it before lifting the mast up to the desired height. I let it stick out 5 feet above the tower, which gives me enough inside the tower to attach a rotator.

I later wished I had done one more thing. I should have slipped the wire through a short piece of Teflon™ or nylon tubing as it comes out of the end of the fiberglass arm. This would help prevent the chafing of the wire by the sharp edge of the tubing and might keep the wire from breaking. It probably will last at least a couple of years, though. There is not much pull on the wire, since I did not draw it up very tight, so perhaps it will last longer.

It makes a lot neater arrangement than a 20 meter quad, and up in the air it looks nice.

I used a quarter wavelength of RG-59/U as a matching section from the driven element to the RG-8/U coax lead-in. I guessed that the beam impedance would be about 20 Ohms, and this would raise it to 40 Ohms. This would give an swr of 1.25:1, so the 1.5:1 final measurement was not far off.

When I got a chance to test it, I first called CQ and a California station came back and said that I had a "really strong signal" in his location. Next, I went in a pileup and got a reply, after only two calls, from P29JS in Papua, New Guinea. He said I was 5 x 9. It was a new country for me. The band was going out, so I went to bed.

The next night I tried to talk to a friend, Dale WD8VTD in Jamestown, Ohio, about 19 miles away, but he was off the side of my beam and we were really weak. While I was listening for him, Hans SM6CVX called me and wanted to know my Ohio county. When I told him Fayette, he wanted a QSL card. He gave me 5 x 7 and he was 5 x 8 here. I guess that my front-to-back is probably about 12-15 dB, so it seems I can work Europe off the back OK.

I usually work 40 meters from about 0600 to 0900 GMT, so I don't get on 20 until late. Thus I work mostly Pacific stations.

Last night I called Harry VK3XI and he came back on the first call. He said the band was going out and my beam must be pretty good, as he would not otherwise have been able to work me. He was 5 x 7 here.

I am running just about 800 Watts PEP, so I am very pleased with the results. I think I could have done well with just a 15 meter quad alone and a 1½-inch boom, but I used what I had. My 15 meter quad boom was only 1½ inches x 5 feet long, so I wanted a longer boom. There is no reason why you can't make your own beam from scratch with bamboo or even 1 x 2 wood and a plywood spider. The fact that there is a support for the arms, and the shortened length, bring up many possibilities for a light, cheap beam or even a dipole.

The director is not connected to the boom. The boom is 8 feet long and 2 inches in diameter—a very husky beam.

After seeing my 20 meter compact beam, Kenny Long WB8NGX wanted a 15 meter like it, and I had four arms left, so I decided to build one for him. I used lightweight spiders and a boom from a Kirk 15 meter quad, and of course, I didn't need such a long wire. I only used about 22 feet of wire for a 15 meter beam, so I decided to thread the wire just to the ends of the arms and bend them back an inch, both to hold them taut and to allow for corona prevention. I then had only about 1 foot, 5 inches left in the center.

I pulled this out along another short fiberglass arm, about 18 inches long. See Fig. 5. Then I fastened the wire to the binding posts on a short fiberglass strip. I bolted this to the arm and then added another strip for a spreader. This kept the wire from touching the metal of the spider arm. This was for the driven element.

For the director, I had only about 5 inches left on each side. I used a short piece of PVC tubing bolted to the arm to hold this piece. This wire was not broken, nor was it grounded to the boom. The boom is 6 feet long.

The beam is a very light, neat, and rugged affair. I guessed that it weighed about 7 pounds. I carried it over to Kenny Long's house on the top of a car, not even tied down. We held it down by hand, sticking our arms out the windows. ■

"Weeping Willow" Vertical for 40

—go out on a limb and build one

A vote for the bends.

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There are two things which I look for in a vertical antenna: simplicity (no traps or hats) and availability of parts. A quarter-wave vertical for forty meters fits both of these criteria, but it is often overlooked when antenna construction is contemplated.

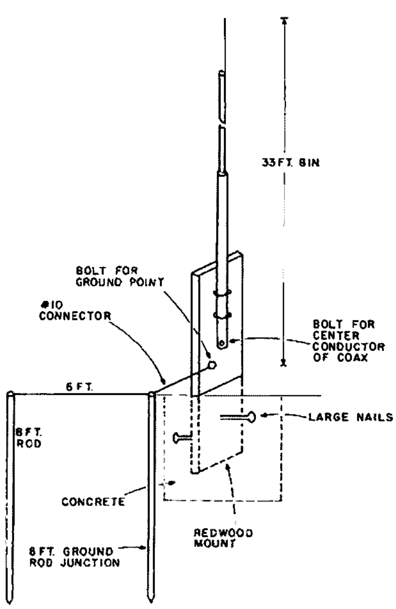

Fig. 1. Forty meter vertical.

There are also two schools of antenna construction: the oak (make it so rigid and strong that it just cannot be destroyed by wind, earthquakes, snow, ice, or whatever) and the willow (able to bend, flex, and take all of the above and spring back). Since the "oak" method never did work for me, this antenna is of the "willow" configuration. It is made of lengths of concentric tubing and ends in a whip.

To determine how much tubing we will need, we have to figure out how long a quarter wave is at forty meters. Using $\lambda/4$(feet)= 246/f (MHz) and then converting the fraction of a foot which remains to inches, we get $\lambda/4 = 33'10''$ for a center frequency of 7.265 MHz. Any center frequency can be chosen by placing that frequency in place of f in the formula.

Construction

Now let's get down to business. The aluminum tubing is available locally in most areas in concentric sizes from 2" to 3/8". I had a 3'×1-1/2"-o.d. piece of tubing on hand, so this was the logical place to start. Now, all we need is 30'10" more. Five 8' sections of tubing were used: 1-1/4", 1", 3/4", 1/2", and 3/8" o.d. After slotting the ends with a hacksaw and clamping the ends with hose clamps, I had 30' of tubing in 6' sections with approximately 2' of each inside the lower tube. An 18" whip was clamped to the top, and the already-on-hand 3'× 1-1/2" tube was attached to

the bottom. Now we have either a very long trout rod or a slightly-oversize quarter-wave antenna for forty meters.

Ground is an important part of a quarter-wave antenna, so ground mounting was chosen. A piece of redwood 3′×4″×1/2″ was found and painted to match my fence. Holes were drilled in appropriate place for U-bolts to hold the vertical to the redwood, and a test fitting showed that the antenna could be securely fastened to the redwood. A couple of large nails were driven into the bottom part of the redwood mount to give the concrete more to grab on to. A 24″-deep hole was dug in an inconspicuous corner of my yard and filled with a 60-pound bag of concrete. The prepared hunk of redwood was then placed in the wet concrete and propped up so that it would be straight when the concrete set. A bolt was put into the bottom of the antenna so that the center conductor of the coax feed could be connected. Another bolt was placed in the redwood mount to serve as a junction point for the ground system. (This bolt must be insulated from the radiating element.)

The Ground System

Some of us have a good ground (swamp or salt marsh) and others don't (rock or sand). My worst-case ground was 120 #18 wire radials, each a little more than a quarter-wave-length long, splayed out sunburst-style around the base of the antenna. The ground system which I wound up with was three radials, six feet long, terminating at 8′ ground rods. These three radials were joined at the antenna base on another 8′ ground rod. I used #10 wire to interconnect the ground rods and the *short* run to the bolt which was previously placed for ground connection on the redwood mount. To be sure, there was a difference in vswr obtainable, but the simpler ground system was satisfactory for my area.

Adjustment

Connect one foot or less of 52-Ohm coax to the antenna, connecting the center conductor to the vertical radiator and the ground braid to the ground connection on the redwood. Connect the vswr meter and the transmitter. Take a reading at the low end of the band, one at the middle, and one at the top. This should be enough to give you an idea of whether to shorten or lengthen the element. If you have built the antenna as described, you will probably have to shorten it a bit. This is best at the top sections. Do your fine tweaking with the whip. You have to take the antenna down each time you want to adjust it, so, by all means, take notes to help you make as few adjustments as possible. When this was done, an swr of 1.2 to 1 was obtained at 7.265 MHz and the swr did not go above 1.6 to 1 in the forty meter band. This was quite acceptable to me. The swr on the top end of fifteen meters was around 2 to 1—not bad for a bonus band.

This antenna has performed well at this QTH and was used when I was net control for the infamous swap net. Using only an FT-101 "barefoot," I was quite well heard in all of southern California, Arizona, and northern California as well. The antenna is also good for DX on forty and fifteen meters because of its low angle of radiation.■

✓ Reader Service—see page 211

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Marine-Band Activity

— a complete guide

Tune in to the world's top traffic.

Between 160 meters and 10 meters, we amateurs generally think in terms of the six HF amateur bands. There are, however, a great many other services operating in those large gaps between our bands. Most hams are aware of some of those other users, such as shortwave broadcasters (Voice of America and Radio Moscow are two examples), if for no other reason than the QRM they cause on the 40 meter phone band at night!

A partial list of the HF band population would include such services as land mobile (U.S. Corps of Engineers, on 5,015 kHz, for example), special industrial, on 4,637.5 kHz (mineral exploration), forestry (in the Pacific Northwest, primarily), and, of course, the military of all nations.

But there is one other major service, one of the oldest, known as the maritime service; that is the subject of this article.

Why is the maritime (or marine) service worth listening to? Because it usually provides the most interesting listening of the communications services (which excludes the broadcast service) and it is the busiest (and therefore easiest to tune in). Also, since it was the first regular user of radio, ship radio has an aura of romance and adventure.

SOS and Mayday — cries for help across the sea — are still heard today, although (thankfully) less frequently than in the past. The famous ship disasters of the last seven decades electrified the public and brought a fleeting fame to the "sparks," as ship operators were known.

Before the SOS was accepted, the most common call for help was CQD, which was made famous in 1909 by Jack Binns, radio officer of the British ship *Republic*. His heroism saved most of the passengers of his doomed ship, which had been rammed by the *S.S. Florida* one day out of New York. Working by candlelight in the January cold, he remained at his key for a continuous 36-hour shift. He delayed his escape from the sinking ship until he knew that help was at hand, risking his life to save the lives of many others.

From the first radio call for help from the British *Goodwin Sands* lightship in March, 1899, through the famous *Titanic* tragedy and the *Morro Castle*, whose smoldering hulk became a tourist attraction when it beached near Asbury Park, New Jersey, boardwalk in the mid 1930s, to the *Andrea Dorea* and the oil tanker sinkings of today's TV news, the tradition of the radio operator's staying at the key until the last possible minute (sometimes losing his life as a result) has remained constant.

I remember following the terrible events of the Texas tower which sank off New Jersey in the early 1960s, from the first Mayday signal to the last announcement that the tower had disappeared with all hands in the horrified sight of the rescue ship. There was a violent gale and there was no way of effecting a rescue. The frequencies used were 2,182 kHz and 500 kHz for phone and CW, both easily heard on an old Navy receiver. That was my introduction to marine radio.

Of course, these tragic

Frequency	Emission		Service
500.0 kHz	A1, A2	(CW)	marine/air
2,182.0	A3, A3A, A3H, A3J	(voice)	marine/air
4,134.3 (ship T) 4,428.7 (ship R)	A3J	(voice)	marine (U.S.C.G.)
6,200.0 (ship T) 6,506.4 (ship R)	A3J	(voice)	marine (U.S.C.G.)
8,241.5 (ship T) 8,765.4 (ship R)	A3J	(voice)	marine (U.S.C.G.)
156.8 MHz	F3	(voice)	VHF marine (ch. 16)
121.5 MHz	A3, A2	(voice/tone)	air/marine*
243.0 MHz	A3, A2	(voice/tone)	air/marine*

*Table 1. Emergency frequencies. *E.P.I.R.B. uses these frequencies — an automatic floating SOS beacon.*

Voice signal	Morse equivalent	Meaning
Mayday	$\overline{\text{SOS}}$ (3 times) (sent as one letter, not S O S)	*Distress*—when there is immediate danger to life or property. Has priority over all other signals. Preceded by "auto-alarm" when time permits.
Pan	$\overline{\text{XXX}}$ (3 times)	*Urgency*—when safety of life or vessel is threatened or if a less immediate danger exists (sickness, out of fuel in open water and no immediate danger, "man overboard," etc.).
Securité	$\overline{\text{TTT}}$ (3 times) (sent 3 letters not as an "O")	*Safety*—when a danger to navigation (hulk in channel, buoy missing, severe weather) exists.
(Voice) Auto-alarm (two alternating audio tones, 1 min. max.)	Auto-alarm (4 sec. on, one sec. off, dashes, one min.)	Sent before Mayday or $\overline{\text{SOS}}$ when time permits, to attract listeners.

Table 2. Priority signals for voice and Morse.

Channel	Frequency*	Channel	Frequency*
4A	4136.3 kHz	22A	22,094.5 kHz
4B	4139.5 kHz	22B	22,098.0 kHz
4C	4434.9 kHz	22C	22,101.5 kHz
6A	6210.4 kHz	22D	22,105.0 kHz
6B	6213.5 kHz	22E	22,108.5 kHz
6C	6518.6 kHz		
			2-MHz frequencies
8A	8281.2 kHz		2,182 kHz
8B	8284.4 kHz		2,638 kHz
12A	12,421.0 kHz		2,670 kHz
12B	12,424.5 kHz		(U.S.C.G.)
12C	12,428.0 kHz		2,738 kHz
16A	16,565.0 kHz		
16B	16,568.6 kHz		
16C	16,572.0 kHz		

*Table 3. HF ship-ship (plus limited coast) simplex channels. *Carrier frequencies are listed; listen on USB. The above 2-MHz frequencies are not, strictly speaking, in the same category, but are often used for similar purposes.*

events are luckily less common today, due to the availability of search planes and fast boats and the fine job done by the Coast Guard. Yet there are about two or three Mayday calls on 2,182 kHz in a week in the Gulf of Mexico alone. Most are promptly solved by the U.S. Coast Guard or nearby ships with no loss of life.

The bulk of traffic is more mundane by comparison, but still very interesting. Some typical SSB traffic, heard on almost any day, would include oil well drilling operational information, fishing fleet chatter, river tugboats, tankers and freighters talking to their home ports or arranging for supplies at their next port, and international radio telephone (phone patch) conversations. I often receive Germany and English marine operators at my Chicago home. If you wish to copy CW, telegrams, ship supply orders, news, weather, and ship arrival times can be heard if one knows where to listen.

Now that I have (hopefully) aroused your interest and curiosity, you are probably wondering where to listen, so here is a fairly complete guide to the marine bands. The information is as accurate and up to date as possible, being derived from a combination of sources, one of which is the rule book of the International Telecommunications Union — a source of many FCC regulations. To this is added my own experience in working with marine radio as HF-SSB consultant for a large Chicago-based company and as an SWL.

The maritime service is divided into several operational categories, four major frequency bands, and two

City	Primary coast transmit	Primary coast receive	Secondary coast transmit	Secondary coast receive
Boston	2506 kHz	2406 kHz	2450 kHz	2366 kHz
New York	2590 kHz	2198 kHz	2522 kHz	2126 kHz
Miami	2514 kHz	2118 kHz	2490 kHz	2031.5 kHz
New Orleans	2598 kHz	2206 kHz	2482 kHz	2382 kHz
Galveston	2530 kHz	2134 kHz	2450 kHz	2366 kHz
San Francisco	2506 kHz	2406 kHz	2450 kHz	2003 kHz
San Pedro (L.A.)	2566 kHz	2009 kHz	2466 kHz	2382 kHz
Seattle	2522 kHz	2126 kHz	2482 kHz	2430 kHz
Hawaii	2530 kHz	2134 kHz	—	—
Great Lakes	2514 kHz	2118 kHz	2550 kHz	2158 kHz
Mississippi (simplex)	2782 kHz	2782 kHz		

Table 4. 2-MHz marine operators.

Station	Code U.S. channels	Ship transmit frequency	Ship receive frequency
KMI—Oakland	401	4063.0	4357.4
	416	4109.5	4403.9
	417	4112.6	4407.0
	804	8204.3	8728.2
	809	8219.8	8743.7
	822	8260.1	8784.0
	1201	12330.0	13100.8
	1202	12333.1	13103.9
	1602	16463.1	17236.0
	2214	22040.3	22636.3
WLO—Mobile	WLO-4	4118.8	4413.2
	WLO-8	8284.9	8808.8
	WLO-13	12407.5	13178.3
	WLO-17	16584.0	17356.9
WOM—Ft. Lauderdale	403	4069.2	4363.6
	412	4097.1	4391.5
	417	4112.6	4407.0
	423	4131.2	4425.6
	802	8198.1	8722.0
	805	8207.4	8731.3
	810	8222.9	8746.8
	825	8269.4	8793.3
	831	8288.0	8811.9
	1206	12345.5	13116.3
	1208	12351.7	13122.5
	1209	12354.8	13125.6
	1215	12373.4	13144.2
	1223	12398.2	13169.0
	1601	16460.0	17232.9
	1609	16484.8	17257.7
	1610	16487.9	17260.8
	1611	16491.0	17263.9
	2215	22043.4	22639.4
	2216	22046.5	22642.5
	2222	22065.1	22661.1
WOO—New York	410	4090.9	4385.3
	416	4109.5	4403.9
	422	4128.1	4422.5
	811	8226.0	8749.9
	826	8272.5	8796.4
	1203	12336.2	13107.0
	1210	12357.9	13128.7
	1605	16472.4	17245.3
	1626	16537.5	17310.4

European channels	Channel #	U.S. Co-user
GCN—Portishead, England	410	(see WOO)
	826	(see WOO)
	1202	(see KMI)
	1611	(see WOM)
PCH—Shevenigen, Holland	802	(see WOM)
	1215	(see WOM)
	1626	(see WOO)
ROME RADIO—Rome, Italy	826	(WOO)
	1209	(WOM)
	1603	(KMI)
		(also Cyprus)
SVA—Athinai, Greece	802	(WOM)
	1232	(none)
	1609	(WOM)
	WLO-17	(WLO)
Atlantic channels		
VRT—Bermuda	410	(WOO)
Caribbean channels		
PLC—Curacao, Antilles	408	(WUQ)
	1607	(WLO-17)
8PO—Barbados	4098.0 (?)	4396.6 (?)
(in process of change)	8210.8	8744.8
Pacific channels		
KQM—Honolulu, Hawaii	418	(none)
	808	(WOO)
	1222	(none)
	1601	(WOM)
KUQ—Pago Pago, Samoa	806	(none)
	1232	(none)
UIS—Sydney, Australia	419	(WLO)
(or other Australian station)	802	(WOM)
	1203	(KMI)
	1610	(WOM)
VQJ—Honiara, Solomon Islands (in change)	8204.4 (?)	8738.4 (?)
ZLW—Wellington, New Zealand	408	(KUQ)
	813	(none)
	1209	(WOM)
P29—Papua, N.G.	805	(WOM)
9VG—Singapore	4078.8	4377.4
	824	(WLO-8)
	1641	(WLO-17)
Tokyo (JMC-?)	810	(WOM)
	1605	(WOO)

Table 5. Selected high seas marine radiotelephone stations (frequencies are shared).

fundamental station types — fixed (coast) and mobile (ship) stations.

Of primary interest to the amateur or SWL are the frequencies, of course, but a summary of the other information will prove useful, enabling the listener to find the type of station he would like to hear.

The basic operational division is that of radiotelegraph (CW) and radiotelephone (phone) operations. These two divisions are interspersed in alternating subbands throughout the 2-26 MHz portion of the spectrum, plus the VLF bands below 500 kHz (exclusively CW except for some weather broadcasts and foreign broadcasting) and the VHF-FM main band which is exclusively phone. RTTY and special data are used a great deal, but are difficult for most SWLs to decode.

An important fact to keep in mind, with regard to ship and shore stations, is that most of their frequency assignments are duplex (actually half-duplex, or two-frequency simplex, at the ship station), with the two stations transmitting and receiving on different frequencies. This is true of many marine channels, from VLF to VHF. An example, WOO 8-26 (WOO is "Ocean Gate Radio" in New York), is given below under "Reading the Tables." The reason for this duplex operation is that the shore stations usually

Station location	Station callsigns	Typical frequency***
Azores	CUG	6,393.5 kHz
Cuba	CLQ	6,435.0 kHz
Dominican Republic	HIA	8,642.0 kHz
England* (Portishead)	GKI**	12,858.0 kHz
Halifax	CFH	12,726, 8,697 kHz
Greece	SVA	12,689, 12,858 kHz
Italy	IAR	8,670.0 kHz
Japan	JOS	8,706.0 kHz
Philippines	DZR	8,568.0 kHz
U.S.A.—East	WSL, WSC**	6-, 8-, 12-MHz bands
U.S.A.—West	KFS**, WNU	6-, 8-, 12-MHz bands, 4,310 kHz
Honolulu—CG	NMO	9,050, 13,655 kHz

*Table 6. Selected CW shore stations. *Sister station of GCN (phone). **Also listen 420-500 kHz. ***Operate many frequencies. See Table 8 for band limits.*

Channel Designator	Ship Rx	Ship Tx
401	4357.4	4063.0
402	4360.5	4066.1
403	4363.6	4069.2
404	4366.7	4072.3
405	4369.8	4075.4
406	4372.9	4078.5
407	4376.0	4081.6
408	4379.1	4084.7
409	4382.2	4087.8
410	4385.3	4090.9
411	4388.4	4094.0
412	4391.5	4097.1
413	4394.6	4100.2
414	4397.7	4103.3
415	4400.8	4106.4
416	4403.9	4109.5
417	4407.0	4112.6
418	4410.1	4115.7
419	4413.2	4118.8
420	4416.3	4121.9
421	4419.4 (4C) Ship simplex	4125.0 (4A)
422	4422.5	4128.1
423	4425.6	4131.2
424	4428.7	4134.3
425	4431.8	4137.4
426	4434.9	4140.5
427	Ship simplex	4143.6 (4B)
601	6506.4	6200.0
602	6509.5	6203.1
603	6512.6	6206.2
604	6515.7	6209.3
605	6518.8	6212.4
606	6521.9 (6C)	6215.5
607	Ship simplex	6218.6 (6A)
608	Ship simplex	6221.6 (6B)
801	8718.9	8195.0
802	8722.0	8198.1
803	8725.1	8201.2
804	8728.2	8204.3
805	8731.3	8207.4
806	8734.4	8210.5
807	8737.5	8213.6
808	8740.6	8216.7
809	8743.7	8219.8
810	8746.8	8222.9
811	8749.9	8226.0
812	8753.0	8229.1
813	8756.1	8232.2
814	8759.2	8235.3
815	8762.3	8238.4
816	8765.4	8241.5
817	8768.5	8244.6
818	8771.6	8247.7
819	8774.7	8250.8
820	8777.8	8253.9
821	8780.9	8257.0
822	8784.0	8260.1
823	8787.1	8263.2
824	8790.2	8266.3
825	8793.3	8269.4
826	8796.4	8272.5
827	8799.5	8275.6
828	8802.6	8278.7
829	8805.7	8281.8
830	8808.8	8284.9
831	8811.9	8288.0
832	Ship simplex	8291.1 (8A)
833	Ship simplex	8294.2 (8B)
1201	13100.8	12330.0
1202	13103.9	12333.1
1203	13107.0	12336.2
1204	13110.1	12339.3
1205	13113.2	12342.4
1206	13116.3	12345.5
1207	13119.4	12348.6
1208	13122.5	12351.7
1209	13125.6	12354.8
1210	13128.7	12357.9
1211	13131.8	12361.0
1212	13134.9	12364.1
1213	13138.0	12367.2
1215	13144.2	12373.4
1216	13147.3	12376.5
1217	13150.4	12379.6
1218	13153.5	12382.7
1219	13156.6	12385.8
1220	13159.7	12388.9
1221	13162.8	12392.0
1222	13165.9	12395.1
1223	13169.0	12398.2
1224	13172.1	12401.3
1225	13175.2	12404.4
1226	13178.3	12407.5
1227	13181.4	12410.6
1228	13184.5	12413.7
1229	13187.6	12416.8
1230	13190.7	12419.9
1231	13193.8	12423.0
1232	13196.9	12426.1
1233	Ship simplex	12429.2 (12A)
1234	Ship simplex	12432.3 (12B)
1235	Ship simplex	12435.4 (12C)
1601	17232.9	16460.0
1602	17236.0	16463.1
1603	17239.1	16466.2
1604	17242.2	16469.3
1605	17245.3	16472.4
1606	17248.4	16475.5
1607	17251.5	16478.6
1608	17254.6	16481.7
1609	17257.7	16484.8
1610	17260.8	16487.9
1611	17263.9	16491.0
1612	17267.0	16494.1
1613	17270.1	16497.2
1614	17273.2	16500.3
1615	17276.3	16503.4
1616	17279.4	16506.5
1617	17282.5	16509.6
1618	17285.6	16512.7
1619	17288.7	16515.8
1620	17291.8	16518.9
1621	17294.9	16522.0
1622	17298.0	16525.1
1623	17301.1	16528.2
1624	17304.2	16531.3
1625	17307.3	16534.4
1626	17310.4	16537.5
1627	17313.5	16540.6
1628	17316.6	16543.7
1629	17319.7	16546.8
1630	17322.8	16549.9
1631	17325.9	16553.0
1632	17329.0	16556.1
1633	17332.1	16559.2
1634	17335.2	16562.3
1635	17338.3	16565.4
1636	17341.4	16568.5
1637	17344.5	16571.6
1638	17347.6	16574.7
1639	17350.7	16577.8
1640	17353.8	16580.9
1641	17356.9	16584.0
1642	Ship simplex	16587.1 (16A)
1643	Ship simplex	16590.2 (16B)
1644	Ship simplex	16593.3 (16C)
2201	22596.0	22000.0
2202	22599.1	22003.1
2203	22602.2	22006.2
2204	22605.3	22009.3
2205	22608.4	22012.4
2206	22611.5	22015.5
2207	22614.6	22018.6
2208	22617.7	22021.7
2209	22620.8	22024.8
2210	22623.9	22027.9
2211	22627.0	22031.0
2212	22630.1	22034.1
2213	22633.2	22037.2
2214	22636.3	22040.3
2215	22639.4	22043.4
2216	22642.5	22046.5
2217	22645.6	22049.6
2218	22648.7	22052.7
2219	22651.8	22055.8
2220	22654.9	22058.9
2221	22658.0	22062.0
2222	22661.1	22065.1
2223	22664.2	22068.2
2224	22667.3	22071.3
2225	22670.4	22074.4
2226	22673.5	22077.5
2227	22676.6	22080.6
2228	22679.7	22083.7
2229	22682.8	22086.8
2230	22685.9	22089.9
2231	22689.0	22093.0
2232	22692.1	22096.1
2233	22695.2	22099.2
2234	22698.3	22102.3
2235	22701.4	22105.4
2236	22704.5	22108.5
2237	22707.6	22111.6
2238	22710.7	22114.7
2239	22713.8	22117.8
2240	22716.9	22120.9
2241	Ship simplex	22124.0 (22A)
2242	Ship simplex	22127.1 (22B)
2243	Ship simplex	22130.2 (22C)
2244	Ship simplex	22133.3 (22D)
2245	Ship simplex	22136.4 (22E)

Table 7. ITU channels for marine HF use.

have separate receive and transmit sites to reduce interaction between on-the-air transmitters and receivers monitoring other channels, thus providing for a more efficient system. It also helps to compensate for the often inefficient ship, yacht, or boat antenna.

There are also a number of simplex channels, such as 2,182 kHz for calling and Mayday use, and 4,125 kHz for ship-to-ship or limited coast station usage.

These frequencies are spread throughout the range of 2-27 MHz, but the most useful for the average listener are between 4 and 17 MHz, providing high activity both day and night and allowing both sides of the conversation to be heard with one receiver, even far inland. Table 3 lists these simplex channels by number and frequency, while Table 4 lists the most interesting duplex channels by band, station, and frequency.

Morse operation is found on the frequencies listed in Tables 6 and 8.

Although not the main purpose of this article, in the interest of completeness I have included several tables listing all the marine bands from VLF to VHF. One last

Limits (kHz)	Assignable working frequencies for high-traffic ships b)	Limits	Calling frequencies d)	Limits (kHz)
4,172.25	4,172.5 -- 4,177.5 11 frequencies spaced 0.5	4,178	4,178.5--- 4,186.5 17 frequencies spaced 0.5	4,187
6,258.25	6,258.75-- 6,266.25 11 frequencies spaced 0.75	6,267	6,267.75- -6,279.75 17 frequencies spaced 0.75	6,280.5
8,341.75	8,342-- 8,345 -- 8,355 14 frequencies spaced 1	8,356	8,357--c)-- 8, 373 17 frequencies spaced 1	8,374
12,503.25	12,504--12,513--12,517.5 --12,532.5 20 frequencies spaced 1.5	12,534	12,535.5 ---12,559.5 17 frequencies spaced 1.5	12,561
16,660.5	16,662--16,672--16,684--16,690 --16,710 25 frequencies spaced 2	16,712	16, 714 ---16,746 17 frequencies spaced 2	16,748
22,184.5	22,187--------------------------22,221 18 frequencies spaced 2	22,222.5	22,225 ---22,265 17 frequencies spaced 2.5	22,267.5

Assignable working frequencies for low-traffic ships Group A	Group B	Limits
4,187.5 -- 4,208 84 frequencies spaced 0.5	4,208.5 -- 4,229	4,231
6,281.25-- 6,312 84 frequencies spaced 0.75	6,312.75-- 6,343.5	6,345.5
8,375 -- 8,416 84 frequencies spaced 1	8,417 -- 8,458	8,459.5
12,562.5 --12,624 84 frequencies spaced 1.5	12,625.5 --12,687	12,689
16,750 --16,832 84 frequencies spaced 2	16,834 --16,916	16,917.5
22,270 --22,320 41 frequencies spaced 2.5	22,322.5 --22,370	22,374

Limit	Calling frequencies	Limit
25,070	25,073.5 --------------- 25,081 6 frequencies spaced 1.5	25,082.5

Limit	Working frequencies	Limit
25,082.5	25,084 ---------------- 25,106.5 16 frequencies spaced 1.5	25,110

(RTTY and data)

Ship stations, wide-band telegraphy, facsimile, transmission systems:

4,142.5 - 4,162.5 kHz
6,216.5 - 6,244.5 kHz
8,288 - 8,328 kHz
12,431.5 - 12,479.5 kHz
16,576 - 16,636.5 kHz
22,112 - 22,160.5 kHz

Ship stations, oceanographic data transmission:

4,162.5 - 4,166 kHz
6,244.5 - 6,248 kHz
8,328 - 8,331.5 kHz
12,479.5 - 12,483 kHz
16,636.5 - 16,640 kHz
22,160.5 - 22,164 kHz

Ship stations, narrow-band direct-printing telegraph data transmission systems:

4,166 - 4,172.25 kHz
6,248 - 6,258.25 kHz
8,331.5 - 8,341.75 kHz
12,483 - 12,503.25 kHz
16,640 - 16,660.5 kHz
22,164 - 22,184.5 kHz

Coast stations, wide-band and manual telegraphy, facsimile, special and data transmission systems and direct-printing telegraph system:

4,231 - 4,361 kHz
6,345.5 - 6,514 kHz
8,459.5 - 8,728.5 kHz*
12,689 - 13,107.5 kHz
16,917.5 - 17,255 kHz
22,374 - 22,624.5 kHz
*plus 8078.1--U.S. Navy, Va.

Table 8. Frequencies assignable to ship radiotelegraph stations using the maritime mobile service bands between 4 and 27.5 MHz.

note on the calls you will hear is that the callsigns follow the same general assignments as amateur calls and a three-letter call is that of a shore station, while a four-letter or letter/number combination is usually that of a ship. Finally, in order to help you read the tables, the following section explains the channel designation numbering system and summarizes what information can be found in the various tables.

Reading The Tables

Many of the frequencies listed have channel designations after the frequency. These refer to the band and number of channels on a particular band. Therefore, a channel labeled "410" tells us that it is a 4-MHz channel, and refers to a particular frequency. Stating the channel as WOM 410, however, tells us that this is a 4-MHz channel of the Fort Lauderdale, Florida, high seas station and is registered as being 4090.9 kHz (ship transmit)/4385.3 kHz (ship receive). These are always half-duplex frequencies.

Channel designators		International Ship stations	Coast stations
c)	60	156.025	160.625
01		156.050	160.650
	61	156.075	160.675
02		156.100	160.700
	62	156.125	160.725
03		156.150	160.750
	63	156.175	160.775
04		156.200	160.800
	64	156.225	160.825
05		156.250	160.850
	65	156.275	160.875
06 e)		156.300	
	66	156.325	160.925
07		156.350	160.950
	67	156.375	156.375
08		156.400	
	68	156.425	156.425
09		156.450	156.450
	69	156.475	156.475
10		156.500	156.500
	70	156.525	
11		156.550	156.550
	71	156.575	156.575
12		156.600	156.600
	72	156.625	
13		156.650	156.650
	73	156.675	156.675
14		156.700	156.700
	74	156.725	156.725
15 d)		156.750	156.750
16		156.800	156.800
17 d)		156.850	156.850
	77	156.875	
18		156.900	161.500
	78	156.925	161.525
19		156.950	161.550
	79	156.975	161.575
20		157.000	161.600
	80	157.025	161.625
21		157.050	161.650
	81	157.075	161.675
22		157.100	161.700
	82	157.125	161.725
23		157.150	161.750
	83	157.175	161.775
24		157.200	161.800
	84	157.225	161.825
25		157.250	161.850
	85	157.275	161.875
26		157.300	161.900
	86	157.325	161.925
27		157.350	161.950
	87	157.375	161.975
28		157.400	162.000
c)	88	157.425	162.025

U.S. channels

Channel	Frequency (MHz) Ship	Coast	Function Intership	Ship-to-shore
	Distress, safety and calling (worldwide)			
16	156.800	156.800	YES	YES
	Intership safety (worldwide)			
6	156.300	156.300	YES	NO
	Liaison U.S. Coast Guard			
22	157.100	157.100	YES	YES
	Navigational (worldwide)			
13	156.650	156.650	YES	YES
	State control			
17	156.850	156.850	NO	YES
	Commercial			
7	156.350	156.350	YES	YES
8	156.400	NONE	YES	NO
9	156.450	156.450	YES	YES
10	156.500	156.500	YES	YES
11	156.550	156.550	YES	YES
18	156.900	156.900	YES	YES
19	156.950	156.950	YES	YES
67	156.375	NONE	YES	NO
77	156.875	NONE	YES	NO
79	156.975	156.975	YES	YES
80	157.025	157.025	YES	YES
88	157.425	NONE	YES	NO
	Noncommercial			
9	156.450	156.450	YES	YES
68	156.425	156.425	YES	YES
69	156.475	156.475	NO	YES
70	156.525	NONE	YES	NO
71	156.575	156.575	NO	YES
72	156.625	NONE	YES	NO
78	156.925	156.925		YES
	Public correspondence (note: 4.6 MHz T/R)			
24	157.200	161.800	NO	YES
25	157.250	161.850	NO	YES
26	157.300	161.900	NO	YES
27	157.350	161.950	NO	YES
28	157.400	162.000	NO	YES
84	157.225	161.825	NO	YES
85	157.275	161.875	NO	YES
86	157.325	161.925	NO	YES
87	157.375	161.975	NO	YES
	Port operations			
12	156.600	156.600	YES	YES
14	156.700	156.700	YES	YES
20	157.000	161.600	YES	YES
65	156.275	156.275	YES	YES
66	156.325	156.325	YES	YES
73	156.675	156.675	YES	YES
74	156.725	156.725	YES	YES

Weather

Channel	Frequency	Usage
WX1	162.550	NOAA primary weather channel
WX2	162.400	NOAA secondary weather channel
WX3	161.650	Canadian weather channel (ITU channel 21)

Table 9. VHF.

Band (kHz)	Comments
14-160	VLF, Morse, shared with radio navigation and direction finding
255-285	VLF, Morse, shared with radio navigation and direction finding
410 ±5	Reserved for direction finding
415-525	MF-low, Morse—most common ship frequency band in early days—still used for medium range today
500	"SOS" and calling
1605-2850	Morse and voice—primarily old "ship-to-shore" band in "AM" days; mostly being replaced for short range by VHF
3155-3400	Voice, Morse—less common in U.S.
3400-3800	In some parts of world, shared with amateur service
4060-4440	CW, Morse, RTTY—propagation like 75m
6200-6524	Mostly CW with a few ship-to-ship and duplex SSB channels. Propagation like 40m
8194-8815	Voice, CW, many high seas overseas stations at night—propagation like 40m
12330-13200	Voice, CW, many high seas overseas stations during day—propagation like 20m
16460-17360	Voice, CW, many high seas overseas stations during day—propagation like 20m
22000-22720	Voice, CW, RTTY—propagation like 15m
25060-25110	Mostly CW—very long daytime range
156.0-162.6 MHz	VHF-FM, voice, weather. 156.8 MHz for emergency calling—40-mile range

Table 10. Summary of marine bands.

NMO—Honolulu	All use AMVERS
NMC—Pt. Reyes CA	frequencies plus
NMN—Portsmouth VA	following: 4955,
NAM—Portsmouth VA	8150, 8682, 13380,
NGR—Athens, Greece	16445, 12730 for CW
NPN—Guam	
NDT, NPO—Slave stations (for weather)	

Table 11. High seas Navy and Coast Guard stations.

For another example, WOO 811 is one of the 8-MHz channels for New York's (actually located in New Jersey, near Atlantic City) Ocean Gate Radio (8226.0T/8749.9R). Table 4 provides a listing of many of the major world high seas stations and their frequencies. There are two other types of channel numbers: for HF ship-to-ship (a number and letter combination), and for VHF-FM (a simple channel number). These are to be found in Tables 3 and 9, respectively.

In order to find the emergency frequencies quickly, they are listed separately in Table 1, followed by the types of emergency or priority signals heard on them in Table 2.

For those who have transceivers or receivers with spare bands, the various bands, channel breakdown schemes, and voice as well as Morse operation are to be found in the remaining tables.

That's it. Pick out where and what you want to hear, tune it in, and enjoy the excitement and fascination of the marine bands. ■

Reader Service—see page 211

W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

from page 6

the blame, so I can understand the need to try to revise the one lone vote against the project into an even split. It was an ambitious project which might have managed to die on its own accord without the jugular being cut by Tenney . . . but that we'll not know for sure, and so, should amateur radio lose frequencies at WARC this fall, we certainly know where to point the finger. My own evaluation is that the project to interest African countries in the benefits of amateur radio to their people would have worked, just as it did in Jordan, and could have made a decisive difference at Geneva . . . perhaps getting some backing for the US proposal for even more amateur bands.

Future historians interested in getting facts on these ARMA meetings should contact me for copies of the tapes. It's all there for anyone with the constitution to listen through.

FM STARTED IT

The Japanese had no serious foothold in the US with ham gear until the advent of FM and repeaters. I would like to point out that when I started pushing FM in *73 Magazine* back in 1969, I made sure that every US manufacturer of ham equipment knew what I was doing and the impact that I expected it to have. They ignored my predictions, feeling that FM never would be a significant factor in the ham market.

This reminded me of my similar failure to interest the major firms in getting into sideband back in 1955 when I saw that one coming. I talked with Hallicrafters, Hammarlund, National, etc., about it and none of them had any interest at the time. It took Central Electronics to get things moving and the big firms came along when there was no other choice.

By leaving the FM field open to imports, the US industry made it possible for them to set up importing and marketing in this country on a large scale . . . laying the foundation for the 70% penetration we see today. If US manufacturers will be adventurous and try to lead the market instead of follow it, they can sell everything they can make.

CANADIAN HIJINKS

Having received some sanctimonious letters from Canada in response to my criticisms of the ARRL pulling what appears to be a con job on the Canadians, I had someone look into the state of affairs of the supposed incorporation of a Canadian League . . . and nothing could be found filed with the Canadian government. This would lead a naive person like me to suspect that all those promises of untying the apron strings are the usual baloney.

In looking over the list of officers for Canada, I see W2HD listed as their vice president. I dunno why Canadians put so much stock in carpetbaggers and prefer to be run from the US instead of from Canada. Perhaps they are still too weak to stand on their own? Yet, which way is the money flowing? Is it going to Canada or from it . . . and I'm kidding there, because I know as well as you which way the money goes . . . into the bottomless pit down in Connecticut.

MEMBERSHIP DISASTER

The League officials were wearing very worried looks at Dayton. It was difficult to even get them to come forth with a wan smile. It seems that the $18 fee has brought renewals almost to a halt. Now hams are taking a gimlet-eyed look at what they are buying. They see a magazine with few interesting articles . . . they see a lot of back-patting news which is stale before they even get the magazine . . . and ads.

The directors have been trying to get the magazine beefed up, but as the editor complained at Dayton, hardly anyone will write for *QST* anymore. They just don't have the articles—except those from the few staffers who have not yet left the magazine.

SUNSPOT MADNESS

It has not been with a little smugness that we've been watching the sunspot cycle to see how well it would correspond with the model predicted by our resident expert, John Nelson . . . particularly as compared with the predictions for this cycle by the many other experts in the field.

Probably one of the real sleepers in the radio publishing field has been John's book, *The Propagation Wizard's Handbook* ($6.95 from Radio Bookshop, Peterborough NH 03458). John was virtually the only "expert" in the field to have accurately predicted this cycle as it has evolved—and his prediction was way out in left field. He predicted a very low sunspot number for this cycle, with the appearance of a very few large spots instead of the myriad of small spots which have made up the past cycles . . . and he has been absolutely right!

The Nelson book is now being ordered in larger numbers by the scientists at NASA and at Boulder, where the National Bureau of Standards runs a propagation laboratory. Nelson's predictions have been right on the nose, while the government predictions have been noticeably short on accuracy.

There is nothing really new about the Nelson system. He's been using it for about 30 years and has described it in many articles down through the years. When I first ran into his concept of the planets having an influence on sunspots, some 25 years ago, it made a lot of sense to me. I met John when he was giving a talk on his system at a Long Island ham club. I was impressed by his cautious approach and penchant for rigorous attention to details. I noted that only his predictions seemed to stand up, while those of the Bureau of Standards and George Jacobs (VOA) would be frequently in serious error. When John said conditions were going to stink, that was the time to take a vacation. When he said they would be hot, you made sure your antenna was working right.

Oh, what value are these long-range predictions? John wrote an article for *73* quite some time ago telling us what we could expect from the eleven meter CB frequencies during this cycle . . . and his predictions have been most accurate. Since this cycle is unlike any other in history and was predicted by John this way, the effects on both the CB frequencies and the ham bands have been remarkably different from past cycles. Knowing about this ahead of time is valuable in making rules and planning activities. Is it worthwhile to put a lot of development time and money into ten meter repeaters? That depends on propagation.

TURKEY CLUB

One club and one club only refused to cooperate with the ham clubs in the greater St. Louis area on their recent ARCH MARCH hamfest. Their excuse was that as an ARRL club they refused to support any amateur activity where Wayne Green was going to talk.

When I heard about this, I wrote to the club and offered to come to St. Louis a day early and go to a special club meeting where the members could have an opportunity to face me with their beefs and have an opportunity to find out the truth of things they believed on trust from the ARRL. The club flatly refused to face me. Failing in that, I tried to get a meeting with the head of the club and this was agreed upon.

Came the time for the meeting, the only time this chap could make it, at 10:00 pm the night before the hamfest, and the chap didn't show up. I sat and waited for almost an hour, but no message and no club president. I was worn out after a full day of television appearances, meeting the mayor of St. Louis, and other meetings. When the chap didn't show, I went to bed to get rested up for the busy hamfest on the day to come. I had to be up very early to set up our booth, get set for my two major talks that day, etc.

Suddenly, the phone rang . . . our friend had finally gotten to the hotel. He got angry when I said I wouldn't get dressed again and come down to argue with him for an hour or so. I had gone to a lot of trouble to make the time available for him—which was wasted—and I was not about to stay up a good part of the night and thus make my talks the next day less entertaining just because he was unable to keep an appointment.

Phooey.

MARCH WINNER

"The NCX-Match" was a close winner over K6IQL's "The 10-GHz Cookbook" in our March Reader Service card balloting, so Rick Ferranti WA6NCX/1 (Newton Centre MA) will be receiving our $100 bonus check for being the author of that issue's most popular article.

Ham Help

I would appreciate it if anyone could help me connect a Heathkit HG-10B vfo to my Swan 500CX to be used as an outboard vfo.

Ancel W. Norris WB4AUB
4357 Mountaindale Road
Birmingham AL 35213

RTTY Loop

from page 14

Certain characters, not represented in Baudot, have an $FF stored at their location. This directs the program to use the special table (SPLTBL), located from $80 to $A6. The table is organized as a three-byte, fixed-format table. The first byte is the ASCII character, and the next two are the Baudot codes for the two-letter symbol for each ASCII code.

The main program starts at $0100 by setting up the stack and initializing the PIA, addressed to port 7, as an output. A character is input through the monitor's input routine and used as the index for the table. If the retrieved character is $FF, the ASCII code needs a special character representation, and a branch to SPLCHR is executed. A retrieved null, $00, initiates a branch back to input, with no output produced. One more test and we're ready to fly. If the retrieved character is a space ($90 in Baudot), a check is made on the running total characters in the line. If it is greater than sixty, forget the space and send a carriage-return, line-feed sequence. If it is not a space, hooray—we put it out.

First things first, the MSB is shifted into the carry bit, where it can be used to set or reset the software flip-flop used to monitor case. This was well diagrammed last month and will not be detailed here. Each of the five data bits is then shifted out and sent sequentially, after a character START bit is sent, and a STOP bit, 33 milliseconds of pure MARK, is plastered on at the end.

Now things are going to get a bit tacky. Each data bit must be sent for exactly 22 ms. The timing is set in a software delay loop, called MSEC10, set for approximately an eleven ms delay.

Program 1 (continued).

```
009B 5C               FCB    $5C,$CC,$D0   \=BS
009E 5D               FCB    $5D,$24,$24   ]=))
00A1 5E               FCB    $5E,$F0,$B4   ↑=UP
00A4 5F               FCB    $5F,$F0,$A4   ←=UL
00A7 0000     TEMP01  FDB    0000
00A9 00       SHIFT   FCB    0
00AA 00       CHRCNT  FCB    0
00AB 0D       CRLFST  FCB    $D,$A,$15,0,0,4
              * MAIN PROGRAM STARTS HERE
              *
0100                  ORG    $0100
0100 8E AC70  START   LDS    #$AC70
0103 4F               CLR A
0104 B7 801D          STA A  PIACA
0107 4A               DEC A
0108 B7 801C          STA A  PIADA
010B 86 04            LDA A  #$4
010D B7 801D          STA A  PIACA
0110 86 01            LDA A  #$01
0112 B7 801C          STA A  PIADA
0115 BD E1AC  INCHR   JSR    INEEE
0118 B7 011F          STA A  INDEX+1
011B CE 0020          LDX    #TABLE
011E A6 00    INDEX   LDA A  X
0120 81 FF            CMP A  #$FF
0122 27 3C            BEQ    SPLCHR
0124 4D               TST A
0125 27 EE            BEQ    INCHR
0127 81 90            CMP A  #$90
0129 26 08            BNE    AROUND
012B C6 3C            LDA B  #60
012D D1 AA            CMP B  CHRCNT
012F 2D 02            BLT    AROUND
0131 20 5A            BRA    CRLFOT
0133 8D 05    AROUND  BSR    OUTPUT
0135 7C 00AA          INC    CHRCNT
0138 20 DB            BRA    INCHR
013A 48       OUTPUT  ASL A
013B 25 11            BCS    CKLTRS
013D 7D 00A9  CKFIGS  TST    SHIFT
0140 27 1B            BEQ    OUTCHR
0142 36               PSH A
0143 86 D8            LDA A  #$D8
0145 BD 01AD          JSR    OUTBDT
0148 32               PUL A
0149 7F 00A9          CLR    SHIFT
014C 20 0F            BRA    OUTCHR
014E 7D 00A9  CKLTRS  TST    SHIFT
0151 26 0A            BNE    OUTCHR
0153 36               PSH A
0154 86 FF            LDA A  #$FF
0156 BD 01AD          JSR    OUTBDT
0159 32               PUL A
015A 7C 00A9          INC    SHIFT
015D 8D 4E    OUTCHR  BSR    OUTBDT
015F 39               RTS
0160 B6 011F  SPLCHR  LDA A  INDEX+1
0163 81 0D            CMP A  #$0D
0165 27 26            BEQ    CRLFOT
0167 CE 0080          LDX    #SPTABL
016A A1 00    SPLOOP  CMP A  X
016C 27 05            BEQ    FOUND
016E 08               INX
016F 08               INX
0170 08               INX
0171 20 F7            BRA    SPLOOP
0173 08       FOUND   INX
0174 86 1C            LDA A  #$1C
0176 8D C2            BSR    OUTPUT
0178 A6 00            LDA A  X
017A 8D BE            BSR    OUTPUT
017C 08               INX
017D A6 00            LDA A  X
017F 8D B9            BSR    OUTPUT
0181 86 1C            LDA A  #$1C
0183 8D B5            BSR    OUTPUT
0185 C6 04            LDA B  #$4
0187 DB AA            ADD B  CHRCNT
0189 D7 AA            STA B  CHRCNT
018B 20 88            BRA    INCHR
018D CE 00AB  CRLFOT  LDX    #CRLFST
0190 BD E07E          JSR    PDATA
0193 86 88            LDA A  #$88
0195 8D A3            BSR    OUTPUT
0197 86 88            LDA A  #$88
0199 8D 9F            BSR    OUTPUT
019B 86 A0            LDA A  #$A0
019D 8D 9B            BSR    OUTPUT
019F 86 FF            LDA A  #$FF
01A1 8D 97            BSR    OUTPUT
01A3 86 FF            LDA A  #$FF
01A5 8D 93            BSR    OUTPUT
01A7 7F 00AA          CLR    CHRCNT
01AA 7E 0115          JMP    INCHR
              *
01AD C6 05    OUTBDT  LDA B  #$05
01AF 8D 16            BSR    SNDSPC
01B1 48       SFTLFT  ASL A
01B2 25 04            BCS    MRKOUT
01B4 8D 11            BSR    SNDSPC
01B6 20 02            BRA    NXTELE
01B8 8D 08    MRKOUT  BSR    SNDMRK
01BA 5A       NXTELE  DEC B
01BB 26 F4            BNE    SFTLFT
01BD 8D 03    SNDSTP  BSR    SNDMRK
01BF 8D 01            BSR    SNDMRK
01C1 39               RTS
              *
01C2 36       SNDMRK  PSH A
01C3 86 01            LDA A  #$01
01C5 20 03            BRA    OUTDAT
01C7 36       SNDSPC  PSH A
01C8 86 00            LDA A  #$00
01CA DF A7    OUTDAT  STX    TEMP01
01CC B7 801C          STA A  PIADA
01CF 8D 04            BSR    MSEC20
01D1 32               PUL A
01D2 DE A7            LDX    TEMP01
01D4 39               RTS
              *
01D5 8D 01    MSEC20  BSR    MSEC10
01D7 01               NOP
01D8 CE 0480  MSEC10  LDX    #$480
01DB 09       MSLOOP  DEX
01DC 26 FD            BNE    MSLOOP
01DE 39               RTS
              *
A048                  ORG    PGCTR
A048 0100             FDB    START
              *
                      END
```

Since this delay is produced by loading a number Into the index register and decrementing it, the speed of the computer's clock can make a significant difference in the delay.

For the "original" SWTPC 6800, with the MP-A CPU board, the clock speed is roughly 902.255 kHz, and a delay constant of $0480 is used. If you have the MP-A2 CPU board, your clock speed may be anything from about 900 kHz to 1.5 MHz. To find the constant that is right for your system, enter Program 2 into your computer and type "G". Time, exactly, the interval, in seconds, between the "B" and "E". Use the formula shown in Fig. 1 to calculate your delay constant. Remember, this is hexadecimal arithmetic. Work through the example to be sure you've got it right.

One more thing to do before we can use the program on the

Program 2.

```
                      NAM    CLKSPEED
                      OPT    0

              *
              * PROGRAM TO DETERMINE
              * DELAY CONSTANT BY
              * ESTIMATING CLOCK
              * SPEED OF THE SWTPC
              * 6800 COMPUTER
              *
              * MARC I. LEAVEY, M.D.
              *
              *************************
              * EXTERNAL REFERENCES
              *
     E1D1     OUTEE   EQU    $E1D1
     E0E3     SWTBUG  EQU    $E0E3
     A048     PGCTR   EQU    $A048
0100                  ORG    $0100
0100 86 42    START   LDA A  #'B      PUT OUT A "B"
0102 BD E1D1          JSR    OUTEE    IN THE BEGINNING
0105 8D 10            BSR    ONEMIN   :    N O W
0107 8D 0E            BSR    ONEMIN   :   W A I T
0109 8D 0C            BSR    ONEMIN   :    F O R
010B 8D 0A            BSR    ONEMIN   :   F I V E
010D 8D 08            BSR    ONEMIN   :M I N U T E S
010F 86 45            LDA A  #'E      PUT OUT AN "E"
0111 BD E1D1          JSR    OUTEE    AT THE END
0114 7E E0E3          JMP    SWTBUG   AND GO TO MONITOR
              *
0117 86 07    ONEMIN  LDA A  #$07     RING THE BELL
0119 BD E1D1          JSR    OUTEE    EACH MINUTE
011C C6 3B            LDA B  #$3B     :
011E CE F800  LOOP1   LDX    #$F800   : THIS LOOP
0121 09       LOOP2   DEX             : IS TIMED
0122 09               DEX             : TO RUN
0123 08               INX             : ONE MINUTE
0124 26 FB            BNE    LOOP2    : WITH A
0126 5A               DEC B           : CLOCK OF
0127 26 F5            BNE    LOOP1    : ONE MHZ
0129 39               RTS             :
              *
A048                  ORG    PGCTR    SET UP PROGRAM COUNTER
A048 0100             FDB    START    WITH STARTING ADDRESS
              *
                      END
```

air: Interface it. The data is coming out of bit 0 (the LSB) of the A side of a PIA interface on port 7. This TTL level signal represents MARK with a high and SPACE with a low. If you have an ST-6 or equivalent, interfacing may be accomplished easily, adding only one diode, as described several months ago for the test generator. Other interfacing schemes could include an opto-isolator or reed relay. Remember, though, *don't* allow the loop voltages access to the computer or you will have a smoking pile of expensive "junque."

If all goes well, when you load the program, adjust the delay constant, and accomplish interfacing, any character struck on the keyboard should come out in Baudot on the other end.

General Formula:
"Constant Delay" × "Constant Time" = "New Delay" × "New Time"

Constants for MP-A System:
Constant Delay = $480 (1152 Decimal)
Constant Time = 332 Seconds

Practical Formula:
$\frac{1152 \times 332}{\text{New Time}}$ = New Delay

An Example:
MP-A2 System Time = 234 Seconds
$\frac{1152 \times 332}{234}$ = 1634 = $666 New Delay

Fig. 1.

Now, one last hooker: If you are using an MP-C "control interface" (the one that was supplied with the computer if it had an MP-A CPU board) and you type in a character while one is sending, you will get garbage. This is an unfortunate result of the software UART written into the MIKBUG™ or SWTBUG™ monitor to handle serial data through a PIA interface on port 1. Yes, I know we are doing essentially the same thing on port 7, but that is the problem. While the system will support one delay loop, it will not support two running at the same time. The solution is to take one of the I/O structures out of a *software* UART and into a *hardware* UART, or ACIA. The easiest way to do that is to use a serial MP-S interface for control on port 1. Now, characters input during an output are simply ignored. Not an ideal solution, but adequate for this simple program.

Next month, we'll . . . no, I'm not going to tell you! There are few surprises in life; let one of them be next month's RTTY Loop.

Contests

from page 19

Phone—3920, 7260, 14300, 21360, 28600, 50.3, 145.1.

Use of FM simplex is encouraged but no repeater contacts are allowed.

AWARDS:

A plaque to the top RI and non-RI scorer, plus certificates will be awarded to the top scoring station in each RI county, state, province, DX country, the top scoring Novice and Technician station in each RI county and state, and the ARC in each state, province, and DX country that submits the highest aggregate score with a minimum of 3 logs per club.

ENTRIES:

Logs must show date/time in GMT, call, exchange, band, and mode. On a separate sheet show name, call, mailing address, club affiliation if any, total QSO points, multiplier claimed, and final score. Entries must be postmarked no later than August 31. Send logs and summary to: East Bay Amateur Wireless Association, PO Box 392, Warren RI 02885. Include an SASE for results.

NEW JERSEY QSO PARTY
Contest Periods:
2000 GMT Saturday, July 28 to 0700 GMT Sunday, July 29
1300 GMT Sunday, July 29 to 0200 GMT Monday, July 30

Sponsored by the Englewood Amateur Radio Association, the contest is open to all amateurs worldwide for the 20th year. Phone and CW are considered the same contest. A station may be contacted once on each band. Phone and CW are considered separate bands, but CW contacts may not be made in the phone segments. NJ stations may work other NJ stations. General call is "CQ NJ." NJ stations are requested to identify themselves by signing "DE NJ."

EXCHANGE:

QSO number, RS(T), and QTH (ARRL section or country/NJ county).

FREQUENCIES:

1810, 3535, 3900, 7035, 7135, 7235, 14035, 14280, 21100, 21355, 28100, 28600, 50-50.5, and 144-146.

Suggest phone activity on the even hours, 15 meters on the odd hours 1500 to 2100 GMT, 160 meters at 0500 GMT.

SCORING:

Out-of-state stations multiply number of complete contacts with NJ stations times the number of NJ counties worked (21 maximum). NJ stations score 1 point per W-K-VE-VO QSOs, 3 points per DX QSO. Multiply total number of points times the number of ARRL sections (including NNJ and SNJ—75 max.). KP4, KH6, KL7, KZ5, etc., count as 3-point DX contacts and as section multipliers.

AWARDS:

Certificates will be awarded to the first-place station in each NJ county, ARRL section, and country. In addition, a second-place certificate will be awarded when four or more logs are received. Novice and Technician certificates will also be awarded.

ENTRIES:

Logs must show GMT date/time, band, and emission, and be received not later than August 25. The contact for each claimed multiplier must be indicated and numbered and a checklist of contacts and multipliers should be included. Multi-operator stations should be noted and calls of participating operators listed. Logs and comments should be sent to: Englewood Amateur Radio Assoc., PO Box 528, Englewood NJ 07631.

A size #10 SASE should be included for results. Stations planning active participation in NJ are requested to advise the EARA by July 7 of your intentions so that they can plan for full coverage from all counties. Portable and mobile operation is encouraged.

ENDEAVOUR AWARD

The Royal Naval Amateur Radio Society already sponsors two awards, the Mercury Award for contacting members of the Society, and the Hampshire County Award for contacting amateurs in the English county of Hampshire. The Society now has great pleasure in announcing a third award, called the Endeavour Award, for contacting Society members residing in Australia. The title of the award links the Royal Navy with Australia and the award is open to all radio amateurs.

Applicants must establish two-way amateur communications with RNARS members residing in Australia. Points will be awarded on the basis of one point per VK RNARS member worked per band, after the commencement date of January 1, 1979. To qualify, the following is required: for amateurs residing inside Australia—15 points; for amateurs residing inside Oceania—10 points; for amateurs residing outside Oceania—5 points.

In addition, for amateurs residing outside Oceania, contacts with VK RNARS members on the 3.5 MHz band will count double points. For the purposes of this award, any RNARS maritime-mobile member when located inside Australian waters may be counted as a VK member.

The award will be endorsed only on the request of the applicant and the following endorsements are available: all CW, all SSB, all 3.5 MHz, all 28 MHz, all Novice, and five-by-five, the last endorsement being for gaining at least five points on each of the five high frequency bands.

To claim the award, no QSLs are required. However, full log details showing the VK member (or /MM + QTH) worked, their RNARS number, date, time, frequency, mode, plus an application fee of $1.50 Aust or 7 IRCs are to be sent to the Endeavour Award Custodian: R. Baty VK5MD, 43, HMAS Australia Road, Henley Beach South, SA 5022 Australia. Please ensure all checks are in Australian currency and made payable to "R. Baty." Clearly state what endorsements are claimed. Certificates to successful applicants will be forwarded by airmail as soon as possible after the claim has been checked.

TESLA COMMEMORATIVE AWARD

A very attractive award is being offered by YU2EAB, the Gospic Amateur Radio Club, to commemorate the birth of Nikola Tesla. To obtain this award you must work the special station YU0NT for 5 points plus any other Gospic station for one point. Six points are needed for the award. No band or mode restrictions exist. YU0NT will operate from July 7 through July 17 from the house where Nikola Tesla was born. Some of the other stations to look for in Gospic include YU2CET, YU2CGE, YU2CGG, YU2CPJ, YU2CTK, YU2CUD, YU2EAB, YU2RWI, YU2RWY, and YU2VE.

No QSLs are necessary to obtain the award; send only the usual log data along with 5 IRCs or $2.00 to: YU2EAB, Box 55, 48000 Gospic, Yugoslavia.

Looking West

from page 12

more fitting than this contact. Fate had been very kind indeed.

The station operates under the callsign W6RO—W6 "Rolling Ocean"—as a tribute to one of the founding members of the club sponsoring the overall *Queen Mary* wireless operation. Amateurs wishing to operate from the *Queen Mary* can do so in one of two ways. Those living in the area and wishing to serve as scheduled volunteer operators can contact the Associated Radio Amateurs of Long Beach and make their intentions and availability known. However, if you are planning a trip to Los Angeles and would like to operate the station, you can take the *Queen Mary* tour and, when it gets to the wireless room, locate the operator in charge and explain your desires. You will have to present your original amateur license and some additional identification before you will be permitted to operate. Guest operating periods will be approximately 15 minutes in duration.

Currently, two motion pictures are in production which in part are being done aboard the *Queen*. One is the epic film "Titanic," scheduled for release late next year. The other hits much closer to home. In early September or thereabouts, the ARRL will be releasing its new film, "The World of Amateur Radio," produced by Emmy-award-winning filmmaker Dave Bell W6AQ. Thanks to Nate and his organization, Dave was able to film the narration sequences (which feature NBC News correspondent Roy Neal W6DUE) aboard the *Queen Mary*.

Dave has made one request of the amateur community now that the news of the new film has been made public. It will be several months before the film is ready for distribution. Please do not call either Dave or the ARRL requesting the film until its availability has been announced. The initial prints are destined for showing at the World Administrative Radio Conference in Geneva in order to underline the attributes of the worldwide amateur service. Eventually, there will be enough prints for all of us to see, so it is suggested that you monitor *QST, HR Report,* The Westlink Amateur Radio News, and this column to find out the availability date. Your cooperation in this regard is deeply appreciated.

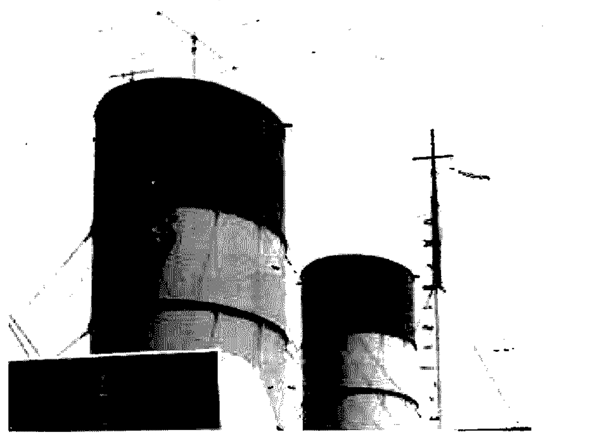
THE "THEY-WON'T-LET-220-DIE" DEPARTMENT

The 220-SMA of southern California has gone on record as being willing to take any action necessary to ensure that the 220-to-225-MHz amateur band never falls into the hands of maritime interests. To show that they really mean business, what is called a "WARC Action Committee" was formed at their April 22 meeting, with Ray Von Neumann K6PUW as its chairman.

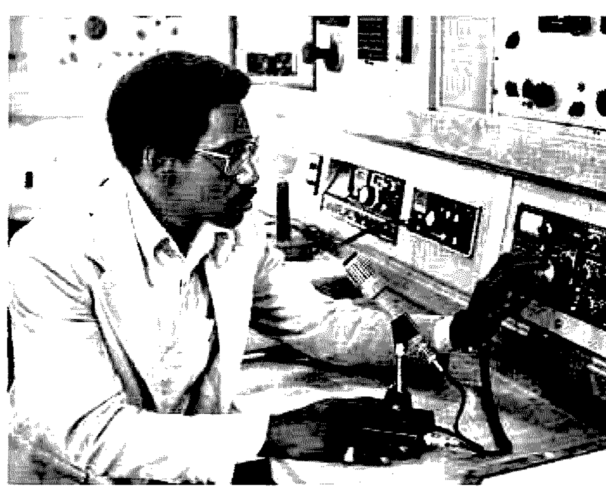
At present, a number of directions are being considered, although two tend to offer the most promise of at least marginal success. The 220-SMA may well have hired a Washington-based attorney by the time this reaches print. His job will be to go into federal court and either file a direct appeal on the matter or request an injunction barring the use by our WARC delegation of the portion of the US WARC proposal dealing with the 216-to-225-MHz spectrum. It is the 220-SMA's contention that both the FCC and the maritime services may have violated the Federal Administrative Procedures Act in regard to the preparation of that portion of the document. One lawyer explained to me that if the 220-SMA were successful In obtaining such an order, then our delegation would be barred from discussing or voting on issues brought before WARC dealing with that spectrum. This could place the US in a rather awkward position at the conference later this year, but the same legal expert did say that he did not feel the 220-SMA could obtain such an order. I thus suspect that any legal action will come in the form of an appeal. Only time will tell where the 220-SMA will go if they choose this route at all.

Another direct offensive action they are considering—one I expect to see initiated quickly—is filing a formal Petition for Rulemaking with the FCC requesting the immediate transfer of currently unused maritime VHF spectrum to the amateur service. The feeling is that the

Joe Rudi WA6PVA, baseball player with the California Angels, makes the first official QSO from W6RO. Looking on is Nate Brightman K6OSC, of the Associated Radio Amateurs of Long Beach, the club which installed the gear. (Photo by W6VGQ)



A new triband addition to the Queen Mary. *(Photo by KH6IAF)*



TV actor/comedian Stu Gilliam WD6FBU operates W6RO, the new amateur station aboard the Queen Mary. *(Photo by W6VGQ)*

need for this can be easily documented by showing the overall inactivity in current VHF maritime operations and the current growth patterns in VHF amateur activity. Basically, the 220-SMA feels that it is time to stop being on the defensive and become outward and aggressive in fighting to save our spectrum. They hope to rally support not only from 220-MHz spectrum users, but also from the overall amateur community.

Already, some words of support have been voiced, such as the following statement issued by the Jet Propulsion Laboratory's Amateur Radio Club: "The Jet Propulsion Laboratory's Amateur Radio Club supports the 220-SMA of southern California in its efforts to keep the 220-to-225-MHz band an amateur one. To this end we have pledged our support." The JPL ARC did more than just add a bit of encouragement. They also provided the facilities and hosted the meeting.

THE "NAVY-TO-THE-RESCUE—MAYBE" DEPARTMENT

The 220-SMA sent copies of its since-denied Petition for Reconsideration to several government agencies in addition to the FCC. Among those who received copies were the nation's military branches. Just prior to the April 22 meeting at JPL, the 220-SMA dropped what might best be described as a bombshell. It had been contacted by the Chief of Naval Operations and had been told that neither the Chief's office nor the Naval Telecommunications Frequency Management Group had ever been informed of any proposed reallocation of the 216-to-225-MHz spectrum. As it turns out, the Navy has a rather vested interest in this spectrum. It operates what is known as the Space Surveillance Systems Group, a nationwide communications network that keeps track of all space debris resulting from US space operations. In fact, the Space Surveillance Systems Group utilizes frequencies from 216 through 233 MHz, according to an SMA-220 spokesman, and is what is termed a "long-term, high-monetary-investment naval operation."

Needless to say, the Navy is more than just a bit upset over finding out that it may be evicted along with the amateur service from spectrum in which it has a definite interest. Apparently, it is upset enough to have ordered the Telecommunications Frequency Management Group to start a detailed investigation of the matter and report their findings back to the Chief's office. What seems to have irritated them the most were the official statements contained in the WARC position paper itself, rhetoric that said this proposed transition had been cleared with the military prior to its inclusion. If this is true, then I wonder whose military the FCC and maritime services cleared it with. According to the Navy, it wasn't ours.

THE "I-NEED-A-FOREIGN-CORRESPONDENT" DEPARTMENT

Is there an amateur in Geneva, Switzerland, who happens to read Looking West? If so, I need your help. I need a volunteer to act as a Looking West correspondent during the World Administrative Radio Conference later this year. His or her job would be to sniff out any news of what's happening at the conference in relation to VHF/UHF spectrum matters, write same into a monthly synopsis, and forward it to me for inclusion in this column. If you have both the time and interest, drop me a line at the address given at the column's top and we can go from there.

THE "BIG-CHANGE-AT-WESTLINK" DEPARTMENT

Actually, there has been more than one change, but the one that affects most Westlink service users is the discontinuance of their "Cassette Exchange Program." Effective immediately, the cassette program has been replaced by an automated telephone system that permits those wishing to obtain the weekly newscasts to simply dial a telephone number in order to obtain the information.

There were two reasons for Network Director Jim Hendershot to make this decision. First, the Westlink News Service has grown far larger than he ever expected. This is a free, nonprofit service, but he found himself spending virtually every free moment duplicating tapes. He could have gone to a high-speed duplication house to have this work done, but it would have meant going away from the free aspect of the operation and possibly charging upwards of $100 or more annually for the service. This he did not want to do.

Second, there have been ongoing postal problems. Not a week had gone by when a subscriber didn't call to complain that his tape had not arrived or that it had arrived too late to air that week. Consequently, Jim has dropped the cassette exchange system.

There has been a second big change at Westlink. Alan Kaul W6RCL, Bill Orenstein KH6IAF/6, and I recently produced a 20-minute documentary entitled "The Peril to 220" which covered the many aspects of the current situation in that spectrum. The response to that special was so positive that Jim asked us to continue producing such programs on a monthly basis. We have accepted the assignment. In fact, currently in production are programs dealing with the OSCAR satellites, DXing from DX lists, and handling malicious interference.

To accomplish this, a second Westlink studio is being assembled at Bill's office in Hollywood; by midsummer, we should be in full production. Distribution will also be via a dial-in telephone number. We will also be setting up another telephone number so that amateurs can leave input for either the weekly newscast or the monthly "magazine of the air." Those interested in obtaining either or both of these services should contact Jim at the Westlink Radio Network, 8331 Joan Lane, Canoga Park CA 91402. Jim no longer must limit the service to repeaters and bulletin stations, so the service is available to just about anyone.

DX

from page 27

The following information has been provided by OK3BG on OK3TAB/D2A. OK3TAB is Laci Toth who arrived in Angola in March. He went to Luanda on a long business trip and was able to get on the air almost immediately. Laci is using a home-brew transceiver running 200 Watts to a triband quad. Look for him after 1700Z around 21360 kHz or 14250 kHz. He seldom strays far from these frequencies. QSLs have already been printed and you can QSL via OK3ALE or through the OK bureau.

Alex Kasevich W1CDC passes along the word that he is planning an extended stay on Montserrat beginning in August when he will be signing VP2MM. Look for him on CW only in the lower 25 kHz listening up 5. QSL to his home call with an SASE, of course.

The 1978 annual report of the Hong Kong Amateur Radio Transmitting Society lists 56 full members, 31 associate members, and six overseas members. With VS6FE as president, the group has an active 2-meter repeater and conducts the nightly Cantonese Net on 14130 kHz. VS6GW runs the QSL bureau at Box 541, Hong Kong.

The Gilbert Islands become independent on July 10 with the present KH1/VR1 prefixes being replaced by one new prefix. Prefix hunters must be going crazy these days trying to keep up.

14240 kHz and 14275/280 kHz are good areas to monitor for various list-type operations, generally after 2300Z.

Joe Ely 7P8BI reports that anyone needing a card for his 3D6BL operation from September, 1977, to August, 1978, or his present stint in Lesotho can QSL to his new manager, Gary Yarus WB0MSZ, 921 N. Clay Avenue, St. Louis MO 63122.

The Mad River Radio Club managed over 4,000 contacts during the ARRL CW DX Contest from FG7AR/FS7 for a score of some 3.4 million points. All contacts from March 14 to March 20 should be QSLed to K8OCR. Neither FG7AR nor his managers have records for contacts during this period.

The Sorel-Tracy Amateur Radio Club, VE2CBS—Province of Quebec, will sponsor a DXpedition to Zone 2 this month to aid those needing this rare zone to fill out their WAZ Award.

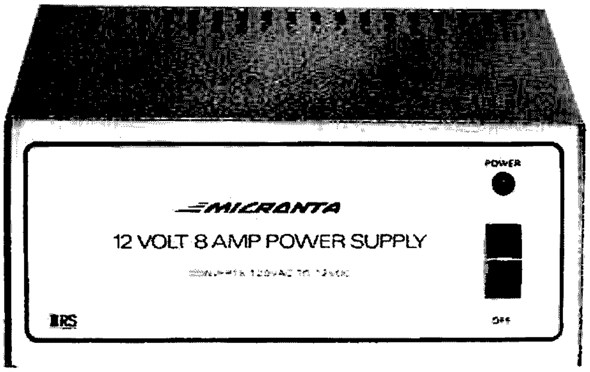
The operation will take place the week of July 21—July 28. They plan to operate all amateur frequencies using both CW and SSB.

As club Public Relations Director Marcel Lapolice VE2EML, would say, "Au plaisir de vous recontrer sur les ondes durant cette semaine de DXpedition dans le nord de la province de Quebec." Right on, Marcel.

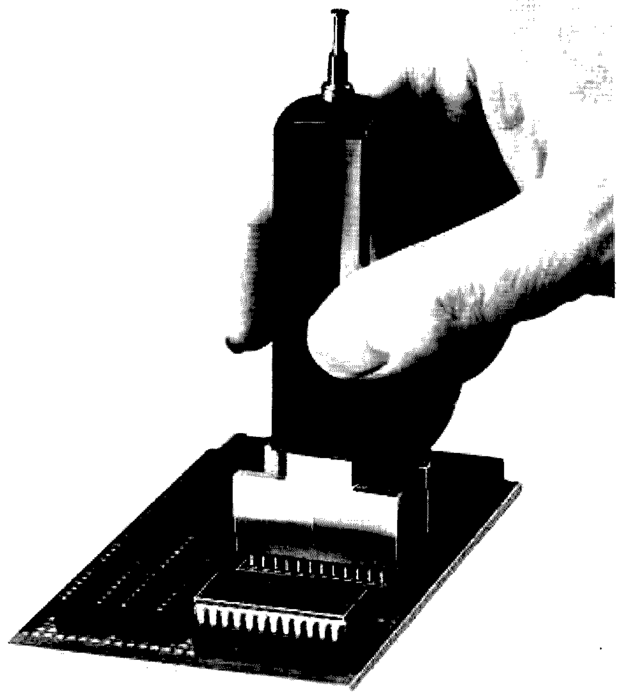
That station on during the WPX contest signing HD1A was a multi-multi operation by K7CA, WA4UAZ, K4ERO, and KA6CNS. HD1 is a special Ecuador prefix and you can obtain a QSL by dropping an SASE to WA4QMQ.

That about covers it for this month. We hope some of the preceding information will help you pick up a few new ones. In the meantime, we are always looking for DX information and photos. Photos can be either black and white or color. We in particular need information pertaining to CW, SSTV, OSCAR, VHF/UHF, and 160 meters. Thanks as usual to the *West Coast DX Bulletin*, LIDXA *DX Bulletin*, and *Worldradio News* for much of the preceding information.

New Products



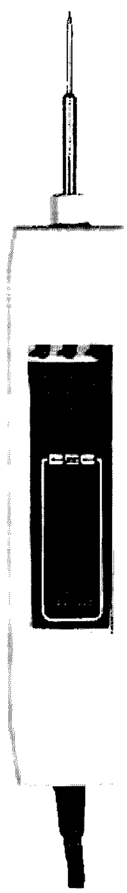
Micronta 12-volt 8-Amp power supply from Radio Shack.



IC Insertion Tool from OK Machine and Tool.

from page 24

Radio Shack stores and dealers. *Radio Shack, 1300 One Tandy Center, Fort Worth TX 76102; phone (817)-390-3272.*



LPK logic probe from CSC.

CSC LOGIC PROBE KIT OFFERS KIT-BUILDERS MULTIPLE BENEFITS

For Continental Specialties Corporation, already well known as a manufacturer of professional digital trouble-shooting instruments, their first kit-style test instrument logically emulates their line of logic probes. Both as a kit and as a probe, the CSC Model LPK Logic Probe Kit represents an excellent value.

The kit instructions are exceptionally well-written, offering step-by-step assembly procedures. Solder, wire, and all miscellaneous hardware are included in the kit—along with the printed circuit board, case, and all components, of course—leaving no extras to buy. Even beginning-level kit-builders can assemble the LPK quickly.

Once assembled, the LPK offers respectable performance as a logic probe. It is circuit powered through attached clip leads. HI, PULSE, and LO LEDs display logic states and transitions. The high logic state is defined as 70% or more of the supply voltage, the low state as 30% or less, making the probe compatible with most digital logic technologies or families. With its high (300,000-Ohm) input impedance, circuit loading is minimized.

With the LPK, even very narrow pulses can be detected. Internal circuitry stretches pulses as short as 300 nanoseconds into 1/10 second flashes of the PULSE LED; pulse trains at repetition rates up to 1.5 MHz keep the PULSE LED flashing.

The LPK includes self-protecting circuitry which permits the power leads to be connected in reverse or to as much as 25 V dc without permanent damage; the probe tip, similarly, can contact ±50 V continuously or 110 V ac for up to 15 seconds without permanent damage to the probe.

As a troubleshooting tool, the LPK holds its own against any logic probe in all but very high speed applications. As an educational venture for the kit-builder, it should be noted that the LPK, while a digital tool, is based on analog circuitry, offering a unique opportunity to see how the two disciplines merge.

The LPK Logic Probe Kit is available through selected local distributors both in the US and around the world.

For more information, or for the name of your nearest CSC stocking distributor, call *Continental Specialties Corporation, 70 Fulton Terrace, New Haven CT 06509; phone (203)-624-3103, TWX (710)-465-1227.* Reader Service number C9.

IC INSERTION TOOL

The new Model MOS-2428 DIP Inserter handles all MOS, CMOS, and regular 24- and 28-pin ICs. This unique new insertion tool also aligns bent-out pins. Simply rock the IC on the straightening saddle to align the pins. Press the tool over the IC to pick it up, then simply place the tool onto the socket and depress the plunger for instant and accurate insertion. The tool features heavy chrome plating throughout for reliable static dissipation. It includes a terminal lug for attachment of a ground strap. The MOS-2428 IC Insertion Tool is available from your local electronics distributor or directly from *OK Machine and Tool Corporation, 3455 Conner Street, Bronx NY 10475.* Reader Service number O5.

FREQUENCY COUNTER PREAMP

This general-purpose counter preamp has up to 25 dB gain from 10 MHz to 1 GHz. Designed to front-end a frequency counter's 50-Ohm VHF/UHF input, the AP-8015 preamplifier can be used with an antenna or pickup loop as well as be direct-coupled to allow low-level signal sources to be counted. The AP-8015 includes a 115 V wall plug transformer for ac operation as well as a dual 9-volt battery harness for portable operation. The preamp is enclosed in a heavy-duty anodized aluminum case. Size: 4-1/8" L x 2-1/4" W x 1-1/4" D. Weight: 6 ounces. For orders or Information, contact *Optoelectronics, Inc., 5821 N.E. 14th Avenue, Ft. Lauderdale FL 33334; phone (305)-771-2050/1.* Reader Service number O3.

FSK-1000 DEMODULATOR FROM IRL

"This is not a sedan or a truck. This is a sports car."

That's how the engineers at iRL describe their new FSK-1000 demodulator.

The FSK-1000 is a new, sophisticated, two-tone limiterless demodulator which offers selectivity as narrow as 55 Hz in each of its matched, selectable-bandwidth, active-filter tone channels. Although it includes such "extras" as continuously adjustable shift, dual-mode autostart, and a keyboard-activated switch, the designers insist, "We don't want a family sedan dressed up with mud flaps and raccoon tails. We want to give the serious HF or VHF operator a TU with the best raw performance available anywhere."

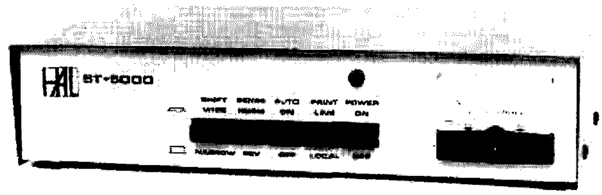
The FSK-1000 has both high-voltage current loop and low-voltage (RS-232 compatible) outputs to interface readily with mechanical teleprinters, computers, or both.

Receiver tuning requires a careful touch with the narrow filters switched in, but this gives the serious operator the selectivity he needs when the QRM gets really bad.

The FSK-1000 circuitry utilizes 48 operational amplifiers (twenty FET types) and a host of other devices. Complete details are available from iRL dealers or by writing *iRL, 700 Taylor Road, Columbus OH 43230*. Reader Service number 127.

NEW RTTY TERMINAL FROM HAL

HAL Communications Is proud to announce a new compact and low-cost RTTY terminal—the DS2000 KSR. The new terminal features operation with Baudot, ASCII, and Morse codes (Morse receive optional) and incorporates many of the features of more expensive terminals. A new 72-character line by 24-line display format, two 32-character programmable "Here Is" messages, and CW identification at the touch of a key simplify operation. A terminal-status line keeps the operator aware of data rate, data code, and other terminal conditions. Text is transmitted one word at a time and editing is possible anywhere In the line being composed. All terminal functions are controlled by a combination of a control key and a key from the top row of the keyboard. Other deluxe features such as unshift-on-space, synchronous idle, keyboard-operated switch, and both QBF and RY test messages are available at the stroke of a key. Connect the DS2000 KSR to a standard 18-120 mA, 200 V dc (maximum) current loop for Baudot and ASCII operation. Morse output is accomplished via a transistor switch to ground for keying either "grid-block" or "cathode" circuits. An optional Morse receive board (MR2000) is available for reception of Morse code at rates from 1-175 wpm and is customer installable allowing purchase at any time. An optional 9-inch diagonal measure video monitor is also available. The terminal weighs 6 lbs. (2.75 kg) net (10 lbs/4.55 kg shipping) and comes in an attractive blue and beige cabinet. Contact *HAL Communications Corp., PO Box 365, Urbana IL 61801*, for further information.



DS2000 RTTY terminal from HAL.

ROHN NO. 25 FOLD-OVER TOWER

When an amateur thinks of towers, chances are that he thinks of Rohn. And for good reason. Rohn has been building towers for a long time, providing amateurs with a variety of top-quality models at a reasonable price.

Recently, when I needed a new tower, my thoughts turned naturally enough to Rohn. Getting out their catalog, I thumbed through it to see just what they had to meet my particular requirements. After a few minutes of browsing, I decided that the 48-foot No. 25 Fold-Over was just what I was looking for.

Among the considerations I had in mind while choosing a new tower was that it get my beams clear of adjacent buildings and trees but not be so tall as to stand out prominently from its surroundings. As a result, I concluded that it should be approximately 50 feet high. And, since I prefer to keep my feet firmly on the ground, it should fold over so that work on the beams and rotor could be done from the ground or, at most, while standing on a short stepladder.

I also felt it highly desirable that the tower be easily assembled and disassembled by two people. And the likelihood that I would want to relocate it within the foreseeable future meant that it should be readily transportable, preferably in a small pickup or van. In addition, it should be rugged, durable, and easy and inexpensive to maintain. And, of course, it should be affordable.

The more I studied the Rohn catalog, the more I became convinced that the No. 25 Fold-Over was the answer. While I had never owned a Rohn tower, I was quite familiar with those used by friends and had been very favorably impressed by what I had seen. I liked the way they stood up to everything from hurricane winds in my native Florida to severe New England ice storms.

No. 25 towers utilize heavy-duty 1¼-inch-diameter #16-gauge steel tubing for side rails in a 12½-inch equilateral triangular design with solid-steel zig-zag cross pieces, entirely electrically-welded and fabricated by precision machines. There are 8 zig-zag steps per 10-foot tower section. Design and construction enables No. 25 towers to be installed at guyed heights up to 200 feet.

The tower's hot-dipped zinc galvanizing provides protection from rust and corrosion. A minimum molten zinc coating of 2 ounces for every square foot of surface fuses permanently to the metal, becoming an actual part of the steel so that it cannot be separated. Also, the tubular steel used in the towers is coated both inside and out to provide protection against deterioration from condensation and moisture. If a galvanized surface becomes scratched or chipped, the surrounding zinc actually "heals the wound" and continues to seal out corrosive elements.

Double-bolted joints are used to join tower sections for sturdiness and dependability. The No. 25's strength allows it to be self-supporting, provided a house bracket is used; it can go 35 feet above the bracket under normal conditions. A 200-foot No. 25 tower will withstand a 30-lb.-per-square-foot wind load—equivalent to 86.6 mph true wind velocity—when guyed and installed according to the manufacturer's specifications. This includes an antenna with an area of 6 square feet as well as 2 transmission lines. Those figures made me confident that a 48-footer with the sort of antennas I planned to use should be almost indestructible under typical New England weather conditions.

One of the things I like best about the No. 25 Fold-Over is the variety of mounting options that are available, covering virtually any situation you're ever likely to face. In addition to the more or less standard short base section for concrete, there is a hinged version for mounting in concrete, hinged and non-hinged base plates for use with concrete, plus mounts for flat and peaked roofs. And, also available and especially handy for Field Day, are a single drive-in base and a base plate for use with drive rods. If you can't guy, or you simply prefer not to, there are several sizes and types of house- and eave-brackets available. In my own case, I decided to install the tower at the rear of the barn using a house bracket for support.

In choosing a location for the tower, care should be taken to ensure that it will be well clear of trees, wires, buildings, and other objects, to permit a free swing of the hinged portion of the tower and antenna. If guys are to be used, the location should be suitable for placing four guy anchors at the appropriate distances.

The work begins with the digging of a hole 30 inches square by approximately 36 inches deep. After spreading a couple of inches of gravel in the bottom of the hole, attach the base section to the first 10-foot section and set the assembly on the gravel. Then spread another 3 inches of gravel around the legs of the base. This allows the tower base legs to extend the required amount below the base of the concrete, thus allowing for drainage of moisture into the gravel.

Before pouring the concrete, coat the base section over an area about 3 inches above and 3 inches below the space where the top of the concrete base will be, using a water-proof asphalt-type material. If the tower is situated near a building, be sure that the base is set so that two of the tower legs lie in a plane perpendicular to the wall of the building. This will cause the hinge axis to also be at right angles to the wall, and the tower will fold clear of the building. With the base set, pour the concrete around it and check its plumb with a carpenter's level on one or more of the legs of the tower. The top of the concrete should be slightly crowned to

prevent water accumulation.

It's a good idea to allow at least three days for the concrete to harden before continuing to erect the tower. An erection fixture or gin pole will make the process easier and faster, especially if you decide to add one or two additional 10-foot sections, bringing the total height to 58 or 68 feet.

If you're doing a 48-footer like mine, you place the hinged section atop the second 10-foot section, making sure the shipping-tab bolt is closed and that the hinge is positioned on the correct side of the tower. Guy wires (if used) are then installed on the guying tabs near the hinge point. The next step is to align and bolt together the two pieces of the boom (lever) section. The boom is then attached to the hinged section. Be sure the hinge bolts are loosened before you attempt to fold the tower over. If practical, a house- or eave-bracket may be used at the hinge point in place of guy wires. The bracket must be placed within 2 feet of the hinge point.

The remaining sections are lifted into place and installed in the usual manner. Next, the winch and cable mechanism is bolted to the leg of the lower tower section, just below the clevis on the boom. If an additional 10-foot tower section has been placed below the hinge section, an extra pulley must be installed just below the clevis on the boom. Finally, the cable must be secured with clamps and a wire rope thimble to the boom clevis and to the winch.

That's all there is to putting up a Rohn No. 25 Fold-Over tower. The installation instructions are quite simple and straightforward. Follow them and you'll get your tower up quickly, easily, and, most important of all, safely!

Once the hole is dug and the base assembly is installed, two people can complete the job in a morning or afternoon, including mounting a rotor and beam. Then you can sit back and enjoy operating, secure in the knowledge that if you pull routine preventative maintenance a couple of times a year and take prompt care of anything that crops up between times, you'll have a setup that should provide many years of reliable service.

While the 48-foot No. 25 Fold-Over tower proved just right for me, it may not be what you need. In that case, you should check out the other versions of the No. 25, as well as the many other models available from Rohn. For more information, write *Unarco-Rohn, a Division of Unarco Industries, Inc., 6718 West Plank Road, PO Box 2000, Peoria IL 61656.* Reader Service number U2.

Morgan W. Godwin W4WFL
Brattleboro VT

LETTERS

from page 10

windows at the higher elevations to Midland, El Paso, and Carlsbad. For the NBVM QSOs, we are carrying a GE Microcassette recorder.

All radio systems will be powered directly, without the use of a battery, from a 72-cell solar array which weighs four pounds. Limited night operations from dark to bedtime will be powered by a palm-sized nicad battery. Antennas will be half-wave slopers or quarter-wave radiators against quarter-wave counterpoises, as most of that area offers a very poor rf ground.

On-the-air operations will occur according to the following schedule, beginning as early as midday Sunday; listen for CQ NBVM from K5SBU on NBVM, SSB, and CW.

0600 CDT/1100 UT	14,235 kHz
0700 CDT/1200 UT	7,195 kHz
0900 CDT/1400 UT	14,235 kHz
1000 CDT/1500 UT	28,85 kHz
1100 CDT/1600 UT	21,385 kHz
1230 CDT/1730 UT	7,195 kHz
1500 CDT/2000 UT	21,385 kHz
1700 CDT/2200 UT	14,260 kHz
1900 CDT/0000 UT	14,385 kHz
2000 CDT/0100 UT	21,385 kHz
2100 CDT/0200 UT	14,260 kHz

The first Texas NBVM station, Bob W5GEL (W5BT), will be on frequency to coordinate, as his time allows. We would be pleased to QSO with any mode and will listen carefully for other QRP stations and DX stations. All NBVM stations should be prepared to tape-record QSOs; send the tape with your QSL. If we can find our tape of the QSO, it will be recorded on the blank side of your tape and returned.

The signal from K5SBU will be very weak, so tune slowly. Ten minutes after the schedule time, if we do not have a QSO, we may QSY to the QRP CW calling frequency for that band (60 kHz up from the bottom of each band). QSL to address below.

C. Richard Hoffman K5SBU
Box 1600
Corpus Christi TX 78403

WAYNE GREEN'S LAIR

I found this editorial, *Wayne Green's Lair* (*VHFER*, Vol. 1, No. 5, September, 1963, Comaire Electronics, Ellsworth MI), written some time ago by Doug DeMaw (Senior Technical Editor, ARRL) and thought you might be interested.

Wayne Green's Lair

The trip would not be complete without a visit to "73 Acres" in Peterborough, N.H. Never before have we been greeted with such hospitality and friendliness. No one should sojourn through N.H. without meeting this dedicated man, his wife, and his staff, who have completely thrown themselves into the cause for improved amateur radio conditions. We enjoyed our overnight stay at W2NSD. A personally prepared waffle breakfast, by the "Ed." himself, with New Hampshire pure maple syrup and all the trimmings and garnished with a vigorous discussion related to the controversial matters of the day (which are destined to affect all ham radio operators) was very invigorating.

For many months I have tried to understand this man Green's motives and his attacks on other publishers and organizations, but until I met this guy face to face, I could not properly evaluate his thoughts. I am convinced through seeing the results of his publishing house efforts, listening to his explanation of his convictions, and hearing him relate his hopes for the ham fraternity and its future, that he is neither vindictive nor radical. He believes in what he is doing, and is willing to fight for those who share his beliefs.

Wayne's empire includes a mountaintop location a few miles distant from his main facility, which is composed of numerous sky wires, a farm house and a magnificent 125' tower supporting 96 elements on 2 meters. Along with all this, a mountain of radio gear reposes in the "shack" and is presently being assembled into operating positions of one kW denomination for all bands.

All in all, we were mighty glad to meet Wayne, his charming XYL, and staff. They are truly a wonderful group. Don't miss stopping at Peterborough when you are in that area.

I have been reading your magazine since its beginning, and I even went on the *73* trip to Europe. I still think you are one of the good guys.

Wm. Edwards K8DNV
Bellaire MI

GUATEMALA '76

One of my favorite pastimes is handling traffic from the nets as fast as I am able. Although the messages that are handled are of the health and welfare type, there is a certain amount of satisfaction which one gains in being able to deliver the message in the least amount of time. Until recently, the practice did not appear too important, but after several proddings by my fellow hams on various nets, I agreed to jot down the details of the contact that took place during the Guatemala earthquake in 1976.

Without any doubt, a major part of the credit for saving lives and organizing the rescue effort during the disaster is due to that very fine group of amateurs that carried the greatest load in and around Guatemala City. Our efforts at the time were devoted to assisting wherever we could and fitting into any circumstance where help was needed. For a time, the traffic was picked up from the Interstate Net on seventy-five in the evening and relayed to the Guatemala City stations the first thing the following morning. Many nets were utilized to ensure the most expeditious handling of the traffic.

During this time, not very many minutes passed when there was a lack of traffic. On February 14, 1976, an amateur station in Peru, OA4CYC, called. It seems that Maria OA4CYC had tried for several days to secure information on two sisters in Guatemala City and had probably monitored the traffic being passed on to the Guatemala City station, TG9DF, which she was unable to hear. After gaining our attention and the verification of callsigns, Maria asked for our help.

After trying for the previous three days by telephone and wire services, Maria wanted to know if it would be possible to secure health and welfare information on the two sisters who were in Guatemala City. On securing the details from Maria in Peru, the information was relayed immediately to Don TG9DF. He recognized the location where the two sisters were, or would be, in the city and indicated that he would try to reach that point via the local telephone system. In less than five minutes, Don had the answer for Maria: "The two sisters were not injured, were feeling fine, and were working hard."

That message was relayed to Dayton OH and then to OA4CYC in Peru within eleven minutes of the moment the message was

received. This was amateur radio in action, and a small example of the real-life drama that can occur.

This short experience of mine would not even have been in print had it not been for my friends and fellow amateurs who pointed out that the benefits afforded by amateur radio would be far greater if the story was put in print.

Paul Weigert, Jr. W8TH
Centerville OH

NEEDED LESSON?

I had no complaints about Bill Pasternak's Looking West column until now, but since he went over to the Int'l HFers Headquarters and was baptized, it seems to me that he may be needed more in their Fox Tango Newsletter than in *73*. These people haven't changed a bit—they still espouse and promote illegal, scofflaw bootlegging outside of the CB band. But I guess even Pasternak is no exception—California is a veritable hotbed of illegal activity—must go along with the kook philosophies prevalent out there in the Land of the Cults.

CB neighbors of mine are in receipt of several letters from various printing callbooks (phoney calls and first names only, of course) and operating QSL card bureaus out of PO boxes. For anywhere from two to ten dollars, you can get a 2 Echo, 19 Whiskey, TCN66, or whatever happens to be in vogue at the moment, plus your QSL cards forwarded to your QTH monthly! Neat.

What I can't understand is how some of them can "guarantee" that the FCC will leave them alone "if they use their Echo call and only operate on certain frequencies." Another club claims that they have "advance notice" when the FCC is going to appear in a given area! Is the FCC really cooperating with these bandits?

Another thing I fail to understand is why the FCC can't seem to find these people, even though the same ones are on the air every day, day in and day out, and talk for hours! Even an idiot could drive up to their door with a simple receiver with no S-meter!

At least (so far) most of the nitwits have had the good sense (or are afraid) to stay out of the 10-meter ham band. But I'd like to see the FCC legalize 27.4 to 28.0—*then* "superior" ones would surely move into ten. There is a certain type of CBer who just *has* to operate illegally, even if there's no reason to. This type will eventually take over and ruin what's left of ham radio.

Frankly, I'm hoping that WARC '79 will give all our ham bands to the minority countries. It might teach the whole damned bunch of us a much-needed lesson!

William L. Harris KN9FOV
Lafayette IN

ASHAMED

This isn't really a letter to the editor, but I thought you should know that Stan Jopek K2JQT passed away on April 13, 1979. Stan was 40 years old and in excellent health, but he had a sudden fatal heart attack. He leaves his wife, Joan, and four teenage children. Stan was very active on six meters in the past, and was more active recently on 2 FM as the owner/operator of the .07/.67 repeater in Fredonia NY.

As tragic as Stan's sudden death was, subsequent events were repulsive, and they were the reason for this letter. One day after his death, while the family and friends were at the funeral home, someone broke into the .07/.67 repeater site and stole the entire machine and backup systems. The total value of the loss was over $3800.

What I find most repulsive in this is that the theft had to have been done by hams. The .07/.67 repeater was located in a remote area, and very few people even in amateur circles knew its exact location. It was located in a building along with several other commercial repeaters and transmitters which were much more valuable, less traceable, and much more portable. These units were not touched. The thieves were thorough. They even searched out the manuals for the 2-meter gear and took them also; they pig-tailed off the power leads, took the input tags for identification, and even taped up the leads to the standby batteries.

A four-wheel-drive vehicle was used, and at least two people carried the 6' high 19" rack over the muddy ground to the vehicle. The theft is being investigated by the Chautauqua County Sheriff's Department, and any information should be forwarded to them at (716)-672-5151. The Spectrum 1000 serial number is 0219.

I feel confident that a theft of this magnitude and perfidy will be solved. I only hope that the persons responsible are apprehended by the authorities rather than members of the repeater club. This is the first time I've ever really been ashamed of being a ham.

Ron Warren WA2LPB
Fredonia NY

Social Events

from page 130

hope to arrange special licenses for visiting hams who may wish to operate from XE1-land during their stay. There will be a flea market and demonstrations at the convention hall. For more information, contact the Radio Club Leon, PO Box 12A, Leon, Guanajuato, Mexico.

ESSEX MT
JUL 21-22

The International Glacier-Waterton Hamfest will be held on July 21-22, 1979, at the Three Forks Campground, ten miles east of Essex, Montana, on US Highway 2. Registration is at 9:00 am. Talk-in on .52 and .34/.94. For more information, write Glacier-Waterton Hamfest, PO Box 2225, Missoula MT 59806.

EUGENE OR
JUL 21-22

The 4th annual Lane County Ham Fair will be held on July 21-22, 1979, at the Oregon National Guard Armory, 2515 Centennial Blvd., Eugene, Oregon. Registration is $3.00, and an extra drawing ticket is given with advance registration. There will be displays, lectures, contests, swapshop, transmitter hunt, and entertainment. The facilities provide plenty of free parking for motor homes and trailers.

For information and advance reservations, phone or write Wanda or Earl Hemenway, 2366 Madison, Eugene OR 97405 at (503)-485-5575.

PITTSFIELD MA
JUL 21-22

The NoBARC Hamfest will be held on July 21-22, 1979, at Cummington Fairgrounds, Pittsfield, Massachusetts. There will be tech talks, demonstrations, and dealers. Flea market admission is $1.00. Advance registration is $3.00 single and $5.00 with spouse, and $4.00/$6.00 at the gate. Gates open at 5:00 pm on Friday for free camping. Talk-in on 146.31/.91. For reservations, contact Tom Hamilton WA1VPX, 206 California Ave., Pittsfield MA 01201.

GOLDEN CO
JUL 22

The Rocky Mountain Radio League, Inc., will hold its Field Demonstration Day and Swapfest on July 22, 1979, at the home of Karl Ramstetter WA0HJZ, which is located on Highway 93, Golden Gate Canyon Road. This is accessible by going one mile north of the city limits of Golden, turning westward off Highway 93 onto Golden Gate Canyon Road, proceeding for approximately 7½ miles, and making a right turn across the cattle guards. Signs will be posted for further directions. There will be demonstrations, including slow-scan TV and computers, door prizes, and a potluck lunch, with soft drinks and ice supplied by the League. It would be appreciated if everyone would make his contribution to the potluck lunch by bringing his favorite dish and helping out the League with any spare blankets and chairs. There will be camping facilities available for campers, trailers, mobile homes, etc., on Saturday afternoon before the Fest. No dogs, guns, or motorbikes, please.

MARSHALL MO
JUL 22

The Indian Foothills Amateur Radio Club will hold its 4th annual hamfest on July 22, 1979, at the Saline County Fairgrounds, Marshall, Missouri. Tickets are $2.00 each or 3 for $5.00 in advance; $2.50 at the door. Registration is at 8:00 am, with lunch at 11:30 pm (all you can eat) and the drawing at 2:30 pm. Prizes include a Tempo S1, a DenTron Jr. Monitor™ tuner, and many more. There will be flea markets for the OM and XYL. There is no charge for flea market tables this year, but reservations are requested. There will also be old and new equipment displays, a 10-X booth, and other activities for the XYLs. Talk-in on .52, .28/.88, and 147.84/.24. For information and tickets, write Norman Gibbins WB0SZI, 692 North Ted, Marshall MO 65340.

SHEBOYGAN WI
JUL 22

The annual Lakeshore Swapfest and Bratwurst Fry will be held on Sunday, July 22, 1979. Events include prizes, a flea market, an auction, and manufacturers' displays. Admission is $1.00. Talk-in on .66/.06. For further information, contact WB9NRM at (414)-457-3203.

BELVIDERE IL
JUL 22

The Big Thunder Amateur Club will hold its annual hamfest on Sunday, July 22, 1979, at the Boone County Fairgrounds. The fairgrounds are located one mile north of Belvidere on IL-76. Talk-in on .52 simplex. Donations are $2.00 at the door. Advance tickets are $1.50. For information and tickets, contact Michael Santucci WD9JGH, 862 Ivy Oaks Rd., Caledonia IL 61011.

MACKS INN ID
JUL 27-29

WIMU (Wyoming, Idaho, Montana, and Utah) will hold its 47th annual hamfest on July 27-29, 1979, at Macks Inn, Idaho. Festivities include 2-meter hunts, OSCAR demonstrations, ladies' crafts, and a repeater display. The pre-registration prize will be a Wilson Mark II handie-talkie complete with touchtone™, battery pack, and charger. The grand prize is your choice of an Icom IC-211 or a Kenwood TS-520. Saturday night special events include kids' movies and an adult dance. For further information, contact Dave Hunting WB7FGV, Box 662, Kemmerer WY 83101, or call (307)-877-9440.

MOOSE JAW SASKATCHEWAN CAN
JUL 27-29

The Moose Jaw Amateur Radio Club will hold its 1979 Hamfest (Particifest 79) on July 27-29, 1979, at the Saskatchewan Technical Institute, 600 Saskatchewan St. W., Moose Jaw, Saskatchewan, Canada. Registration will be held on Friday evening with a full day of activities on Saturday culminating in a banquet and dance. Most of the meetings and workshops will be held on Sunday. There will also be a busy schedule for the XYLs.

OKLAHOMA CITY OK
JUL 27-29

The Central Oklahoma Radio Amateurs will sponsor the Oklahoma State ARRL Convention and "Ham Holiday" on July 27-29, 1979, at Lincoln Plaza, 4445 Lincoln Blvd., Oklahoma City, Oklahoma. The program will include an ARRL forum and technical talks on 1-GHz techniques, fast-scan TV for radio amateurs, NBVM, and other subjects of current interest. In addition, a full program is scheduled for the ladies. Pre-registration will be $4.00 if received before July 20. After that date, it will be $5.00. A synthesized 800-channel VHF transceiver will be awarded to encourage pre-registration. The main award will be a TS-120V with power supply. Adequate rooms are available for commercial exhibitors and swappers. Mail your registration to CORA, PO Box 14424, Oklahoma City OK 73113.

Unlimited parking space is also available.

OLIVER BC CAN
JUL 28-29

The Okanagan International Hamfest will be held on July 28-29, 1979, at Gallagher Lake KOA Kampsite, 8 miles north of Oliver, B.C., Canada. Registration starts at 9:00 am Saturday. Activities start at 1:00 pm Saturday and continue until 2:00 pm Sunday. Ladies may bring their hobbies and items for a white-elephant sale. Featured will be prizes, a flea market, bunny hunts, entertainment, a home-brew contest, and more. A potluck lunch will be served Sunday at noon. Call-in on 3800, .34/.94, and .76 simplex. For information, write John Juul-Andersen VE7DTX, 8802 Lakeview Dr., Vernon, B.C., Canada V1B 1W3, or Lota Harvey VE7DKL, 584 Heather Rd., Penticton, B.C., Canada V2A 1W8.

BOWLING GREEN OH
JUL 29

The Wood County Amateur Radio Club will hold its 15th annual Wood County Ham-a-Rama on July 29, 1979, at the Bowling Green Fairgrounds, Bowling Green, Ohio. Gates will open at 10:00 am, with free admission and parking. Dealer tables and space are available. Trunk sale space and food will also be available. Tickets are $1.50 in advance and $2.00 at the door. Prizes will be awarded. Talk-in on .52 K8TIH. For information, write Wood County ARC, c/o Eric Willman, 14118 Bishop Road, Bowling Green OH 43402.

NASHVILLE TN
JUL 29

The Radio Amateur Transmitting Society (R.A.T.S.) of Nashville, Tennessee, will sponsor the Nashville Hamfest on Sunday, July 29, 1979, at the National Guard Armory on Sidco Drive, in Nashville, Tennessee. Tables, bargains, and refreshments are available, as well as prizes. Admission is $3.00. Talk-in on .90/.30. For more information, contact Richard Wagner K4MZE, 1015 Haber Drive, Brentwood TN 37027, or phone (615)-794-5356.

BALTIMORE MD
JUL 29

The Baltimore Radio Amateur Television Society (BRATS) will be holding the annual BRATS Maryland Hamfest on Sunday, July 29, 1979, at the Howard County Fairgrounds, Rtes. 32 and I-70, 15 miles west of Baltimore, Maryland. The event, beginning at 8:00 am rain or shine, includes a giant flea market, indoor and outdoor exhibit areas, top prizes, and plenty of good food and refreshments. Tickets are $2.00, tailgating is $2.00, and tables are $4.00 in advance, $5.00 at the

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door. Talk-in on .16/.76, .63/.03, .52/.52, and 52.525. For information, contact BRATS, PO Box 5915, Baltimore MD 21208.

IRVING TX AUG 3-5

Encounter '79, the Texas VHF-FM Society's 1979 Summer Convention, will be held August 3-5, 1979, at the Villa Inn, Irving, Texas. Activities include a transmitter hunt, flea market, FCC exams, manufacturers' exhibits, hospitality room, and several programs and forums. Talk-in on 146.52 and repeaters in the area. Pre-registration is $5.00 until July 1. Registration at the door is $6.00. For information, write Encounter '79, PO Box 3608, Arlington TX 76010.

FLAGSTAFF AZ AUG 3-5

The Amateur Radio Council of Arizona will hold its annual Ft. Tuthill Hamfest on August 3-5, 1979, at Flagstaff, Arizona. Prizes include TS-520 transceivers, a microwave oven, a Wilson Mark II HT, a Wilson System III triband antenna, and more. Featured will be a western barbecue, tech sessions, and exhibits. Camping facilities are also available. For further details or information, write Ft. Tuthill Hamfest, c/o 8520 E. Edwards Ave., Scottsdale AZ 85253.

LITTLE ROCK AR AUG 4-5

The Central Arkansas Radio Emergency Net (CAREN) Amateur Radio Club will hold its second annual Ham-a-Rama on Saturday and Sunday, August 4-5, 1979, at the Arkansas State Fairgrounds, Little Rock, Arkansas. There will be two main prizes given, as well as door prizes. Featured will be forums, dealers' exhibits, a Saturday night party, and a large flea market. Talk-in on 146.34/.94. For details, send an SASE to Morris Middleton AD5M, 19 Elmherst Drive, Little Rock AR 72209.

REND LAKE IL AUG 5

The Shawnee Amateur Radio Association Hamfest will be held on August 5, 1979, at Rend Lake in southern Illinois. Complete camping and recreational facilities will be available, so plan to spend the weekend at the lake and attend the hamfest on Sunday. Family activities are planned. Hourly door prizes will be awarded. There will be no charge to vendors. For information, contact WB9ELP or WB9SWG.

PITTSBURGH PA AUG 5

The South Hills Brass Pounders and Modulators will hold its 42nd annual Pittsburgh Hamfest on August 5, 1979, from noon until dusk at the Allegheny County Community College south campus on Rte. 885, 2 miles south of the Allegheny County Airport and approximately 15 miles southeast of Pittsburgh, Pennsylvania. Advance registration is $1.50; $2.00 at the door. There will be a large indoor air-conditioned area for vendors and the flea market, and a large paved surface for the outdoor flea market. There will also be prizes and food. Talk-in on 146.13/.73 and .52/.52. For information and preregistration, write Bruce Banister, 5954 Leprechaun Dr., Bethel Park PA 15102.

MT SINAI LI NY AUG 5

The Radio Central Amateur Radio Club will hold its "Ham-Central" on Sunday, August 5, 1979 (rain date is August 12, 1979), at the Mt. Sinai Elementary School, Rte. 25A, Mt. Sinai, Long Island, New York. Admission for sellers is $3.00 per tailgate space and $1.50 for buyers, with XYL and children under 12 free. Monies are to be used for Radio Central and the St. Charles Hospital Repeater. Doors will open at 7:00 am for sellers and 9:00 for others. They will close at 4:00 pm. Featured will be antenna advice with Art and Madeline Greenberg, a Novice table, great food, a CW contest, an ARRL table, a special event of a fly-in by the Suffolk County Police Dept. helicopter, and a Radio Central Club table. Talk-in on 146.52 WA2UEC and 144.71/145.31 K2VL. For information, call Joan Longtin at (516)-924-8438 or Robin Goodman at (516)-744-6260, or write Radio Central, "Ham-Central," PO Box 680, Miller Place NY 11764.

JACKSONVILLE FL AUG 4-5

The Jacksonville Hamfest Association is pleased to announce the 1979 Jacksonville Hamfest and ARRL North Florida Section Convention to be held on August 4-5, 1979, at the Jacksonville Beach Municipal Auditorium, Jacksonville, Florida. The location is just one block from the beach, where U.S. 90 meets the sea.

Advanced registrations are available at $3.00 per person from R. J. Cutting W2KGI/4, 303 10th St., Atlantic Beach, Florida 32233. Price at the door will be $3.50.

A large indoor swap area will be featured, with advance table reservations available for $5.00 per table per day from Robbie Roberts KH6FMD/W4, 10557 Atlantic Blvd., #31, Jacksonville, Florida 32211. Information on exhibitors' booths and space are available from the same address.

Other features and programs include statewide organization meetings on such topics as traffic nets and MARS, a microprocessor seminar, a solar power demonstration, a DX "pileup" contest, a hidden transmitter hunt, an OSCAR forum, ARRL forums, emergency preparedness programs, DX and contest presentations, antenna and technical seminars, and much more.

More general information may be obtained from JHA, 911 Rio St. Johns Dr., Jacksonville FL 32211.

SALEM OH AUG 5

The second annual Salem Area Hamfest will be held on August 5, 1979, from 9:00 am to 3:00 pm at the Kent State Salem campus, Salem, Ohio. Tickets are $1.50 in advance and $2.00 at the door. Inside tables are $5.00 with space for your own table at $2.00. Flea market space is $1.00. There will be air-conditioning, a wheelchair ramp, free parking, refreshments, and prizes, consisting of an Atlas RX-110, TX-110, and a PS-110. Talk-in on 146.52. For details, write Harry Milhoan WA8FBS, 1128 West State, Salem OH 44460.

AMARILLO TX AUG 10-12

The Panhandle Amateur Radio Club will hold its sixth annual Golden Spread Hamfest and Convention on Friday, Saturday, and Sunday, August 10-12, 1979, at The Inn of Amarillo, 601 Amarillo Blvd. West, Amarillo, Texas. The format consists of two full days of exhibits and trading, six technical sessions, programs for the ladies, valuable door prizes, Army and Navy MARS meetings, ARES meeting, an ARRL forum, and plenty of free parking. Displays may be set up any time after 1:00 pm on Friday, August 10th, at a fee of $20.00 per table. For information, write Hamfest, PO Box 10221, Amarillo TX 79106, or phone Jay Ledbetter WB5UBM at (806)-376-6042 (nights and weekends) or Chuck Passmore WB5BRC at (806)-372-1631.

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propagation

by
J. H. Nelson

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GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	14	7	7	7	14	14	14	14	14
ARGENTINA	21	14	14	14	7	7	14	21	21	21	21	21
AUSTRALIA	21	14	14	7A	7	7	7	7	7	7	14	21
CANAL ZONE	21	14	7A	7	7	7	7A	14	14	21	21	21A
ENGLAND	14	14	7A	7	7	7	14	14	21	21	21	14
HAWAII	21	21	14	7A	7	7	7	14	14	14	21	21
INDIA	14	14	14B	7B	7B	7B	14	14	14	14A	14	14
JAPAN	14A	14	7A	7	7B	7B	7B	14	14	14	14	14A
MEXICO	21	14A	14	7	7	7	7	14	14	14	21	21
PHILIPPINES	14A	14A	14	7B	7B	7B	7B	14	14	14	14	14
PUERTO RICO	14	14	7	7	7	7	7A	14	14	14	14	14
SOUTH AFRICA	7B	7	7	7	7B	14	21	21	21A	21	14	14B
U. S. S. R.	14	14	7A	7	7	7	14	14	14A	14A	14	14
WEST COAST	21	21	14	7	7	7	7	14	14	14	14A	14A

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	14	7	7	7	14	14	14	14	14
ARGENTINA	21	21	14	14	7	7	14	14	21	21	21	21
AUSTRALIA	21	21	14	14	7A	7	7	7	7	7	14	21
CANAL ZONE	21	14A	14	7	7	7	14	14	21	21	21	21A
ENGLAND	14	14	7A	7	7	7	7	14	14	21	21	14
HAWAII	21	21	14	14	7	7	7	7A	14	21	21	21
INDIA	14	14	14B	7B	7B	7B	7B	14	14	14	14	14
JAPAN	14A	14	14	7A	7B	7B	7B	14	14	14	14	14A
MEXICO	14	14	7A	7	7	7	7	7A	14	14	14	14
PHILIPPINES	14	14A	14A	7B	7B	7B	7B	14	14	14	14	14
PUERTO RICO	21	14	14	7	7	7	14	14	14	21	21	21
SOUTH AFRICA	7B	7	7	7	7B	7B	14	14	21	21	14	14B
U. S. S. R.	14	14	7A	7	7	7	7	14	14	14	14	14

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	14	7	7	7	14	14	14	14	14
ARGENTINA	21	21	14	14	7	7	7	14	21	21	21	21
AUSTRALIA	21	21A	21A	21	14	7A	7	7	7	7	14	21
CANAL ZONE	21A	21	14	7	7	7	7	14	14	21	21	21
ENGLAND	14	14	7	7	7	7	7	14	14	14A	14A	14
HAWAII	21	21A	21A	21	14	14	7	7	14	21	21	21
INDIA	14	14	14	14B	7B	7B	7B	7A	14	14	14	14
JAPAN	21	21	21	14	7A	7	7	7A	14	14	14	14
MEXICO	21	14	14	7	7	7	7	14	14	14	21	21
PHILIPPINES	14	14A	14A	14	7A	7B	7B	14	14	14	14	14
PUERTO RICO	21	14A	14	7	7	7	7	14	14	21	21	21
SOUTH AFRICA	7B	7B	7	7	7B	7B	7B	14	14A	14A	14	14B
U. S. S. R.	14	14	7A	7	7	7	7	14	14	14	14	14
EAST COAST	21	21	14	7	7	7	7	14	14	14	14A	14A

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor
SF = Chance of solar flares

july

sun	mon	tue	wed	thu	fri	sat
1 G	2 G	3 F	4 F	5 G	6 G	7 G
8 G	9 G	10 G	11 F/SF	12 F/SF	13 F/SF	14 P/SF
15 P/SF	16 F	17 F	18 F	19 G	20 G	21 G
22 G	23 G	24 F	25 F	26 F	27 G	28 G
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W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

DXING AGAIN

It's been a long time since I've been on twenty meters seriously seeking out DX. I got heavily into this back in the mid-60s. Then I got into FM and repeaters . . . and there really is only so much time a week I can spend on hamming. Next came enthusiasm for slow scan . . . another incredible user of hamming time . . . and also a lot of fun. Then I got into OSCAR, and boy, does that take a lot of time and work . . . and is also immensely rewarding with fun.

A couple of years ago, I decided it was time to poke into the newly developing sunspot cycle and get some DXing done. I had a Tech working at the magazine at the time and I wanted him to refurbish our beam . . . which resulted in his totally destroying both the beam and the tower. It sure was exciting when it crashed down!

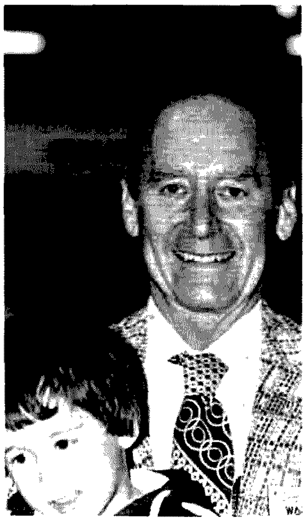
Anxious to get going, I started dickering for a new tower. Several tower firms responded favorably to my offer to swap some ad space for a new tower. One firm was super hot on this and wanted me to put up their newest and biggest crank-up system. They weren't able to get things going in time for the job to be done before the 1977-78 ice age settled in up here, so we planned on setting it all up in the spring of 1978. Then they kept putting me off with vague promises and delays for an entire year. I finally gave up on them and got a tower almost immediately from Rohn . . . bless 'em. This one arrived the day before the ground froze solid for the winter.

The tower is now up and working, complete with a Wilson tribander antenna. I finally got a rig hooked up to it the other day and found out something which I hadn't realized . . . most of the modern-day rigs don't put out enough soup to drive my old Henry 2K amplifier to anywhere near full output. I had that trouble years ago with my Central Electronics 200-V exciter. It takes about 300 Watts or so to hit the 2K hard enough to push it to 1,000 Watts average output.

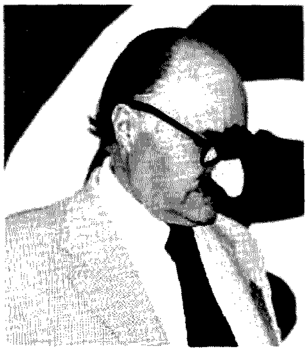
Even with only about 400 to 500 Watts registering on the Bird Wattmeter, I found the new station to work extremely well. There is an initial psychological handicap when I am not running a full gallon . . . I know I am up against 5-kW and 10-kW competitors in the pileups and I don't go in with the confidence I might otherwise have.

My first call was to FM7WE on Martinique, which used to be relatively rare. Guy came back the first try and gave me a nice report. The distance wasn't amazing, but my ability to shoulder my way through a medium pileup was impressive. No sooner was I finished talking with Guy than I tuned up a few kHz and heard VP8RX in the Falkland Islands trying to con-

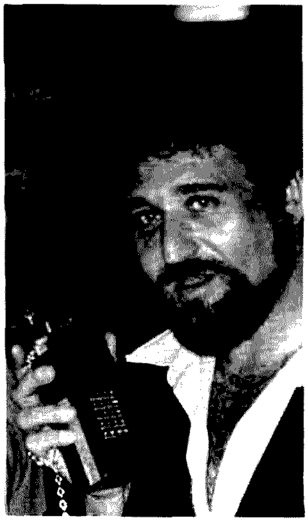
SCENE AT DAYTON



Howard Furst W6PHA runs Global Importing and sells keyers and a lot of other interesting gadgets. Seen here with his junior op, Howard also is a lawyer practicing before the FCC . . . and an old friend.



Who is this mysterious and handsome stranger? Could it be The Long Ranger? Superham? Or might it even be legendary Larson E. Rapp WIOU? Dayton was agog.



Marv Druskoff of Yaesu created quite a stir at the Dayton Hamvention with his prototype synthesized rig. He had it chained to his belt to make sure that there was no way to mislay the unit. Programmable.

DX

Chuck Stuart N5KC
5115 Menefee Drive
Dallas TX 75227

Hard as it is for us to believe, 10 months have passed since this column first appeared in these pages. At that time we had high hopes and a lot of ideas as to what would make an interesting DX column.

Most of those hopes have been realized, and from the mail we receive, many of you find our efforts worth reading each month. Credit goes to all of you who have written or called with information, suggestions, and comments. Without a constant flow of news, rumors, gossip, and facts, there would be no column. Thanks to all of you and keep those cards and letters coming, folks.

SLIM

Many of you have written in wondering just who is this Slim character we keep mentioning. Slim was invented by Hugh Cassidy WA6AUD, editor of the weekly *West Coast DX Bulletin*, as a personalization for pirate, phoney, etc. Any illegal operator is called Slim.

It began in 1968 when a station showed up signing 8X8A, giving his QTH as Cray Island and his name as Slim. Cray Island was supposed to be a newly-formed volcanic island just south of Iceland that would definitely count as a new one. Although most everyone was taken in, it soon became apparent that this was just another pirate operation when Slim's designated QSL manager denied any knowledge of the operation.

From that time on, any illegal operation has been said to be the work of Slim. Slim has operated around the world since first appearing in 1968. You've probably worked him sometime yourself, for Slim is everywhere.

HEARD ON THE BAND

The OE6XG/A group ran off some 13,800 contacts from Abu Ail despite generator problems. QSL to WA3HUP with SASE, etc. Financial contributions to help offset the several thousand dollars spent by each member of the group would be appreciated.

3B8CF, 3B8CD, and 3B8DA all hold licenses for 3B6, Agalega, and visit the island regularly to maintain the radar and weather-monitoring equipment.

While we're in the area, 5R8AN has been active Mondays and Thursdays from 1900Z on 14345 kHz. QSL to K4IE.

VK9NI on Norfolk Island runs a daily sked to Europe on 28585 kHz from 0900Z to 1100Z. He listens for stateside Sundays on 28900 kHz after his 0001Z sked with W6EDN. QSL to PO Box 290, Norfolk Island, via Australia.

KA1IW plans to keep the following schedule until his August 15 departure from Ogasawara Island: 3797 kHz from 1200Z to 1300Z, 7064 kHz from 1130Z to 1200Z, 14285 kHz from 1000Z to 1130Z, 21365 kHz from 2330Z to 0100Z, and 28550 kHz from 2300Z to 2330Z. QSL to K8DYZ.

You CW fans can find HS1ABD most days near 14030 kHz from 1400Z and around 3515 kHz from 0300Z. QSL to K3EST.

If you are confused by the UK8 callsigns, the following list should help to ease your pain. UH8 is UK8B/E/H/Y. UJ8 is UK8J/R/S. UI8 is UK8A/C/D/F/I/L/O/T/Z. UM8 is UK8M/N/P/Q. Now look back through your log to see how many new ones you worked without knowing it.

KC6AT in the Western Carolines is active regularly around 14285 kHz from 0800Z. QSL to Box 490, Koror, Palau, WCI 96940. SASE, please.

KV4AA's record of 48,100 QSOs in a single year will go into the *Guinness Book of World Records* unless someone can prove a higher total. If you can, contact Frank Anzalone W1WY.

Although you might be getting a late start, a prize of a holiday for two to the Isle of Capri will be awarded to the amateur making the most contacts with Naples, Italy, from now to December 31, 1979. Logs must reach Box 336, 180100 Naples, Italy, by January 31, 1980.

N4XX offers a free copy of the *Shortwave Propagation Handbook* to anyone helping him obtain a valid QSL for 10-meter contacts with 5A1TG (December, 1957) and/or 5A4TT (January, 1958).

Business Week magazine of May 7th had a very interesting article on WARC 79. They note that some of the lesser-developed countries are already on record as planning to demand and get everything in sight. They draw a parallel to one of the ITU conferences a few years back when some totally land-locked countries demanded and got maritime frequencies. The results of WARC 79 will have a strong effect on amateur radio for years to come.

The Jersey ARC club station, GJ3DVC, operated by GJ4HSW, can usually be found on 21300 kHz Fridays from 1800Z and on Sundays from 0930Z around 14270 kHz.

5T5CJ looks for stateside daily during the week on 28525 kHz from 2100Z to 2200Z. He also seeks stateside contacts via OSCAR 8. QSL to W4BAA.

OH2BH is mounting a massive effort to activate Mt. Athos this summer. A whole new generation of DXers has come into being since this rare spot was last heard.

The following Americans are active with the peace-keeping forces in the Sinai: Rich WD4SCJ/SU, Ed K5AON/SU, Ken WB5BXQ/SU, Ed W5PYW/SU, and WA7JRL/SU. They have 10,000 QSLs printed and waiting to be filled out at ESY-SFM, PO Box 21, FPO NY 09527. SASE, please.

Congratulations to the first officers of the newly-formed South Florida DX Association: Joe Plcior WB4OSN, President, Norm Alexander W4QQN, VP, Rob Robinson W2SR, Secretary, and Vic Dubois N4TO, Treasurer.

The QSLs for the K4YT/5R8 operation are not being accepted for DXCC credit, unauthorized operation being the reason given.

The Caribbean Net on 14175 kHz at 1100Z is a good place to snag some of the more rare types in that area. A recent roll call was answered by VP2A, VP2D, VP2K, VP2L, J3, J6, 6Y5, 9Y4, HI8, VP2M, VP2S, 8R1, C6, HK, HC, HS, 9M2, CO, 9M6, 9V1, VS5, YJ8, DU, YB, VR1, VR6, H44, 3D2, VK9, ZL, UA, JD1, 4S7, BV2, T2, FB8Z, A51, KX6, and KA1. Actually, some are rather far removed from the Caribbean area, but you get the idea.

A9ZEX was a special call used at the Middle East Communications Faire. QSL to the A9 Bureau.

The March Norfolk Island operation by HB9AAA netted some 5500 QSOs covering 112 countries. Cards were mailed in April.

The Bangalore Radio Club in India meets most days on 7090 kHz at 0730Z.

We have reported in the past on the advantages of enclosing IRCs, mint stamps, dollar bills, etc., when requesting QSLs direct from overseas QSL routes. We also made a point of suggesting that it is usually best to follow the directions of the DX station himself. Now along comes PY1APS with a new request concerning his recent PY0APS operation from Fernando de Noronha. Gerson says to skip the IRCs, stamps, etc., and send computer programs instead. Seems he has a new Radio Shack TRS-80 microcomputer with 16K Level II BASIC and he needs programs to use with his new computer. If you have any programs you want to share, you can send them to Gerson Rissin, PO Box 12178 Copacabana, 20000 Rio de Janeiro, RJ, Brasil.

XT2AW is a new operator in the Voltaic Republic. His name is Harold and you can QSL to Box 2332, Ouagadougou, Voltaic Republic.

The newly-formed Bangladesh Amateur Radio Club is in need of service manuals for Hailicrafters SBT-20 crystal-controlled transceivers. If you can supply information on these units, contact K1ZZ at ARRL Headquarters.

Bob Geary 5Z4NH, a DX Profile of a few months back, has left Kenya after 13 years and is returning stateside.

Congratulations to new Radio Club of America members Jim Fisk W1HR, John Knight W6YY, and Bill Vette K6TXR.

One of the side benefits of the recent 1S1DX operation from Spratley Island was the 16,000 plus QSOs the group handed out from VS5, Brunei, and some 3,000 from VS6, Hong Kong. The main Brunei operation by N2OO was from VS5MS's QTH. Gear used was a FT-901DM barefoot and a TH6DXX at 65 feet. Even with all the problems that developed, some of the group are planning another trip to Brunei. The following list should help to locate the correct QSL route for the station you worked. VS5AR and VS5M to N4GG. VS5SW to K4SMX. 1S1DX, VS5ZR, and VS5JB to VK2BJL. VS5OO, VS5MS, VS5KV, and VS6AK to N2OO. Be sure to enclose the usual SAE or SASE. The group is still in debt for the trip and, should you be so inclined, support can be directed to the South Jersey DX Assn., 33 Shore Drive, Manahakin NJ 08050.

There is apparently a new low-power AM license class in Russia, having a code-free exam and aimed at the younger set. The class is identifiable by the EZ prefix. While in Russia, we might mention that the looked-for 160-meter authorization came through in March. Maximum power is ten Watts in the 1850 kHz to 1950 kHz band. Subbands are 1850 to 1875 for CW, 1875 to 1900 for CW and SSB, and 1900 to 1950 for CW/SSB/AM.

If you are among the many thirsting for a Dodecanese contact, check 21345 kHz on the weekends after 1330Z. SV5JH hangs out in that area, or so the story goes. QSL to DJ9ZB.

LU3ZY in the South Sandwich group has been quite regular on both 40 and 15 CW.

Continued on page 172

Looking West

Bill Pasternak WA6ITF
24854-C Newhall Ave.
Newhall CA 91321

Something great happened recently in San Diego, California—score one for amateur radio! San Diego amateurs have won a major victory in the realm of tower height ordinances. This is bound to have a lasting effect on communities throughout this state and elsewhere. Exactly what happened, you ask? Jim Allen W6OGC of La Mesa, California, sent us this report.

WHO SAYS YOU CAN'T WIN AT CITY HALL?

"Have you heard about the new zoning code restricting ham towers to 50 feet in the county?" asked K6NA as I walked into the local radio store one Saturday late last December.

"What!!!??" was my incredulous response. Thus did I learn that the Board of Supervisors of San Diego County had, in enacting a complete revision of the County Zoning Ordinance, slipped in a "zinger" which had escaped the notice of local hams. It was to become effective on January 1, 1979, only a matter of days away.

Obviously, something had to be done. Glenn suggested I contact Sybil W6GIC, who was a delegate to the San Diego County Amateur Radio Council (SANDARC), which had begun to react. I contacted Sybil and learned that while SANDARC was hosting 7,000 visitors to the ARRL National Convention, the county had been in the process of enacting this new ordinance. Sybil suggested I contact Larry N6LY, a SANDARC officer who had been assigned the job of writing a letter protesting this ordinance to the local Department of Land Use and Environmental Regulation. She also suggested contact with our SCM, W6INI. Larry was able to give me the text of the height limitation section and a summary of the letter to LUER. He also gave me the name of the LUER employee to contact. Sybil had gone over to their office and gotten the name.

Not being technically well-trained, I have many times been the grateful recipient of help on technical problems from more technically-oriented fellow hams. Now it seemed like here was a problem that I, as a lawyer, might be able to help with. So, I offered to help in any way I could. The response to this offer of help was immediate, enthusiastic, and affirmative.

As best I could determine, the ordinance had completely escaped the attention of local amateurs in the pre-enactment consideration. The staff had not thought to seek out amateurs, and amateurs were oblivious to the revision which was only 2 sections less than one page long in a completely rewritten zoning ordinance over an inch thick.

When I spoke to the staff at LUER, I learned that the reason 50 feet was chosen was that it was a nice round number that seemed high enough to accommodate us. I promptly disabused them of that idea!

The new zoning ordinance established "height designations" for each zone which permitted building heights of between 15 and 60 feet, depending upon the area. Exceptions to the maximum height were available for, among other things, "Transmitting antennas no more than 50 feet in height used by licensed amateur (ham) radio operators." Amateur antennas in excess of 50 feet would be allowed provided a minor use permit could be obtained. A minor use permit required payment of a $200 fee, a hearing upon notice, and an environmental impact review, which, we learned, cost $250.00 and up. A more dismal prospect could scarcely be imagined.

To us, it was clear that this ordinance had been proposed and considered by people who had no idea of the disastrous impact of this type of regulation on our activities. Consequently, our first thrust was to educate.

I prepared a brief draft report explaining what amateur radio is, what we do, and how and why we do it. I also explained elementary antenna and propagation practice. The draft was reviewed by W6GIC, W6INI, N6LY, and K6NA. Many helpful ideas were considered and incorporated. In this process, K6NA and I spent many hours changing, editing, thinking out loud, arguing the merits and demerits, and banging the thing into shape. Glenn is an individual who is not only thoroughly familiar with just about every aspect of ham radio (including "hands on" experience with large, tall antennas), but also brings a good measure of practical common sense to bear on the task at hand. It is due to his creative and practical ideas that the report was brief, readable, and informative. The report included, as exhibits, FCC Regulations, Subpart A, Section 97.1, Chapter 1 of the *1979 Amateur Radio Handbook*, copies of *QST* articles dealing with emergency communications, and a representative set of plans and drawings for a well-known free-standing tower.

Armed with this, I made an appointment to see the staff member at LUER. He was at once receptive and discouraging. After listening for about 45 minutes, he said he would be happy to review the report, but felt that the prospect of LUER recommending an amendment was none too bright. A few weeks later, I heard that the Director of LUER had decided not to recommend an amendment.

Initial research had led me to the conclusion that a court challenge was out of the question. This impression was confirmed by Howard W6US, a fellow lawyer of vast experience. This was not so much a legal problem as it was a political problem.

At the January SANDARC meeting, I reported on my activities and conclusions. I had no political experience, but it seemed to me that the Board of Supervisors had to be shown that (1) this was a serious problem, (2) our reasons and proposals for an amendment were reasonable and in the public interest, and (3) our views would have considerable voter support. One way to show support would be a petition signed by county residents.

The delegates directed me to prepare a suitable petition which would be circulated throughout all member clubs. Each club member would be supplied with petition forms and asked to obtain as many signatures as possible. I immediately prepared the petition and delivered it to W6GIC, who had accepted the responsibility of getting it distributed to the SANDARC member clubs, who would print up as many as necessary for its members' needs. All petitions would be returned to me or to the delegate representing the particular club in time to be taken to the SANDARC meeting in late March.

The word was passed on local repeaters and ARES nets. Within a very short time, practically every active ham in San Diego was alerted to the situation. Announcements were made at club meetings and published in club newsletters.

Pretty soon, I could not listen for very long on the local repeaters without hearing some discussion of the county ordinance. I had hundreds of QSOs with local hams offering suggestions, asking for details, requesting more petition forms, or offering to help. Petitions were distributed to local ham equipment outlets. They were available at the swap meet, were mailed out with club newsletters, and were distributed at meetings. Some hams filled up the ones they had and asked for more.

While all this was going on, LUER changed its mind. I learned that LUER would recommend an amendment to 75 feet to the County Planning Commission, which would consider it and make a recommendation to the Board of Supervisors. While 75 feet was not what we had in mind, it was at least an opportunity to get our foot in the door, so to speak, and sell our position. The hearing was set up for March 25 at 9 am, the morning after the SANDARC meeting at which petitions were to be returned.

Along with the idea of the petition, it seemed important to have as many hams as possible attend the hearing. A large turnout supporting our position would be persuasive. Again the word was passed on local repeaters and ARES nets. Everyone who could possibly take the time to come to the hearing was urged to go.

Prior to the hearing, I had sought the advice of John K6KOI, another local attorney with experience in land use and regulation matters. He and one of his partners met me for lunch and were able to make many extremely valuable suggestions as to how to best present our position to the Planning Commission. I sprang for lunch, and it was one of the best investments I've ever made. They were intimately familiar with the Planning Commission and what kinds of arguments would be most persuasive.

At the March SANDARC meeting, the delegates passed a motion commissioning me as their spokesman. A fairly impressive stack of petitions was delivered.

The next morning, about a dozen hams and I appeared at the hearing. I gave a presentation, much shorter than planned, since the Chairman refused to allow more than 5 minutes or so, in spite of the rules which allow each speaker 3 minutes, each of whom can cede his time to a spokesman, not to exceed a total of 15 minutes.

Paul WA6GDC spoke at the hearing to relate an incident which had occurred the previous evening. Paul is active in "Happy Flyers," an organization of ham-pilots. An ELT had gone off in the mountains east of San Diego. No one on the ground had heard it. It was reported by a jet plane passing over at 30,000 feet. Search and rescue teams had been dispatched and were then combing

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LETTERS

PLANNING

The ARRL's new Long-Range Planning Committee is seeking to obtain input and ideas from amateurs throughout the country. As the committee's first chairman, I have prepared the attached "open letter" to US amateurs to solicit (via the amateur radio press) their assistance with the work of the committee. I'm hoping that you would be willing to include it in an early issue of *73*.

Victor C. Clark W4KFC
Clifton VA

Dear Fellow Radio Amateur:

For more than sixty years, amateur radio in the United States has grown like Topsy, carried along on the wave of a galloping technology, without a great deal of thought being given to its long-range future. Having established during this initial half-century an impressive record of technical innovation and a growing repertoire of services to society, we have not done too badly.

But where are we going from here, and what will be our "basis and purpose" in the years ahead? Some express concern, for example, that the character of amateur radio in this country has been moving away from the technical aspects of yesteryear—the designing, constructing, and subsequent testing of home-built equipment. If, in fact, our technically-oriented justification for spectrum occupancy is declining, there is little evidence that the impact of such a trend upon our long-range future is being given a great deal of thought. Most of us recognize that amateur radio is changing and will continue to change, for our activities are closely linked not only to a rapidly changing technological field, but also to a dynamic society that confronts us with new obstacles, challenges, and opportunities for providing useful public service.

With a steadily increasing number of new amateurs, the spectre of more government intervention, and pressures on our frequencies and erstwhile freedoms (via WARC, changes in licensing regulations, revision of the Communications Act of 1934, the growing rash of restrictive antenna legislation, RFI problems, etc.), it becomes increasingly apparent that *all* of us—ARRL members and nonmembers alike—need to give much serious thought about where the Amateur Radio Service is or should be going in the decade ahead.

Long-range planning is hardly an exact science, but it *is* possible to anticipate some problems, to perceive certain distant opportunities, and to develop appropriate recommendations. If we put our collective heads together, perhaps we can do something to establish positive courses, rather than simply drifting and reacting to external events. But it will require a substantial amount of effort on a continuing basis by a number of concerned amateurs who are willing to assess the past for the guidance it may provide in planning for the future, rather than merely criticizing past decisions or failures.

As a method of providing a focus for a long-range planning effort, the ARRL's Directors at their January board meeting created a Long-Range Planning Committee (LRPC), set aside initial funding for its operation, and gave it the responsibility of "... reviewing and making recommendations to the Board concerning the programs which the League is and should be providing to its members and to the Amateur Radio Service ..."

At its initial meeting in February, the members of the LRPC—Dick Baldwin W1RU, Hazard Reeves K2GL, Charles Dorian W3JPT, Vic Clark W4KFC, Larry Price W4RA, Jay Holladay W6EJJ, and Herbert Hoover III W6ZH (with ARRL President Harry Dannals W2HD, ex-officio)—agreed upon a number of criteria governing its activities: No facet of the ARRL's operation was exempt from scrutiny and/or recommendations; the general welfare of the entire Amateur Radio Service was to be served, not just parts of it; and a subject as complex and far-reaching as the future of amateur radio and the ARRL could not be thoroughly appraised without the input of many different people ... ARRL members or not.

Therefore, if *you* have some thoughts, comments, and/or recommendations about the future of the Amateur Radio Service and/or the ARRL in general, or some very specific portions thereof, please let the LRPC have the benefit of your thinking. A letter or card sent to me at the address given below, marked for the attention of the LRPC, will be acknowledged, and I will make sure that your comments are made available to each of the members of the committee.

Vic Clark W4KFC
Chairman, LRPC
12927 Popes Head Road
Clifton VA 22024

It is interesting to see a leading director of the ARRL admit in print that the material we have been reading in QST *about the League providing guidance for amateur radio has been hogwash. Here is the admission that there has not been much thought given to long-range problems ... which anyone who has been keeping up with events knows all too well.*

Next Vic tries to put over that old saw about amateurs not building any more. I'm sick and tired of hearing that from the League ... it is a lie and a put-down for amateurs. The fact is that more amateurs than ever before are building and designing equipment. The percentage of the magazine ads for parts is proof positive of this. Just compare the parts advertised today with the meager parts ads of the 1930s, back when hams were really hams. Utter rot. In those days the construction projects filled two very small magazines ... we print more projects in a couple of issues than you could find in a year in the olden and golden days of ham construction.

Sure we're having problems with the FCC and with WARC. We are living in a much more political world than we were forty years ago and we are stuck with a sixty-year-old organization which is still somewhere back in the '30s politically. You deal with the FCC in a political manner, not with dockets and testimony or even with lawsuits. It is time the ARRL learned this and started dealing realistically with the world of the '80s. Remember that the FCC got backed down once and once only in recent years, and that was over the repeater rules. I organized that project completely and ran it with the ARRL refusing to cooperate, saying it wouldn't work. It did work ... and nothing else has.

The ARRL has funded almost identical efforts before. The directors set aside $100,000 to be used to help preserve amateur radio. Instead, it was used as a slush fund for vacations and other nonsense. There never has been an accounting of the expenses put to this fund ... and there never will be. So here we go again.

However, despite my cynicism, take Vic at his word and give him the input he wants. Let's see if anything happens this time ... and perhaps we can find out what they ever did with the $100,000 they set aside and kept replenishing for preserving amateur radio.—Wayne.

INTRUDER WATCH

Wells R. Chapin W8GI
507 Franklin
Kingsley MI 49649

Dear OM:

Your article, "Where Have All the kHz Gone?", in the June, 1977, issue of *73* made me realize that mine was not the only voice crying in the wilderness. Reminds me of Clair Foster and Boyd Phelps too many years ago.

Now for the record: I've been licensed since 1936 and an ARRL member almost that long. My *QSTs* go back to 1934. I view with alarm the "increased expenses" of this non-profit organization that requires all too frequent raises in dues. I view with alarm the high pay of the top management people in Newington and their all-expenses-paid junkets to overseas conferences, along with wives or secretaries. I view with alarm the loss of dedicated staff along with the "necessary" building addition.

I wonder about all those fine "services" provided to the membership. (My own attempt, once, to utilize their "Technical Information Service" was a disaster.) I wonder about their vaunted "Intruder Watch," which you mention.

Let me tell you about their "Intruder Watch." Two years ago, I was home recovering from an operation, so I scanned all the HF bands during the day to see what was going on, just as I did in 1938 when I was also home for reasons of health. The comparison in daytime ham activity between 1938 and 1977 was astonishing—the HF bands are *less* crowded now! It made me wonder about the great "band crowding" claimed by the ARRL.

But, getting back to the "Intruder Watch," I discovered during the day very strong Russian language *AM* nets, sometimes two or three, on frequencies around 3550 and 3650 kHz in our 80-meter CW band. These obviously were the foreign fishing boats right off the coast of Long Island, and they could be *seen*. This was before the 200-mile law went into effect.

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Contests

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

DAFG 10 METER CONTEST
Contest Period:
1200 to 1600 GMT
August 4, 1979

Note: This contest started In May, 1979, but information was received too late for entry in the contest calendar. This is therefore the second and final part of the test.

EXCHANGE:

RST, QSO number, name, QTH.

FREQUENCIES:

28075 to 28175 MHz, RTTY only!

SCORING:

Each station may be worked once. Each complete two-way RTTY contact counts as one point. The multiplier is determined by the number of countries worked. The European Country List (WAE) and the latest ARRL Country List will be used. In addition, each different prefix will be considered as a multiplier, too. The final score will be a total of the multipliers multiplied by the total of QSO points.

CLASSIFICATIONS:

Class A—up to 100 Watts output; Class B—above 100 Watts output; Class C—SWL.

LOGS AND ENTRIES:

Logs must contain name, call, and complete address of participant, class, call of station worked, complete exchange sent and received, country, final score, and time in GMT. Logs without final score will be considered check logs. SWLs—for points, multiply and score same as above. The same station may be reported a maximum of 5 times. Instead of exchange received, report call of station worked. Your log should be in the hands of the manager no later than 30 days after closing the test. Address entries to: Klaus K. Zielski DF7FB, PO Box 1147, D-6455 Erlensee 1, West Germany. Awards to the highest-scoring SWL and first five in each class.

BARC COMMEMORATIVE STATION

The Bancroft Amateur Radio Club will be operating a special commemorative station, XJ3TBC, 24 hours a day during the centennial "Homecoming Week" of August 11 to 18 from the Centennial Headquarters. CW and phone operation on all HF bands except 160 meters, VHF on 146.52 simplex, and repeater VE3TBF on 147.24/.84. Special QSLs for working XJ3TBC on receipt of your log information. A certificate award is available for working XJ3TBC on any three different bands on receipt of your log in-

Continued on page 141

Calendar

Aug 4	**DAFG 10 Meter Contest**
Aug 4-5	**ARRL UHF Contest**
Aug 25-26	**All Asian DX contest—CW**
Sept 8*	**DAFG Short Contest—VHF**
Sept 8-9	**ARRL VHF QSO Party**
Sept 9*	**DAFG Short Contest—SW**
Sept 11-12	**Kentucky QSO Party**
Sept 15-16	**Scandinavian Activity—CW**
Sept 15-17	**Washington State QSO Party**
Sept 22-23	**Scandinavian Activity—Phone**
Sept 29-30	**Delta QSO Party**
Sept 30-Oct 1	**Fall Classic Radio Exchange**
Oct 13-14	**ARRL CD Party—CW**
Oct 20-21	**ARRL CD Party—Phone**
Nov 3-4	**ARRL Sweepstakes—CW**
Nov 10-11	**CQ-WE Contest**
	IPA Contest
Nov 11	**OK DX Contest**
Nov 17-18	**ARRL Sweepstakes—Phone**
Nov 24*	**DAFG Short Contest—SW**
Nov 25*	**DAFG Short Contest—VHF**
Dec 1-2	**ARRL 160 Meter Contest**
Dec 1-3	**Connecticut QSO Party**
	North Carolina QSO Party
Dec 8-9	**ARRL 10 Meter Contest**

*** = described in June issue**

Reader Service—see page 179

RTTY Loop

Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

How did that Gershwin tune go? "Summertime, and the RTTY is easy"? Well, the season is upon us, and it's time to see what the mailperson brings.

Al Baketel K7ZMO of Kennewick, Washington, sends along his RTTY transmitting program, which he combined with the receiving program published in last year's RTTY Loop. Al has submitted it to the LFD-400 User's Group for owners of 6800 systems and Percom disks, and I am sure that users of compatible systems will appreciate his efforts.

Victor Johnson, in Minneapolis, Minnesota, writes requesting a similar RTTY program written for the H-8, the Heathkit 8080-based system. While there have been several RTTY programs published in the various ham magazines, I have yet to find one written specifically for the H-8. I do not know if the architecture of this machine would prevent using programs written for other 8080-based systems, but I invite any readers with information on such a program to drop me a line and let me know. Victor also asks one of the most common questions of newcomers to the Green Key set: "Where can I get equipment?" I would urge you all to check the ads in *73* carefully and make contact at your local ham club or clubs. Frequently you may be able to find a machine locally which would normally go unsold; let someone know you are in the market.

Another RTTY neophyte (or is it neo-RTTY-phyte?) is Jerry Strauss KB6BP (ex-WB6QIN), of Yorba Linda, California. Jerry followed a rather interesting course in his entry into RTTY. He notes that as an active ham for 15 years, he had always wanted to get into RTTY, but the thoughts of "all those gears, printers, etc." was totally foreign and somewhat frightening to him. So, when Radio Shack came out with the TRS-80 and a RTTY adapter was developed and marketed by Microtronics, he decided to kill the proverbial two birds and get into RTTY and have a computer, too. He states that the system worked well, but that there were problems. The most troublesome one he noted was the leakage of TRS-80 square waves into his receiver, particularly on twenty meters. So, Jerry followed the path most of us travelled in the other direction and bought a Model 28 and a HAL ST-5000. Now happy on RTTY, he is looking forward to the purchase of punched tape equipment soon. He also has thought about installing a spark gap, I suppose. Seriously, Jerry's letter raises an important point that needs to be emphasized more and more these days. You *don't* need all the super-modern gizmos with video displays, memories, and ASCII to enjoy RTTY. Whether you are using the lowliest thirty-year-old printer covered two inches deep in grease and dust or a $10,000 computer system with triple buffers and direct memory speed inversion, once that signal goes out on the air, it is the same 60-wpm Baudot code. We can all talk to one another. That's what makes it so much fun!

Jim Dollinger WB9QPY echoes that sentiment in another letter. While Jim is using all the "standards," Model 19, etc., he is also interested in video terminals and such. He would like to see more about UARTs, and we hope to have more about these interesting devices in the future. Jim also asks for tips to convert a TV set to a video display. The "source authority" (as they used to say on *Jeopardy*) for that information would probably be Don Lancaster's book, the *TVT Cookbook*, available most anywhere from Sams and now "second-sourced" by Radio Shack. Another description can be found in the July, 1977, issue of *Kilobaud Microcomputing*, page 30. Grant Runyan writes of "The Great TV to CRT Monitor Conversion," and that may be just what you're looking for.

Whew! With all this talk of sophisticated RTTY equipment and state-of-the-art techniques, we sometimes lose sight of the simple puzzles that confront the neo-RTTY-phyte (I like that word!). R.E. Ferguson, from Wolf Point, Montana, writes: "I have a Model 15 TTY. The line feed double spaces. Can this be changed to single line spacing?"

Well, R.E., the Model 15 was set up to provide either single or double line feeds. The double setting is commonly used in commercial press, where double-spaced copy is easier to read on the air or to edit for publication. I will admit that it has a tendency to waste paper when used on the ham bands and is less than desirable when someone is sending you a picture.

Fig. 1 is a diagram of the left side of the Model 15 platen as you face the machine. The Model 19 is the same, of course. The winged lever protruding out of the side is called, would you believe, the single-double line-feed lever. When the lever is up, the machine will line feed once upon receipt of a "line feed." When the lever is down, two line feeds are issued. I suspect your machine is set in the "down" double-line-feed position.

In case you have to adjust this mechanism, you may wish to operate the motor by hand, with "line feed" coded in to assess the way the pawl latches a toothed wheel to produce the line-feed action. This pawl is called the detent lever, and where it hinges is termed the "detent-lever eccentric screw." This screw, when rotated, changes where the pawl hits the ratchet that turns the platen. If, after checking the position of the "single-double line-feed lever," the machine is still double line feeding, you may need to turn the eccentric. Note, if you do, that there are two positions of the detent-lever eccentric screw which will provide correct adjustment. You should use the position which applies the least tension to the detent-lever spring and be sure that the detent roller rests in the bottom of a notch on the detent ratchet. To sum up, as with all adjustments to TTY machines: Good luck, don't force anything, and if you are not sure what you are doing, ask for help.

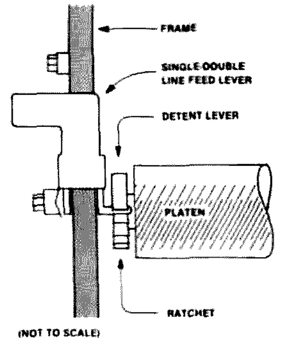


Fig. 1. Single-double line feed on the Model 15/19.

Quite a few responses have been received to the question about commercial RTTY frequencies. In general, a few points have come up. Commercial RTTY stations, if using Baudot code, are rarely following ham conventions. That means they frequently use strange shifts, like 425 Hz, speeds, like 67 wpm, and transmit "upside down," with high shift. Nonetheless, they are copyable if you know where to look and have equipment which can copy.

The shift problem can usually be obviated by "straddle tuning," with autostart and the like turned off. Most all converters can invert an upside-down signal. The speed problem is a little tackier, but a Model 15 will copy 67 wpm with adjustment of the range control, usually. Those of you with Model 28 systems or computers should have no problems.

As far as where to look, there is really all kinds of advice. The September, 1977, issue of *73* carried an article on page 52, "RTTY SWLing," by Webb Linzmayer, which presented several long lists of signals copied that year in New Jersey. Bob Melville K3WRV passes along the guidance to look around three and seven MHz, where he finds quite a few interesting signals.

Bill Mauldin, of Boca Raton, Florida, passes along the information that the Voice of America operates on 14638 kHz, 100 wpm, with full-time news, in English and Spanish. Weather information is all over the place; one might try 10950 kHz, 16440 kHz, 8110 kHz, 8130 kHz, and 18765 kHz. All of these are also 100 wpm, 850-Hz shift. The weather transmissions use the "weather" code, which uses different symbols to represent cloud cover, etc. We will cover interpretation of some of these codes in a future column.

So scout around and let me know what you find. If I hear it, too, so much the better! I will try to pass along any good information to you all, the links in the RTTY Loop.

Ham Help

I am in need of a manual or schematic for a Hallicrafters general coverage receiver, model S-38D. I will be happy to pay any postage or duplicating costs.

William P. Smith K3LF
RD#2,
Cold Spring Creamery Rd.
Doylestown PA 18901

Can anyone help me find a manual and schematic for an Allied AX-190 receiver? I would appreciate any help.

Mike Marmer KB8GH
2749 Symphony Way
Dayton OH 45449

I would like to get in touch with hams who are former members of the Civilian Conservation Corp (C.C.C.).

Joseph Schwartz K2VGV

New Products

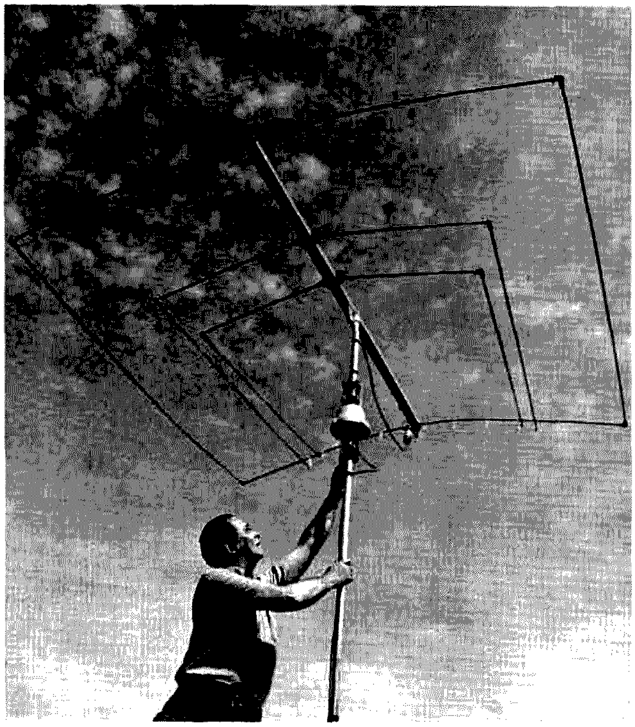
TEMPO INTRODUCES NEW K6FZ MINIATURE TRIBANDER ANTENNA

Henry Radio has announced the full availability of a new miniature K6FZ 20/15/10 meter tribander antenna under its Tempo brand name. Measuring only 8 feet square, the new antenna is based upon a full half-wave-long constant-current loop design using capacitive phase shifters in the outer arms to achieve front-to-back ratios on the order of 15 dB. Gain over a full-size dipole is 1 dB.

The new Tempo tribander is constructed mainly of exceptionally strong and lightweight fiberglass antenna rods made by Monogram Industries. A copper conductor is positioned centrally in each rod. The basic antenna is the 20 meter loop (onto which the smaller 15 and 10 meter loops can be mounted optionally). Elements screw or snap together in a matter of minutes to simplify assembly or disassembly, a feature of particular interest to field day and DXpedition enthusiasts. The overall weight of the tribander is 14 pounds, and the antenna can be rotated, if desired, by any inexpensive TV rotor.

In addition to its more than adequate front-to-back ratio and gain, considering its small size, the bandwidth on 20, 15, and 10 is exceptionally wide. The 20 meter resonant frequency is set by rotating a knob in the boom to any desired spot. On 10 and 15 meters, the user can select operation on either phone or CW. The power rating is a full kilowatt. One common 50-Ohm feed is used for all three loops, and swr is adjustable to 1:1 on 20. It is almost as low on the other two bands.

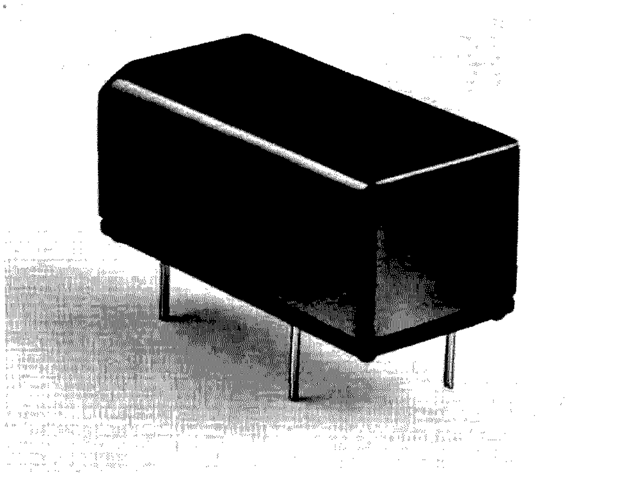
Looking like a TV antenna to laymen and angry neighbors, the new Tempo tribander can be the answer to the amateur "shut-in." Where rooftop mounting is not possible, the antenna can be hung in an attic, in a tree, or just about anyplace and still put out a creditable signal. For further information, contact *Henry Radio, 11240 W. Olympic Blvd., Los Angeles CA 90064; (213)-477-6701.* Reader Service number H3.



New Tempo miniature tribander.

DIP NICKEL CADMIUM BATTERIES ANNOUNCED BY PANASONIC

Two models of DIP (dual-in-line) nickel cadmium batteries for easy mounting on printed circuit boards are now available from the Electronic Components Division of Panasonic Company. Designated as "MEMORY MOUNT™" nickel cadmium, the new batteries are available in two voltage ratings —2.4 and 3.6 V dc—with the capacities of 110 mAh. The rectangular DIP package offers pins that have standard PC-board spacing.

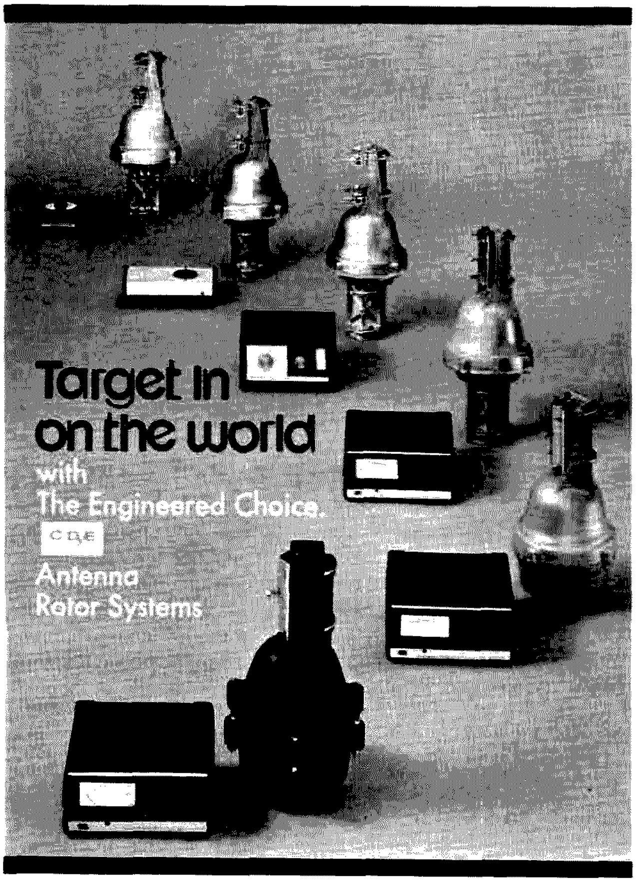


Panasonic's new DIP nickel cadmium battery.

To prevent accidental battery discharge during the widely-used wave soldering of PC boards, the new DIP batteries are available in the discharged state. Once they have been soldered into the PC board, they can be charged to the desired capacity.

The new DIP batteries offer standard high-performance characteristics of Panasonic nickel cadmium rechargeable batteries. These include good capacity retention, 500 or more charge-discharge cycle capability, and high degree of cell uniformity.

These new batteries will be available after July. For further information, contact *Panasonic Company, Electronic Components Division, One Panasonic*



CDE's new antenna rotor brochure.

Way, Secaucus NJ 07094; (201)-348-7136. Reader Service number P31.

NEW BROCHURE DESCRIBES COMPLETE LINE OF CDE ANTENNA ROTOR SYSTEMS

Cornell-Dubilier Electric Corporation has released a new eight-page color brochure presenting their complete line of antenna rotor systems. Each of the six rotor systems is illustrated and described.

They include: the Tailtwister™, designed for king-sized antenna arrays of up to a 30 sq. ft. wind load area; the new Ham IV™, the latest version of the world-famous Ham series; the new CD 45, incorporating professional features at a popular price; the BIG TALK™, with IC control that lets you preprogram locations most commonly used; the AR 40, a deluxe unit with solid-state accuracy and silent operation; and the AR22XL, a popular system with automatic control. Included in the CDE Antenna Rotor Systems brochure is a breakaway photograph of the time-tested Bell rotor.

For further information, contact *Leonard Sabal, Cornell-Dubilier Electric Corporation, subsidiary of Federal Pacific Electric Company, 150 Avenue L, Newark NJ 07101; (201)-589-7500.* Reader Service number C143.

SENCORE INTRODUCES NEW IN-OR-OUT-OF-CIRCUIT POCKET CRICKET TRANSISTOR TESTER

Sencore has recently introduced a new pocket-sized transistor tester to meet the increasing need of solid-state field service. Battery-operated, and weighing only 14 oz., the Pocket Cricket is totally prepared to check virtually all transistors and FETs on the market, in or out of circuit. No setup book or transistor data is needed at all to check transistor gain and leakage between all transistor elements. This patented new device has the unique capability of automatically connecting the test leads for test, regardless of how they are connected to the transistor. For test lead identification, a 12-position switch is rotated through all positions until the Cricket "chirps." The chirping noise notifies the user that the leads are connected correctly and the switch control points to the test lead connections. Gain is simply read as good or bad on the meter scale for fast field operation.

The TF54 Pocket Cricket also identifies the component being tested as a transistor or FET during the test, should the user not be able to identify a replacement transistor. The company claims 99.9 percent testing reliability.

New features, not found on small transistor testers made by Sencore, include solid action bat handle switches, a D'Arsonval meter movement for more accurate leakage measurements on critical transistors, and an automatic off circuit that turns the instrument off after 10 minutes of use (to save batteries). The instrument can be ac-operated on the bench with an optional PA208 power adapter. Other accessories include a three-pronged touchtone probe (part no. 39G85) for easy connection to a printed circuit board and a highly durable leatherette carrying case (part no. CC217).

For further information, contact *Sencore, Inc., 3200 Sencore Drive, Sioux Falls SC 57107; (605)-339-0100.* Reader Service number S102.

Optoelectronics' new PDT-590 digital thermometer.

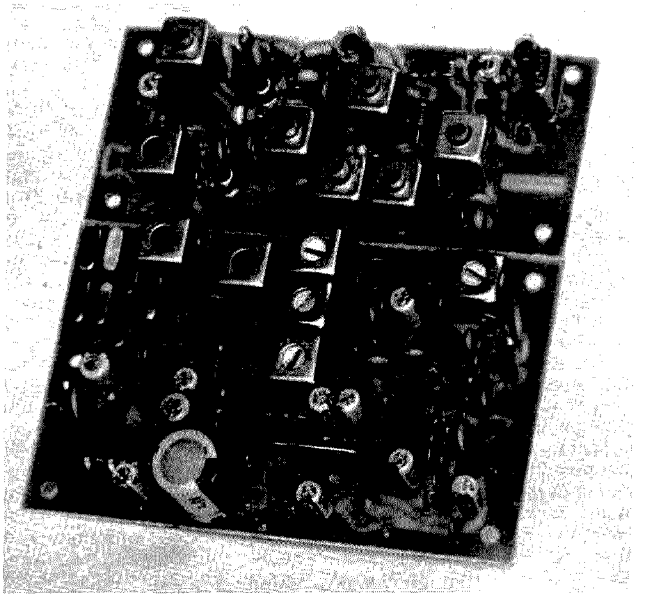
PRECISION DIGITAL THERMOMETER

Optoelectronics' new precision Celsius/Fahrenheit digital thermometer has .1° resolution and two sensors (switch-selectable). The PDT-590 has a −50° C to +150° C (−60 to +200° F) temperature range with better than ±.7° accuracy. Two laser-trimmed temperature-to-current transducers can be remoted over hundreds of feet of two-conductor cable without noise pickup. The switch-selectable Fahrenheit or Celsius temperature is displayed on four .43-inch high-intensity LEDs. The PDT-590 is enclosed in an attractive heavy-duty bronze aluminum case and is provided with a 115 V wall plug transformer for ac operation. Optional internal nicad batteries provide several hours of portable operation. Size: 1¾" H x 4¼" W x 5¼" D; weight: 14 ounces. For further information, contact *Optoelectronics, Inc., 5821 N.E. 14th Avenue, Ft. Lauderdale FL 33334; (305)-771-2050/1.* Reader Service number O3.

VHF FM RECEIVER KITS FROM HAMTRONICS

Hamtronics, Inc., has just announced an exciting new series of VHF FM receiver kits. The model R75 is the fourth generation receiver by Hamtronics, and it incorporates all the design features of the previous designs—plus some new ones. The chief feature of the R75 series is a wide range of selectivity options. Four models, with different crystal filters, provide the optimum selectivity for each type of service, ranging from

Sencore's Pocket Cricket.



A Hamtronics VHF FM receiver board.

±30 kHz at −60 dB for weather satellite reception to ±15 kHz at −100 dB for demanding split-channel repeater service. Other features include increased sensitivity, smaller size, and easy construction. The 4- x 4¼-inch receiver consists of two PC boards, allowing for mounting flexibility. Kits are available for the 10m, 6m, 2m, and 220-MHz ham bands. They can also be used on adjacent commercial and weather satellite frequencies.

For more information, contact *Hamtronics, Inc., 65F Moul Rd., Hilton NY 14468; (716)-392-9430.* Reader Service number H16.

MFJ's Signal Enhancer II.

A LOOK AT THE SIGNAL ENHANCER II

In the fifties and sixties, the best way to improve receiver selectivity at low cost was to add one of the outboard devices popular then, such as a Q-multiplier (which worked on the set's i-f stages) or a war surplus radio range filter (which was inserted in the set's headphone lead). Both methods left a lot to be desired.

It seems that suddenly hams have discovered that the easiest—and in some ways, most cost-effective—way of improving receiver selectivity is to add an outboard audio filter. The popularity of these so-called "active" filters has not been lost on manufacturers either—perhaps a dozen make these handy accessories, including Kantronics, Datong, Electronic Research Corporation of Virginia, Dynamic Electronics, Palomar Engineers, Waneco Radio, Autek Research, and MFJ Enterprises.

MFJ has come up with several good designs, each one better than the one preceding it, with each mod adding new convenience features. Their latest "maxi-filter" is the Signal Enhancer II, a very attractive dual tunable design intended to remove interference from SSB, AM, CW, and RTTY signals. The ads for the new filter stressed its flexibility and improvements over earlier models, so I arranged with the hams at MFJ to put one of the new filters to work in my ham shack.

The Model 752 filter arrived on a Friday afternoon, and by that evening I had digested the installation instructions. From the instructions, I learned that the 10" x 2" x 6" cream-and-walnut cabinet contains not one, but *two*, independent filters. The main filter is a two-section, four-pole variable filter with four major functions: peak, notch, lowpass, and highpass modes. There is also a second "auxiliary" filter having peak and notch functions only. (The idea of having two filters is to allow you to peak or "enhance" the desired signal while at the same time you remove or "notch out" QRM.) The four-page instruction manual and the catalogue that was included in the shipping package told the facts: The main and auxiliary filters allow selectivity down to 40 Hz bandwidth, variable over the frequency range of 300 to 3000 Hz, and the notch depth goes all the way down to 70 dB. Six front-panel controls allow function selection (bypass, on, and SSB or CW noise limiter), main filter operating mode (peak, notch, lowpass, or highpass), and main filter selectivity and frequency adjustment. There are also two controls for the auxiliary filter, which can be operated simultaneously with the main one. The auxiliary selectivity control has a push-in, push-out feature so that either the peak or notch function can be selected with a gentle push on the control knob.

The filter came complete with a 110-volt power supply; it's of the "external power adapter" types commonly used with portable radios and small tape recorders. The filter will also run directly from any 9-18-volt source of filtered dc. The audio from the rig is connected to the filter input by means of RCA-type phono plugs; the MFJ-752 can accommodate two inputs which are selected by a rear-panel slide switch, allowing you to connect two rigs to the filter. A standard (¼") phone jack is used to hook up your regular station speaker; the speaker line is disabled whenever headphones are inserted into the headphone jack on the rear panel. I should point out that this jack is of the *2-circuit* (stereo) type; it's best used with stereo headphones to take advantage of the so-called "simulated stereo" feature. (When you use stereo phones, unfiltered audio directly from the receiver is fed to one earphone; the other ear gets "processed" or filtered audio. Mono headphones can be used if the stereo feature isn't wanted. More on this later.)

The power switch is the main control. When power is off, the filter is cut out of the circuit and audio is routed directly to the speaker or headphones. In the "on" position, the filter is in business, without the noise limiter feature. Going to NL/SSB or NL/CW, noise limiters are cut in that are designed to limit impulse noise peaks and remove background noise.

Having owned the Autek QF-1 and QF-1A filters, both excellent units, I found tuning and adjustment a bit more complicated using the Signal Enhancer II—possibly because there are more knobs to turn! Once I got the hang of it, though, I found that it did a good job on both CW and SSB in slicing through QRM and QRN. On CW, I could zero-in on the desired signal in the peak mode and almost completely eliminate other signals by carefully adjusting the selectivity and frequency controls. I found that the lowpass mode was "super" for CW work; signals could be boosted even more so than in the peak mode, and this mode gave more audio output to boot. (Because circuit gain rises in the lowpass mode, you have to watch the input audio level to prevent overdriving the filter with consequent distortion.)

I also prefer using the lowpass mode on SSB, although peak and notch can also be used depending on QRM conditions. If heterodyne QRM is the major problem, you can run in the notch mode, adjusting the frequency control to null out the offending signal. You can run in any main filter mode and cut in the auxiliary filter in either the notch or peak modes. For instance, you can, when working SSB, operate the main filter in the peak mode, adjusting the frequency and bandwidth controls for best audio response, and then—using the auxiliary filter—notch out any annoying heterodyne. On CW, you can kick in both the primary and auxiliary filters to yield very "tight" selectivity with little ringing, or you can peak with the main filter and notch out another signal with the auxiliary filter. The possibilities are almost endless and are really limited only by your imagination and dexterity!

I found the noise limiter circuits very useful, even though my transceiver (a Tempo 2020) has a built-in noise blanker. The limiters were especially helpful when used in conjunction with my Yaesu FRG-7, whose ANL (automatic noise limiter) works only on AM signals. The limiters did, however, cut down on the filter's audio output (particularly noticeable when using a speaker rather than headphones), and the CW limiter had to be used judiciously (as it could be overloaded and start to "chop" the desired signals if the receiver's audio gain were run too high). The trick is to set the audio or rf gain on your rig at the right level so that the signal is passed but the noise is blocked.

A tinkerer, I also tried the MFJ filter with my KLM-2700 multimode 2-meter transceiver and with a JC Penney 6237 AM CB base station set. The filter worked surprisingly well with the KLM rig, especially on SSB and CW where there is no provision to install optional, sharper i-f filters. On FM, there was no noticeable selectivity improvement, although the filter's controls could be adjusted to modify and enhance the set's audio response. When using the MFJ unit with the Penney CB transceiver, a very noticeable improvement in selectivity was obtained, and it was easy to null out AM carrier heterodynes. The noise filter was effective with both units (even on FM), despite the fact that the KLM rig has a built-in noise blanker and the Penney CB set is equipped with an adjustable noise limiter.

The "simulated stereo" feature took some getting used to, but has its place, particularly on CW. The idea is to have "raw" receiver audio fed to one ear and filtered or "processed" audio fed to the other. This unique feature allows you to copy off-frequency stations in one ear while you simultaneously hear "single-signal" audio in the other; the brain hears all the signals, but the processed signal stands out from the pack. I found that working in the simulated stereo mode cuts down fatigue as well. The kind of phones with individual volume controls on each ear work best, since you can easily strike a balance between processed and unprocessed audio levels.

A couple of cautions are in

Continued on page 130

Microcomputer Interfacing

David G. Larsen
Peter R. Rony
Jonathan A. Titus
Christopher A. Titus

In many analog-to-digital converter applications, it is too expensive to dedicate one A/D converter to each sensor. An alternate approach is to share one A/D converter among several sensors. This is called *multiplexing*, since many signal sources share a common transmission path to a single receiving device, in this case, the A/D converter.

A multiplexer may be a rotary switch having multiple taps or positions (Fig. 1), a small-signal reed relay available in a dual in-line package (DIP) the size of a 14-pin or 16-pin integrated-circuit device, a semiconductor switching device based upon *complementary-metal-oxide semiconductor (CMOS) or metal-oxide field-effect transistor* (MOSFET) technology, or a complex communication device used by the telephone companies. Some of the advantages of semiconductor switches that make them practical for multiplexers are: 1) small size, i.e., housed in a standard dual in-line package; 2) directly compatible with TTL signals; 3) built-in on-board digital decoders for channel select; 4) positive and negative signal inputs, i.e., bipolar operation; 5) high speed switching; 6) long life, i.e., no mechanical wear; 7) low contact resistance, less than 100 Ω; and 8) high off-state resistance, 100^9 Ω typical.

Semiconductor switches are not ideal devices, and they too have some limitations or constraints that must be considered prior to their use in multiplexer circuits. Almost all such switches require two power supplies, typically +15 V and −15 V. Signal inputs cannot exceed these potentials without damaging the device. Most of the semiconductor switching devices, particularly the CMOS and MOSFET devices, are easily damaged by static electrical discharges, such as those produced by synthetic fabrics, rugs, etc. Newer designs incorporate static protection devices within the multiplexing integrated circuit device. Early semiconductor switches were susceptible to a problem called *latchup*, which caused them to act as though they were silicon-controlled rectifiers. Once they were turned on to pass a signal, they refused to turn off until the input signal reached zero volts.

A variety of signal sources can provide outputs to be multiplexed. These outputs can include low-level thermocouple signals, high-level pressure transducer outputs, dc and ac outputs, and high and low frequency outputs. These types of signals may all be multiplexed successfully, although some premultiplexer and post-multiplexer signal conditioning may be required. As an example, low-level signals may require amplification before they are input to a multiplexer, since transient signals may be large enough to cause significant errors in the low-level multiplexer output. If necessary, the resulting amplified and multiplexed signal may be attenuated after being multiplexed. Alternatively, a post-multiplexer filter could be used to remove un-

Continued on page 136

GLOSSARY

Bandwidth	The ability of the multiplexer to pass a signal at a particular frequency once it is turned on. The bandwidth is the −3 dB point and is equivalent to the *small-signal bandwidth* associated with sample-and-hold devices.
Crosstalk	A measure of the amount of a signal input to an "off" channel that appears at the output of the multiplexer superimposed upon the signal passed through the "on" channel. This is a direct function of the frequency of the signals, since the semiconductor switches are capacitively coupled within the integrated circuit chip. The higher the frequency, the greater the crosstalk. This phenomenon is similar to the *feedthrough* problem associated with sample-and-hold devices.
Settling time	The time necessary for the multiplexer's output to be within a certain error percentage of the input signal once the channel is *selected*, or turned "on." This time may be specified either as the switching time of the semiconductor switch plus the analog output settling time, or as the analog output settling time alone.
Switching transients	Transient voltage spikes that appear at a multiplexer's output when the multiplexer is switched from one channel to another and one of the switches is turned off. Such spikes may cause inaccurate measurements if the output is sampled, digitized, or integrated during this time.
Throughput rate	A measure of the fastest channel-to-channel switch rate that may be used if the rated accuracy, generally 0.01%, is to be achieved.

AD7506

A_3	A_2	A_1	A_0	EN	"ON"
0	0	0	0	1	1
0	0	0	1	1	2
0	0	1	0	1	3
0	0	1	1	1	4
0	1	0	0	1	5
0	1	0	1	1	6
0	1	1	0	1	7
0	1	1	1	1	8
1	0	0	0	1	9
1	0	0	1	1	10
1	0	1	0	1	11
1	0	1	1	1	12
1	1	0	0	1	13
1	1	0	1	1	14
1	1	1	0	1	15
1	1	1	1	1	16
X	X	X	X	0	None

AD7507

A_2	A_1	A_0	EN	"ON"
0	0	0	1	1 & 9
0	0	1	1	2 & 10
0	1	0	1	3 & 11
0	1	1	1	4 & 12
1	0	0	1	5 & 13
1	0	1	1	6 & 14
1	1	0	1	7 & 15
1	1	1	1	8 & 16
X	X	X	0	None

Truth Tables

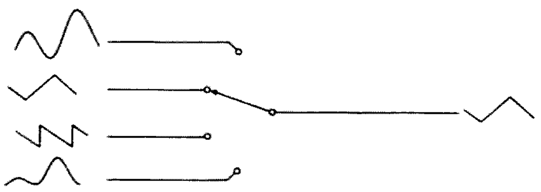


Fig. 1. Simple rotary switch multiplexer showing four possible inputs.

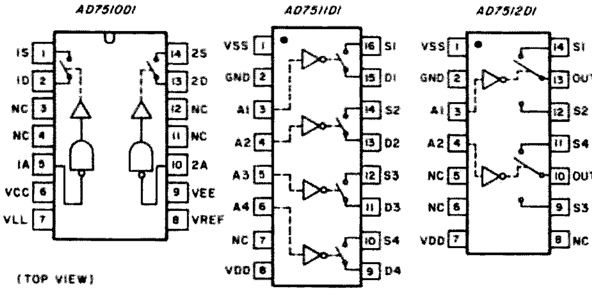


Fig. 2. Pin configurations of typical multiplexers that do not have decoding logic.

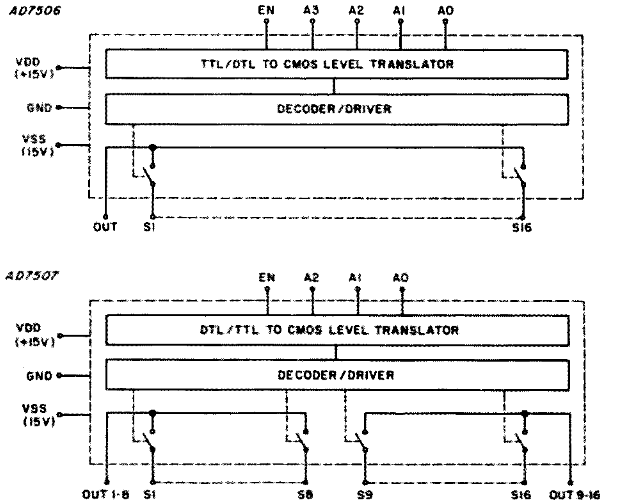


Fig. 3. Block diagrams of typical multiplexers with on-chip decoders.

Awards

Bill Gosney WB7BFK
4471 40th N.E.
Whidbey Island
Oak Harbor WA 98277

Welcome to *73*'s new "Awards" column. To offer some variety, both domestic and DX-type achievements will be outlined here. Naturally, I must ask our readers to submit additional award news and information as it becomes available. I would like to encourage you to check with your local radio club to see if they might have an award they sponsor which would be of interest to our readers. Ask them to submit a copy of their award program rules along with a sample copy of the award certificate.

Just the other day I received a cheerful note from Tom Owens K7RI, president of the Western Washington DX Club. Tom, along with awards chairman Morris Shepard W7LVI, provided me with the latest up-to-date information about the Washington Totem Award, sponsored by their DX organization.

The Washington Totem Award was initiated in 1973 by the Western Washington DX Club, thus becoming the first major W7 award available to the amateur community. It used as its motif the colorful totem pole, symbolic of the Indian culture of the Pacific Northwest.

The first award was issued to 9X5NA; to date, 133 awards have been issued to 61 DX countries. To qualify:

1. Applicants must submit proof of QSOs with 100 different Washington stations. Twenty (20) of these must be confirmed contacts with different Western Washington DX Club members. DX stations need only confirm twenty-five (25) Washington stations including ten (10) WWDXC members.
2. General certification rules apply. Submission of QSL cards is not required. Cards may be checked and certified by an officer of any recognized club or society. DX stations may submit log data in lieu of QSL card confirmation.
3. To be valid, all contacts must have been made January 1, 1973 or later.
4. Certified lists submitted must be in alphabetical order, with date and time in GMT.
5. The Washington Totem Award is free to all stations outside of the United States. US stations must include an application fee of $1.00. If QSL cards are sent to WWDXC for checking, sufficient postage for their safe return must be included with the application and confirmation list.
6. Special endorsements will be issued for specific band or mode accomplishments if all supporting information is included with the application.
7. The WWDXC will furnish a current membership listing upon request (and SASE). Mail all inquiries to: Awards Manager, WWDXC, Inc., PO Box 224, Mercer Island WA 98040, USA.

I might hint to our readers wishing to seek this award that members of the Western Washington DX Club sponsor three DX Nets daily. To be part of the "W7PHO Family Hour," tune to 14.225 MHz at 1400 and 2300 GMT and to 21.320 MHz at 0000 GMT daily.

While on the subject of domestic awards, particularly those from Washington State, I cannot go without mentioning the awards program sponsored by the Boeing Employees' Amateur Radio Society, more commonly referred to as the BEARS. The BEARS offer quite an array of incentives for parchment pursuers. Let's take a closer look at each one individually:

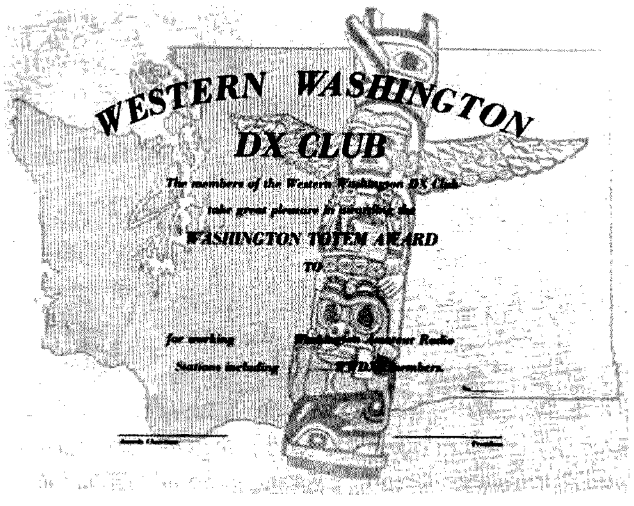
WORKED FIVE BEARS AWARD

This award is offered for those stations confirming contact with at least five (5) members of the Boeing Employees' Amateur Radio Society. There are no band, mode, or time restrictions. General certification rules apply.

WORKED THREE BEAR CUBS AWARD

Issued specifically to any station confirming contact with at least three (3) Novice members of the Boeing Employees' Amateur Radio Society. There are no

Continued on page 139



You Can Watch Those Secret TV Channels

—a complete MDS receiving system

Good-bye, commercials!

Jim Barber K0JB
Rt. 1, 22518-97th Ave. North
Rogers MN 55374

Jevon Lieberg K0FQA
Rt. 1, 12285 Genereux Place
Rogers MN 55374

Did you know that there are two secret TV channels? Nobody advertises them, and you can't even buy a TV set that has these channels.

How long have you been complaining about all the commercials while watching your favorite program or a late night movie? Well, here is the answer to your prayers—*these channels don't even have commercials!*

The programming on these channels consists of movies (P-, PG-, and R-rated), nightclub acts, and sporting events. They are allocated to Multipoint Distribution Service (MDS). The existence of these channels was written up in *73* last November.[1]

If you have heard of MDS via other amateurs, friends, or magazine articles, your curiosity has probably urged you to be on the lookout for a receive system you could build yourself. If this is true, read on!

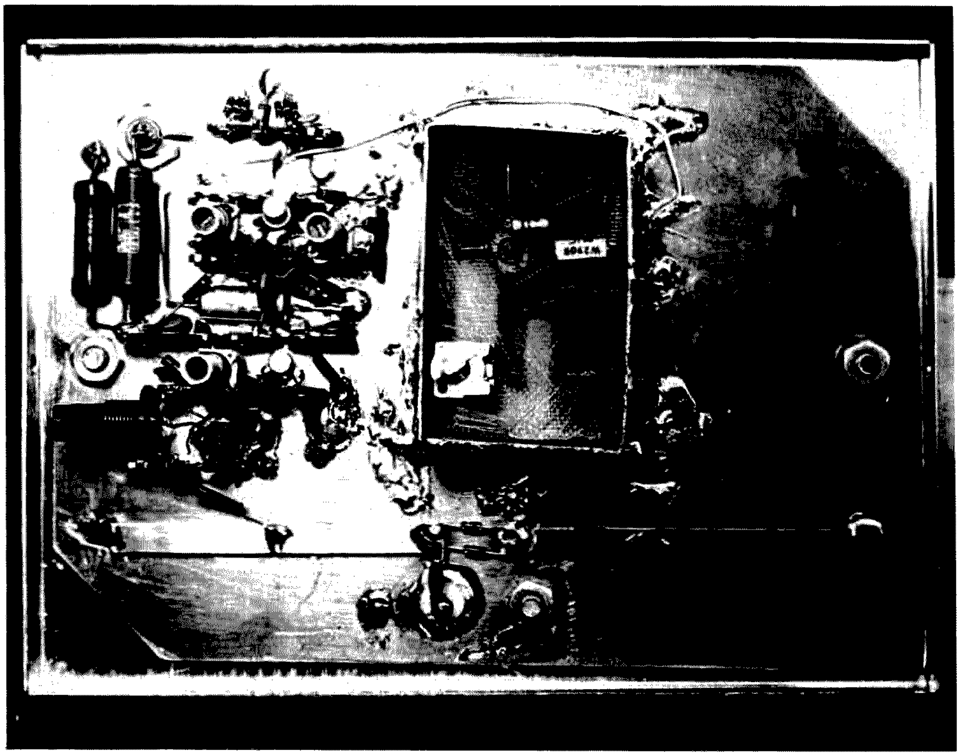


Photo A. This is a close-up of the downconverter showing i-f amplifier, mixer, and the local oscillator in its brass box with the cover removed. The piece of angle aluminum used to mount the box to the mast can also be seen.

The MDS Receive System

In this article we will give complete construction details on how to build a cheap and simple MDS receive system. This system will include the antenna, mixer, local oscillator, i-f amplifier, power supply, and complete mechanical layout.

The frequencies of the two microwave MDS video channels are 2154.75 MHz for channel 1 and 2160.75 MHz for channel 2. The audio is 4.5 MHz below the video. For more detailed information about microwave TV, read *A Vidiot's Guide to Microwave TV* by Paul Shuch.[2]

Locating the MDS Transmitter

If you have seen or

heard of small dish antennas located on apartment buildings or hotels, this indicates that there is an active MDS channel nearby.

There are several ways to locate the source of the MDS signal in your area. If your city has an FCC office, they will have a list of all allocated frequencies and the locations of the transmitters. This list is on microfiche and is public information. Stations are listed by their frequency, so look up both MDS channels. The location will be given by latitude and longitude; with a good map, you will be able to pinpoint it.

Another way is to note the direction of several receiving antennas on buildings and use triangulation to find the transmitter. If you can find out the name of the company offering MDS service locally, just call and ask them. One thing is certain—it will be located on one of the highest structures around. After all, their objective is to be line-of-sight to as large an area as possible.

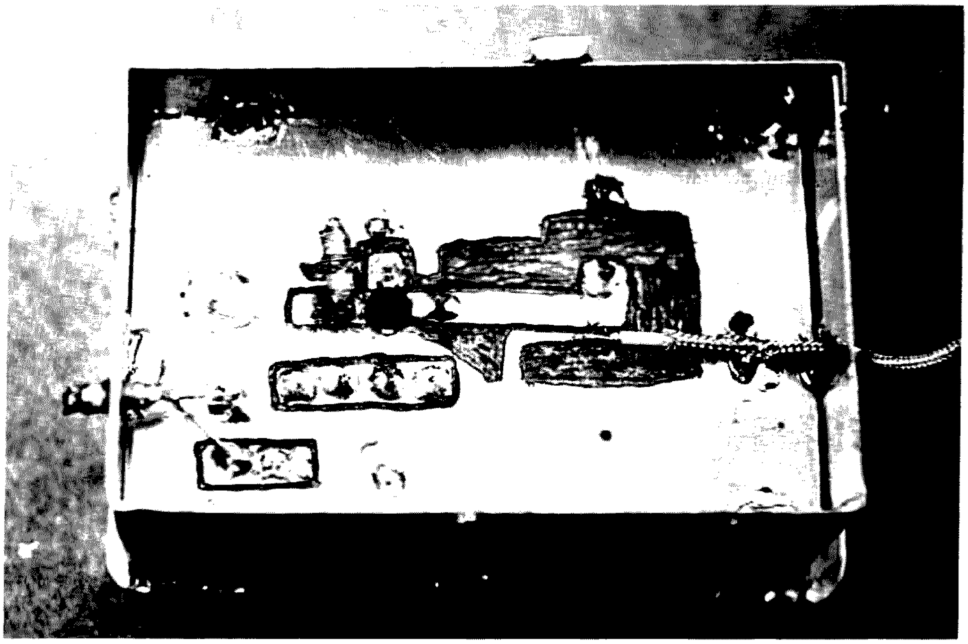


Photo B. This picture shows a close-up of the foil side of homemade printed circuit board used for the local oscillator. Note the modified feedthrough capacitor used for a base bypass capacitor. A 270-pF disc with very short leads also can be used.

Checking the Receive Path

After finding the source of the MDS signal, you must confirm your location as being suitable for good reception. As you know, microwave signals generally travel only in a straight line, and obstructions such as trees and buildings severely attenuate the signal strength. As a rule of thumb, if you can see the building or tower where the MDS transmitting antenna is located, no matter how distant, then you have a very good location.

If you are line-of-sight, you will not gain much by increasing the height of the antenna. In other words, don't put your antenna at the top of your fifty-foot tower if you can see the location of the signal source from your living-room window. Some obstructions can be tolerated if not too severe, and the signal loss can be made up through the use of preamplifiers and/or a larger antenna.

Circuit Description: Mixer

The mixer is the secret to a good microwave downconverter. It normally contains most of the critical parts and generally is the most difficult to construct. I think we can speak from experience on this subject, having built the interdigital converter by WA2CQH,[3] the high-performance balanced mixer for 2304 MHz by WA2ZZF,[4] and the solid-state 2304-MHz converter by K2JNG, WA2LTM, and WA2VTR.[5] Then, along came the October, 1978, *Ham Radio* magazine, with Jim Dietrich and his twin-diode mixer article.[6]

This mixer is so simple that you find it hard to feel that you have earned the quality of the signal that comes out of it. The mixer consists of two half-wave lines mounted above a ground plane. The first half wave is grounded on one end, and the other end has a pair of back-to-back diodes connecting it to the second half-wave line. This second line is open on its far end, and the i-f output is taken from the center of it.

The rf input is at the diode end of the second half-wave line, and the local oscillator input is at the diode end of the first half-wave line. (See Fig. 1 for detail.) The input circuit at the rf port is a high-pass filter to keep the i-f energy from getting out of the rf port. This filter also keeps the antenna input at dc ground. The output circuit at the i-f port is a low-pass filter to keep the LO out of the i-f. For a more detailed description of the mixer, read Jim Dietrich's article.[6]

The diodes used in the original article were MA4882. We were unable to get these locally, so we used Hewlett-Packard 5082-2835. This is a very

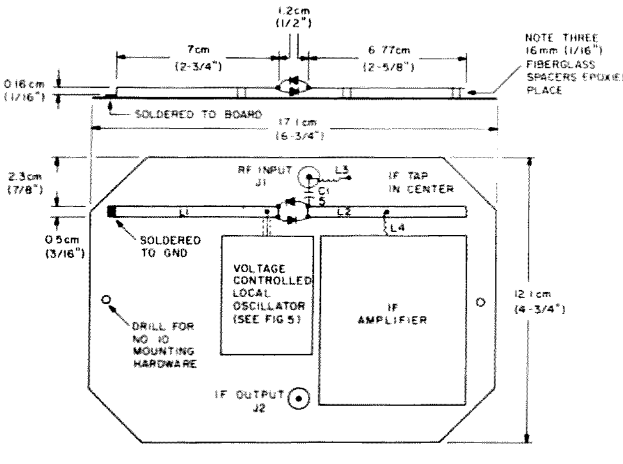


Fig. 1. General layout of the downconverter and construction details of the twin-diode mixer. J1 is a type N or BNC. J2 is an F61 TV-type connector.

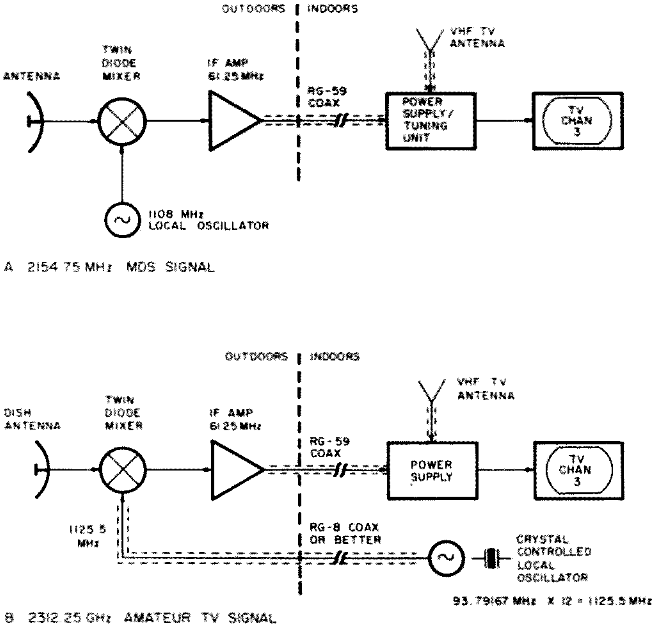


Fig. 2. (a) Block diagram of MDS receive system as described in this article. (b) Block diagram using alternate crystal-controlled local oscillator. Frequencies shown are correct to convert down to standard VHF TV channel 3 (video).

fine inexpensive diode for microwave mixers, but H-P does not give a noise figure rating for it. Any good Schottky diode can be in this circuit, but if you want to know its noise figure rating, you will have to pay more. The 2835 is about $1.10, and the prices go up from there. A good compromise, possibly, is H-P's 5082-2817. It has a 6-dB noise figure at 2 GHz and costs only $1.85.

Block Diagram

The block diagram shown in Fig. 2(a) is representative of the MDS receive system as described in this construction article. This system consists of a mixer, voltage-controlled local oscillator, and i-f amplifier located at the antenna, and the combination power supply/tuning unit, located at the TV set. The RG-59/U feedline then performs the dual purpose of carrying the i-f signal down the line to the TV and carrying the power supply/tuning voltage up the line to the converter.

This results in a nice, cheap, and efficient system requiring no expensive feedline and connectors and a minimum of critical circuits. No special test gear is required for tune-up.

The block diagram shown in Fig. 2(b) is one of many configuration alternatives possible and is shown mainly to provoke some thought about other uses for the basic system. An example of another use would be for fast-scan amateur television where the usual DX signal would be much weaker than an MDS signal, and the guesswork of tuning is eliminated through the use of a crystal-controlled local oscillator.

Circuit Description: The Local Oscillator

Building a satisfactory local oscillator is the next hurdle one must overcome in the construction of a microwave converter. You will be thankful to know that the twin-diode mixer helps us here, too, because this mixer requires an LO running at only half the frequency needed for other mixers.

In this system we have done away with all the drudgery of those crystal-controlled oscillator/multiplier chains also and settled on a nice simple free-running oscillator.[8,9] This oscillator has a tuning range of about 900-1300 MHz and a power output capability of several milliwatts. You might ask, "Is that possible? Won't it drift?" The answer to both questions is "yes." Not only is it possible, but it's also very simple.

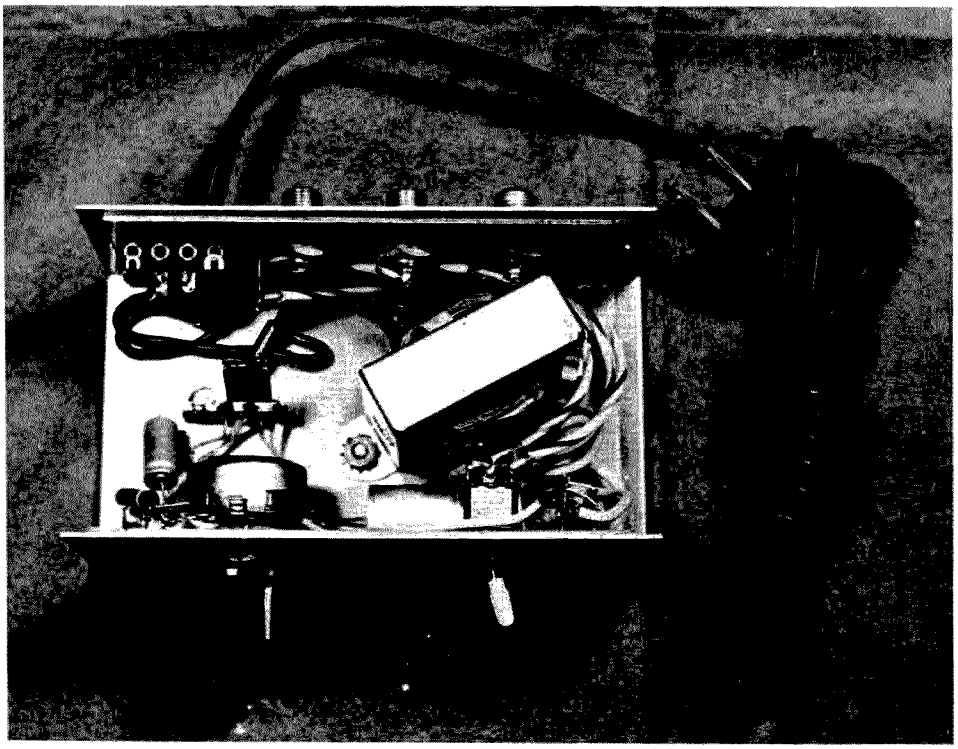


Photo C. This is a top view of the power supply/tuning unit.

The oscillator consists of a printed circuit board with an etched inductor, a Motorola MRF901 transistor, and about six other parts. This is about as simple as it could be. As far as drift goes, we have found that it is at a very slow rate, completely due to changes in outside temperature.

A TV set is a very broad receiver and will tolerate considerable dirft. Since this LO is a voltage-controlled oscillator and can be remotely tuned from the control box, frequency adjustments can be made at any time. If this type of stability is not satisfactory for you, you may wish to build a crystal-controlled LO. We might suggest the one used on the interdigital converter[3] with a doubler from a Paul Shuch article.[10] Possibly another consideration along this line would be the Paul Wade article in *Ham Radio*, October, 1978.[11] Although these alternatives would double the size of the converter, it may be worth it—particularly if you plan to distribute the signal to a number of TV sets. This is because, when tuning the converter for one TV set, the others are affected. This may be necessary once your neighbor finds out what you are watching.

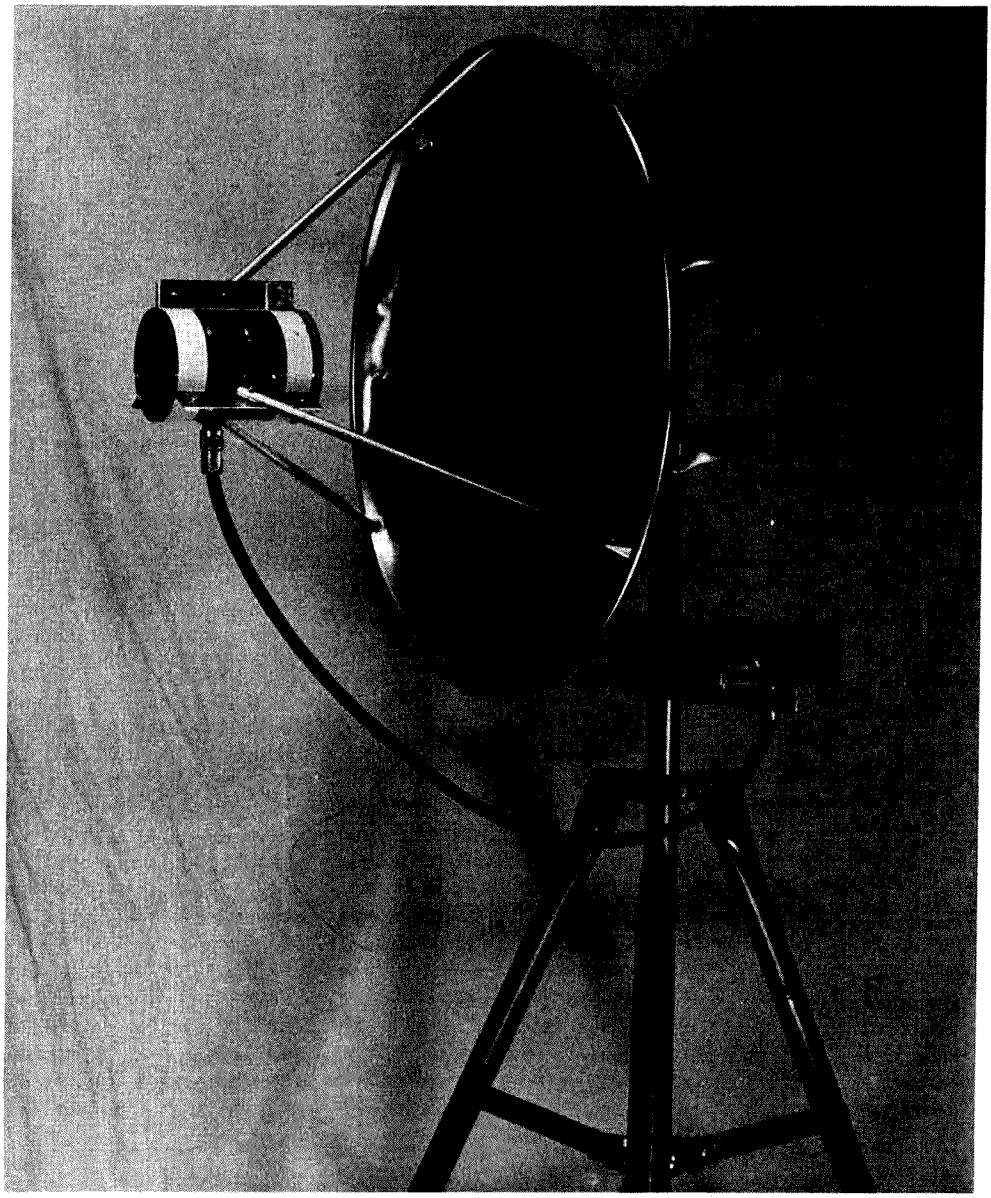


Photo D. This photo shows a complete MDS receive system. The tripod, mast, and U-clamps are standard TV items. All connectors and the box containing the downconverter should be weatherproofed.

Circuit Description: I-f Amplifier

The i-f amplifier is a two-stage amplifier using dual-gate MOSFETs. The function of the i-f amplifier is to boost the signal from the mixer and also provide enough power to drive the RG-59/U coax line to the control box and TV set. This amplifier has been used to drive up to 600 feet of RG-59/U cable with enough signal at the far end to still have a good picture. Although the center frequency is 63 MHz (channel 3), the amplifier is broad enough to cover channels 2 through 4. The output of the amplifier goes into a 75-Ohm, 3-dB pad. This pad gives the amplifier a constant impedance to look into, and, along with the ferrite beads on gate two of both of the MOSFETs, helps make this amplifier very stable.

Circuit Description: Power Supply/Tuning Unit

The power supply used in the MDS receive system performs two separate functions. First, it supplies the operating voltage for the i-f amplifier and local oscillator, and second, because it is adjustable and the local oscillator is frequency-sensitive to voltage, it provides tuning control for the downconverter.

The 24-volt ac transformer, diode bridge, and filter capacitor provide about 34 volts dc to the 12-volt regulator. The regulator is made adjustable by the addition of the fixed resistor, R1, and the variable resistor, R2. With the values shown in Fig. 4, the voltage is adjustable from 12 to 17 volts.

Rf choke RFC1 isolates the rf from the supply, and the dc is carried via the feedline to the downconverter. DPDT switch S1 performs the dual function of switching the TV between the VHF antenna and the MDS downconverter and properly terminating the unused lead with a 75Ω resistor.

It may seem that the current capacity of the power supply far exceeds the requirements of the downconverter, and it does. The

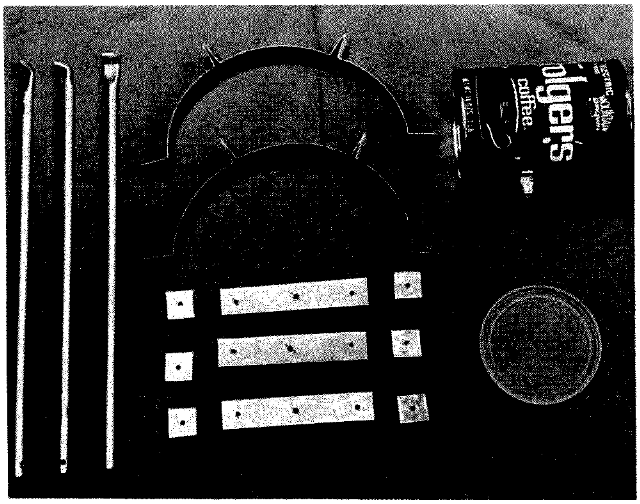


Photo E. This photograph shows the feedhorn before it was painted. Also shown are the supporting legs, straps, ties, and square washers used to mount the feedhorn in front of the reflector. The plastic cover that comes with the coffee can is used as a radome.

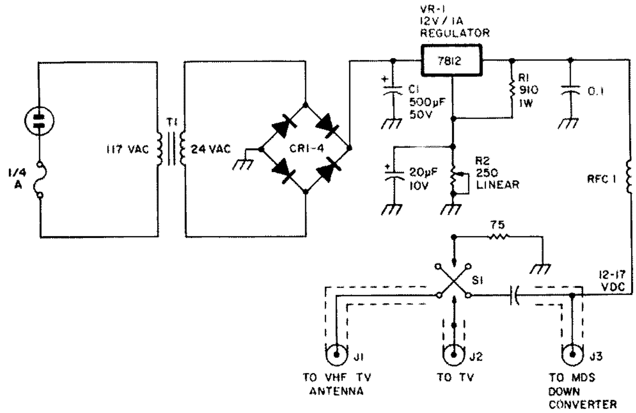


Fig. 4. Schematic diagram of the MDS downconverter power supply/tuning unit. T1 is 300 mA to 1 Amp at 24 V ac maximum. CR1-4 are 50 piv, 1 Amp, such as 1N4001. C1 is 500 uF or more. RFC1 is about 7 uH, such as Ohmite Z50 or Miller RFC-50. The three chassis-mount coaxial connectors, J1-3, are TV-type F61. S1 is a subminiature DPDT wired so that the unused cable input is terminated with a 75-Ohm resistor. A power switch seemed unnecessary, but don't forget the fuse.

overkill is for two reasons. First, there is generally no difference in the cost of the larger parts, so you may as well use them and have the added capacity. Second, the relatively stiff supply provides a very well-regulated voltage to the downconverter regardless of any power line changes.

Circuit Description: Antenna

The antenna is constructed from a child's 25-inch snow saucer and a one-pound coffee can.

The saucer is not a true parabola, but it is close enough to give 15+ dB of gain at 2 GHz.[12] It was chosen for its light aluminum construction and availability. The saucer used is manufactured by Mirro Aluminum Co., Manitowoc WI 54220; the model number is T3589. Another source is Sears. They have what looks like the same saucer in their toy catalog, and the catalog number is 79N85063L.

The one-pound coffee can is also readily available and makes an excellent feedhorn. This horn was described in the May, 1976, *Ham Radio* by WA9HUV.[13] This antenna has been compared with a commercial two-foot dish with a dipole and splash-plate-type feed. It was considerably better, but no attempt was made to measure how much better. When the same feedhorn was put on the commercial dish, it became the better antenna. So, if you already have a dish antenna and don't plan to use the saucer, we still recommend using this feedhorn. To find the focal length of surplus microwave antennas, see *Ham Radio*, March, 1974,[7] or the *RSGB VHF-UHF Manual*.[14]

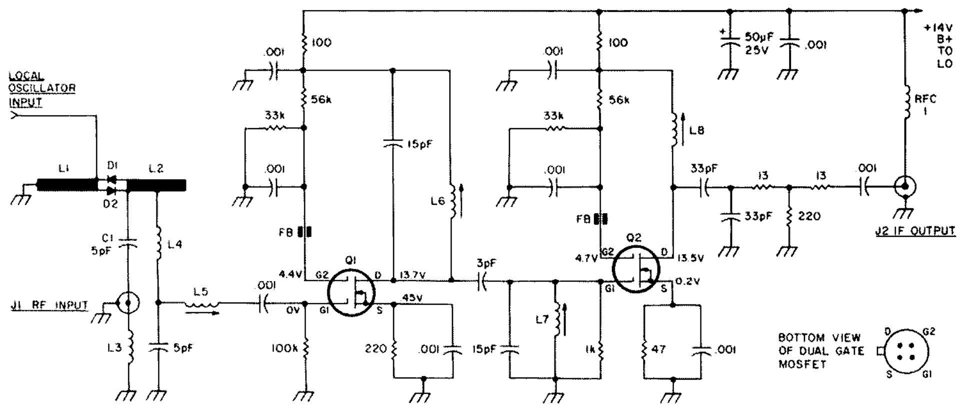


Fig. 3. Schematic diagram of i-f amplifier and mixer sections of the MDS downconverter. D1 and D2 are H-P 5082-2835, or the best microwave mixer diodes you can afford. Q1 and Q2 are Toshiba 3SK35 dual-gate MOSFETs; others, such as RCA 40673, work well. RFC1 is Ohmite Z50 or Miller RFC-50 (see power supply RFC1). L1 and L2 are shown in detail in Fig. 1. L3: 4 turns #28 AWG .3-cm (1/8-inch) diameter. L4: 15 turns #32 AWG .16-cm (1/16-inch) diameter (.085 uH). L5: 11 turns #22 AWG .56-cm (7/32-inch) diameter slug-tuned plastic form (.8-1.8 uH). L6-L8: 7 turns #22 AWG .56-cm (7/32-inch) diameter slug-tuned plastic form (.2-.6 uH). J1 is a type N or BNC chassis connector. J2 is a TV-type F61 chassis connector. Voltages shown were measured with a 10-megohm input VTVM.

Downconverter Construction

The downconverter is housed in an LMB 572, 12.7-cm (5-inch) by 17.7-cm (7-inch) by 5.1 cm (2-inch) aluminum box. The first step in construction is to cut a piece of .16-cm (1/16-inch) double-clad printed circuit board to the dimensions shown in Fig. 1. Cut off the corners and drill the holes to accommodate the coaxial connectors and mounting hardware. Also, drill corresponding holes in the cover of the LMB box at this time. Temporarily mount the board in the cover and, placing the cover on the box, check for clearance between the box and the

board.

Remove the board from the cover and begin building the twin-diode mixer. Cut the two copper or brass lines as shown in Fig. 1 and attach to the board by soldering the end shown as grounded, and using epoxy cement and three small .16-cm (1/16-inch) fiberglass spacers as shown. Scraps of PC board are used for the spacers. You may have to rough up the copper a bit with emery paper in order to get the epoxy to stick well.

Next, wire the i-f amplifier and complete the wiring of the mixer as shown in the schematic in Fig. 3. Use short, direct wiring, using the copperclad board for all ground connections. The unit shown in Photo A uses point-to-point wiring, using Bakelite™ terminal strips. This seems to work well, and no trouble has been encountered. Don't forget the ferrite beads on gate 2 of the two MOSFETs, and keep L5-8 as far apart from each other as possible.

The local oscillator shown in Photo B is built on a homemade printed circuit board. The board is a 4-cm (1½-inch) by 6-cm (2¼-inch) piece of .16-cm (1/16-inch) G10 single-sided circuit board. A Dremel Moto-tool® with a small carbide tipped burr was used to grind away the unwanted copper plating. Fig. 5(a) shows the circuit board layout and dimensions. The circuit is not really critical, but the board layout should be followed as closely as possible for best results.

Bypass capacitor C2 is a modified 270-pF feedthrough type. Both ends are snipped off as short as possible, then one end is soldered to the base of Q1 and the mounting ring is soldered to ground. Tuning capacitor C1, shown in Photo A, is a Johnson type U 189-502-5 1.3-6.7 pF air-variable. Later, it was found that a small tubular type such as a Centralab 829-3 .5-3 pF worked better. Using a tuning capacitor with an NPO temperature coefficient and metal film resistors reduces frequency drift due to temperature changes. Wire the remainder of the local oscillator as shown in Fig. 5(b).

The local oscillator is mounted in a small box fashioned from a strip of brass 3.2 cm (1¼ inch) wide and about 20.2 cm (8 inches) long. The board is suspended in the center of the box by soldering the edges of the circuit board to the center of the inside walls of the box. Holes for the B+ feedthrough capacitor, C3, and rf output coaxial cable are drilled, then the box is placed near the mixer as shown in Fig. 1 and temporarily tack-soldered in place. Make a cover for the box by cutting a 4.5-cm (1¾-inch) by 6.5-cm (2½-inch) piece of printed circuit board or thin brass. Drill a hole in it

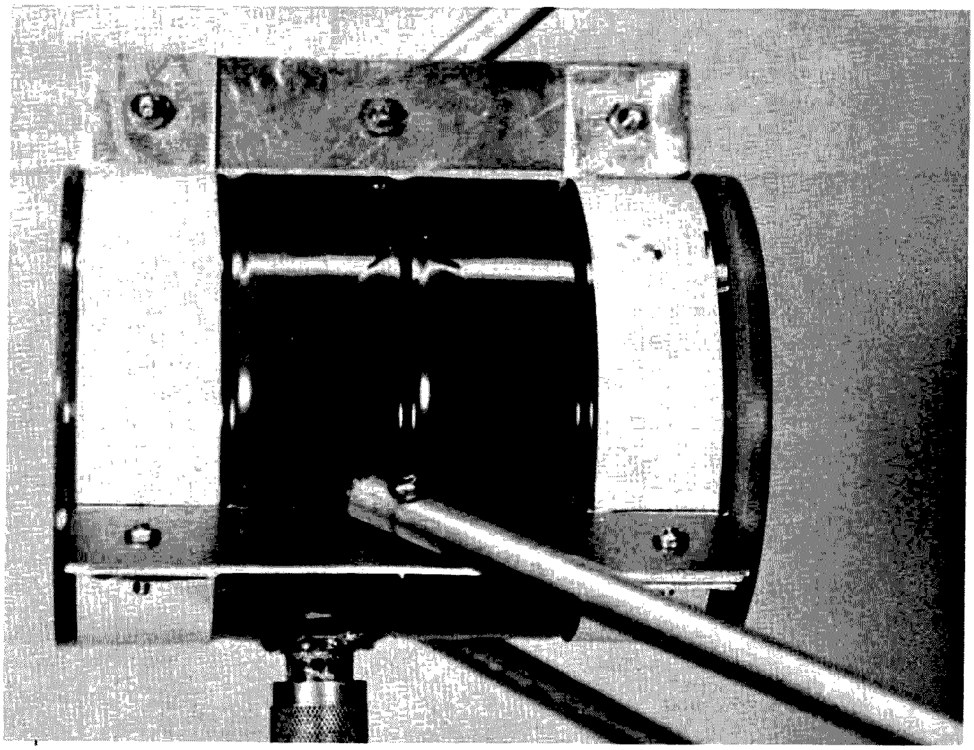


Photo F. Here is a close-up of the completed feedhorn and supporting hardware. Note the plastic radome cover is in place.

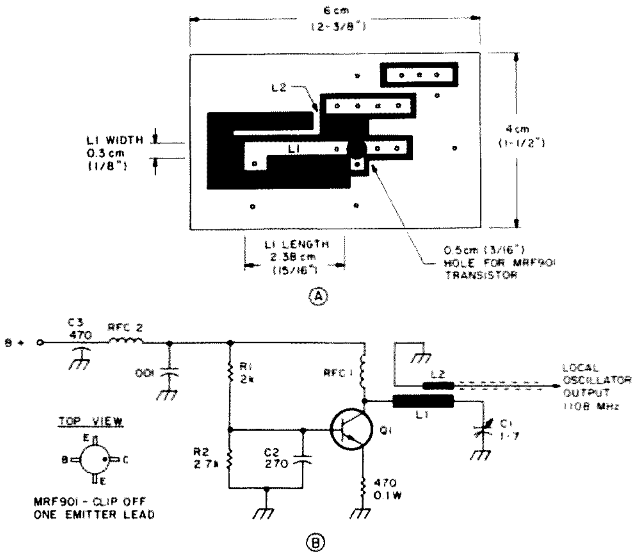


Fig. 5. (a) Bottom-view layout of local-oscillator circuit board. The shaded area indicates the area etched away. Use single-sided G10 epoxy circuit board. (b) Schematic diagram of local oscillator. Q1 is Motorola MRF901. RFC1, 2 is 13.5-cm (5¼-inch) #26 AWG close-wound, using a piece of #14 AWG as a mandrel. C1 is a 1-7-pF Johnson-type U (see text). R1 and R2 are ¼-W metal film-type resistors. C2 is a modified 270-pF feedthrough (see text) or other small low-inductance capacitor. This capacitor is soldered to the foil side of the circuit board to ensure short lead lengths. L1 and L2 are PC board inductors. Keep L2 as narrow and as close to L1 as possible. See Fig. 5(a).

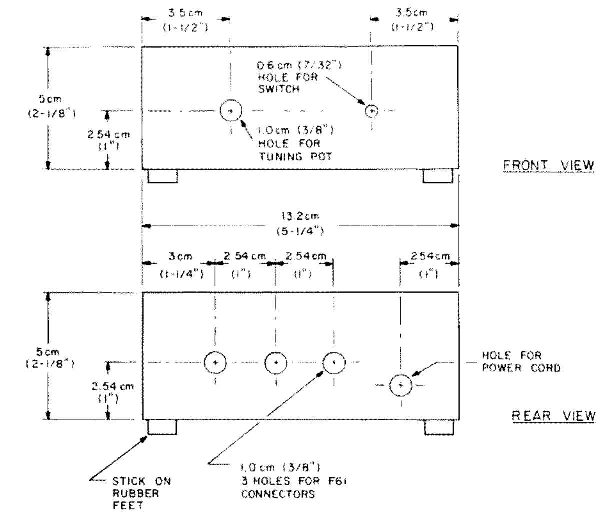


Fig. 6. Front and rear panel layout of the power supply/tuning unit chassis.

to permit access to tuning capacitor C1, and tack-solder the cover in place. Permanent attachment is not done until checkout and tune-up are complete.

Power Supply

The combination power supply/tuning unit is built into a 13.3-cm (5¼-inch) by 7.6-cm (3-inch) by 5.4-cm (2-1/8-inch) aluminum box. An LMB Tite-Fit chassis #780 works well. The box is drilled to accept mounting of the controls and type F61 coaxial connectors. The function switch is a DPDT subminiature, requiring a .6-cm (7/32-inch) hole. Holes for the coaxial connectors, the tuning pot, and the ac line grommet are 1-cm (3/8-inch). See Fig. 6.

The unit shown in Photo C was lined with double-clad printed circuit board. This was done in order to accommodate soldering to ground conveniently. This is a personal construction preference and certainly is not required. At this time, before the hardware is attached, the two-piece box may be covered with contact paper or painted as the builder desires. Small rubber stick-on-type feet are then attached.

Point-to-point wiring using Bakelite terminal strips was used in the unit shown. Follow the schematic in Fig. 4 and no trouble should be encountered.

Antenna Construction

The antenna design is shown in Figs. 7 through 10 and Photos D, E, and F. For the reflector bracket, you will need two 79-cm (30-inch) pieces of 1.27-cm (½-inch) aluminum tubing. Bend both ends of the pieces of tubing 90° to make the two U-shaped brackets as shown in Fig. 7. Use an electrician's ½-inch EMT conduit bender for this job, bending very slowly, and you will end up with a nice kinkless bend. Now, flatten about 1.9 cm (¾ inches) of each end of the two U-brackets in a vise and drill a .5-cm (3/16-inch) hole in the center of each of the flattened areas. Bend these flattened ends back at an angle that matches the contour of the outside edge of the back of the reflector.

Next, cut a 14-cm (5½-inch) by 16.5-cm (6½-inch), by .3-cm (1/8-inch) thick piece of aluminum plate. Drill a .5-cm (3/16-inch) hole in each corner and the four .64-cm (¼-inch) holes for the TV U-clamps. Center this plate on the two U-brackets and mark and drill four .5-cm (3/16-inch) holes in the U-brackets, matching the corner holes in the plate. Attach the plate to the brackets using four #10 bolts, nuts, and lock washers. See Fig. 7.

Now, hold the bracket against the back of the reflector, mark, and drill four .5-cm (3/16-inch) holes in the reflector, matching the holes in the flattened ends of the U-bracket. Attach the bracket to the reflector using four #10 bolts, flat washers, lock washers, and nuts.

The feedhorn is made from a one-pound coffee can measuring 10.2 cm (4 inches) in diameter by 13.7 cm (5-3/8 inches) in length. Drill a 1.3-cm (½-inch) hole 5.1 cm (2 inches) from the bottom of the can. Prepare a flange-mount type N or BNC connector (remembering that this is a microwave antenna, and SO-239/PL-259 connectors will not work) by soldering a 2.9-cm (1-1/8-inch) by .5-cm (3/16-inch) piece of copper or brass tubing to the center pin. Solder this connector into the hole previously drilled in the can. Soldering the connector to the can is recommended for both electrical and mechanical integrity. (See Fig. 9.)

Before mounting the feedhorn to the reflector, it

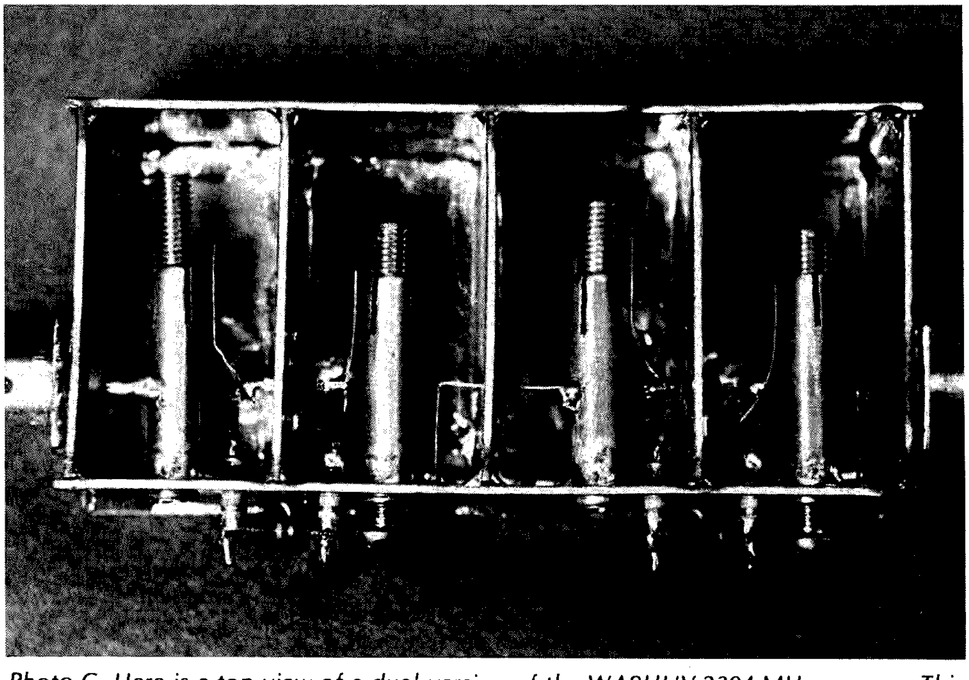


Photo C. Here is a top view of a dual version of the WA9HUV 2304-MHz preamp. This preamp covers the MDS band with no modifications. Note the L-shaped coupling link passing through the center partition.

should be given a thorough paint job inside and out. Don't paint the rf connector, the dipole, or the plastic cover. A good quality, anti-corrosion exterior metal paint should be used.

The feedhorn is held over the focal point with a three-legged support. The legs are made from three pieces of 1-cm (3/8-inch) diameter aluminum tubing 38 cm (15 inches) long. One end of each leg is flattened 1.3 cm (½ inch) back, and a .3-cm (1/8-inch) hole is drilled in the center of each flattened area. Drill a .3-cm (1/8-inch) hole in each of the legs 1.27 cm (½ inch) from the opposite end and 90° around from the first hole. Bend the flattened ends back to about a 45° angle. See Fig. 8.

In order to attach the supporting legs to the feedhorn, two straps are made of thin aluminum flashing material. Two strips, 2.5 cm (1 inch) wide by 46 cm (18 inches) long are bent and drilled, as shown in Fig. 8. These straps are wrapped around the can and tied together, using three 12.7-cm (5-inch) by 2.5-cm (1-inch) pieces of .16-cm (1/16-inch) aluminum sheet. Six 2.5-cm (1-inch) square pieces of the same material are used as washers, and #8 hardware is used to hold it all together. The supporting legs are then bolted between the reflector and the strap ties, using #8 hardware. See Fig. 10.

All of the hardware used in this antenna should be of the plated type to assure long life; you wouldn't want the thing to fall apart while you're watching something good on the tube.

The open end of the can faces the reflector, and, for proper focus, should end up 28 cm (11 inches) from the surface of the reflector.

All of the dimensions used here are correct for the 63.5-cm (25 inch) aluminum saucer sled. Some adjustments may have to be made if a different reflector is used.

Care should be taken in choosing a mount for the antenna. The reflector presents a surface area of over .3 square meters (3½ square feet) to the wind. A 61-cm (2-foot) roof tripod fitted with a 3.2-cm (1¼-inch) mast should be able to withstand all but the strongest winds. Mount the antenna as low as possible above the tripod, and make sure all bolts and clamps are secure. If possible, mount the antenna in a wind-sheltered location that still has a line-of-sight view of the MDS transmitting antenna.

Final Assembly and Tune-Up

Attach the antenna and downconverter to the mast and set in a tripod as shown in Photo D. Connect a *short* piece of *good* coax between the feedhorn and the downconverter. We have found that Berk-tek brand ultra-flex RG-8X coax fitted with BNC connectors works well for this purpose. The remainder of the cabling uses RG-59/U coaxial cable and TV-type F connectors.

The system can be tuned up with little or no test gear. If you are lucky enough to have a signal generator that covers 2.15 GHz, by all means use it. But, if you are like the rest of us, you will have to get by without it.

The tune-up steps will be to first check out the power supply, tune the oscillator, and peak up the i-f amplifier. This tune-up requires a location that is line-of-sight to the MDS transmitter, easy access to the downconverter and antenna assembly, and a TV set.

Don't attempt tuning up the downconverter on your roof or tower. Play it safe!!

Ensure that the power supply is operating properly by measuring the output voltage. It should be adjustable from 12 to 17 volts by varying the tuning pot, R2. This check should be done before applying power to the downconverter.

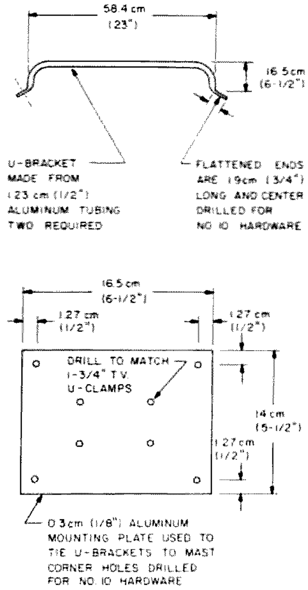


Fig. 7. Construction details of the U-brackets and mounting plate.

I-f Amplifier Tuning

Tuning the i-f amplifier is

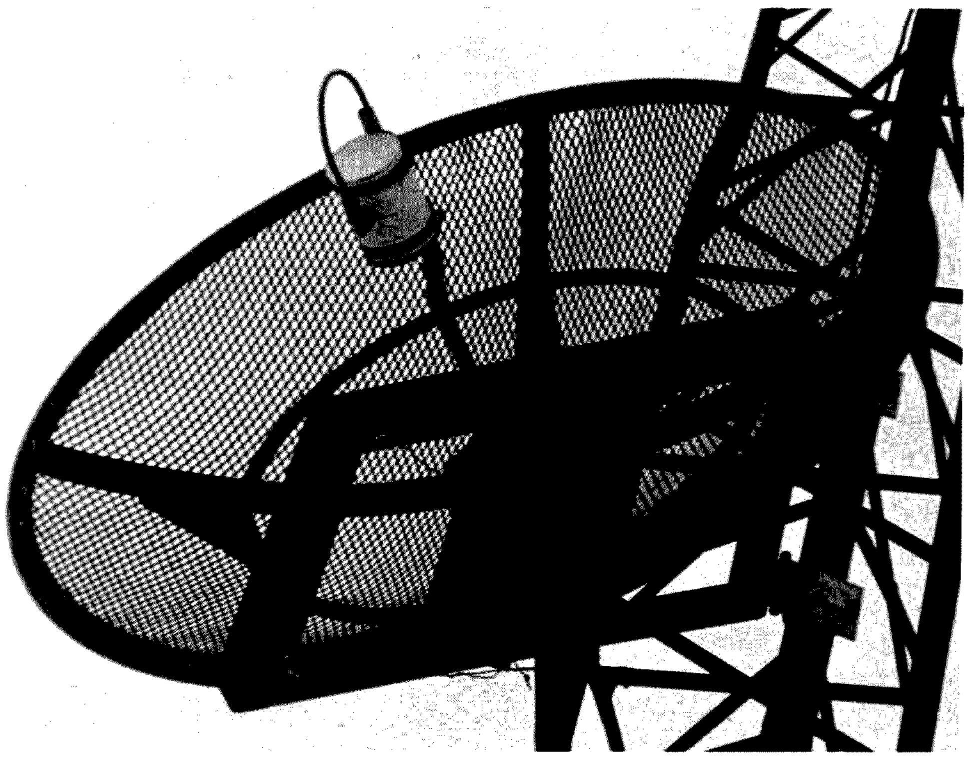


Photo H. This is a 122-cm (4-foot) commercial dish using a WA9HUV coffee can feedhorn. This antenna is used for MDS reception in a marginal signal location.

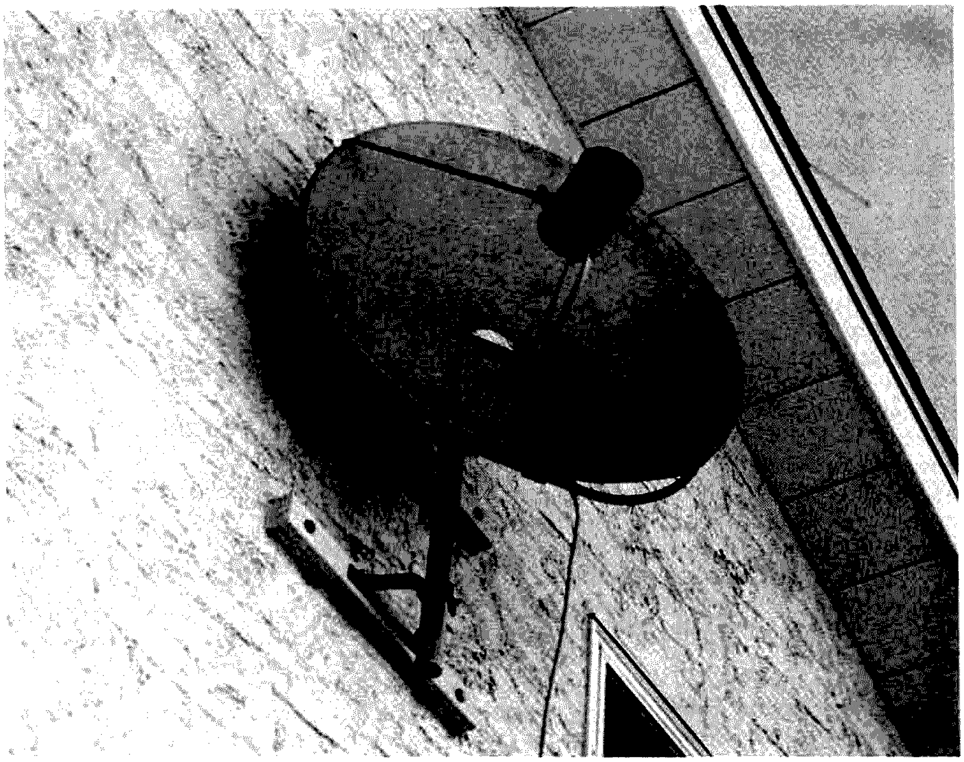


Photo 1. This is a 74-cm (29-inch) commercial reflector using a WA9HUV coffee can feedhorn. Located 4.5 meters (15 feet) high, this antenna pulls in snowfree color MDS TV signals over a distance of 32 kilometers (20 miles).

quite simple. First, you must choose which TV channel you will be using in your system. This should be channel 2, 3, or 4. It should not be in use in your area. Inject a signal into L5 from a signal generator or a grid-dip meter. The signal frequency should be 57 MHz for channel 2, 63 MHz for channel 3, or 69 MHz for channel 4. On the output of the i-f amplifier, use an rf probe or a series diode and a .001-uF capacitor to ground. Peak all coils (L5, L6, L7, L8) for maximum voltage across the .001-uF capacitor.

If you do not have a signal source at the i-f frequency, then set the slugs in all of the i-f coils halfway into their windings. Once you have completed the oscillator tuning, you can use the MDS signal for peaking up the i-f coils.

The local oscillator frequency required when using channel 2 as an i-f is 1105 MHz, for channel 3 it is 1108 MHz, and for channel 4 it's 1111 MHz. Set the power supply tuning control to midrange. Set switch S1 to the MDS position. Using an insulated tuning wand, adjust C1 to the proper frequency. If you have a frequency counter or spectrum analyzer that covers the LO frequency, use them. We have found, however, that using an off-the-air signal and adjusting for a good TV picture is the fastest and most sure way to accomplish this.

While tuning C1, you will probably see all sorts of strange patterns on your TV screen along with two or more settings that produce a standard TV picture. The tuning range of the LO is enough so that both the signal that we want and its image can be tuned in. Tune C1 to the higher of the two, which is the setting when the plates of C1 are the least meshed. The tuning control in the power supply can now be used for fine tuning. In the event that C1 shows no effect, you can test the oscillator for activity by using the signal sniffer shown in Fig. 11.

Preamps

There undoubtedly will be some locations that will have marginal signals. If, after having built the system, you find that your signal is snowy, you may wish to improve it with a preamp. There have been several good articles about 2304 preamps in the ham publications in recent years. The one that appears easiest to build is in the July, 1974, *Ham Radio*, by WA9HUV.[15]

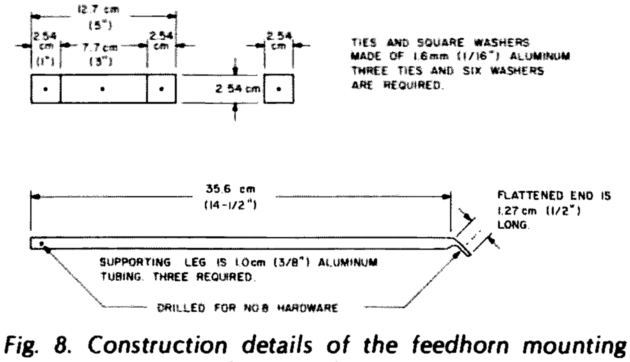


Fig. 8. Construction details of the feedhorn mounting straps, strap ties, and support legs.

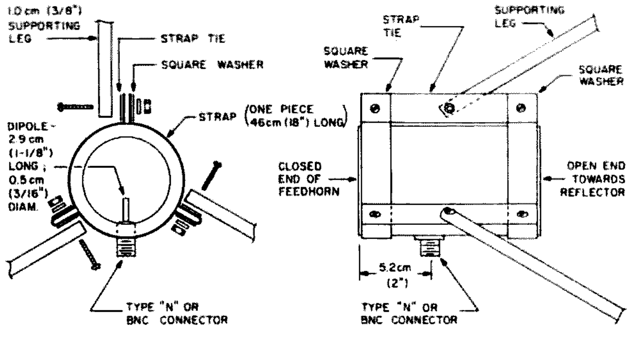


Fig. 9. Feedhorn mounting details.

You will find that most of the transistors the article recommends run from $17.50 to $70.00 each. As you can see, this could get expensive, especially if you need two or three preamps in series for more gain. What we have done is change the transistor to a MRF901, which costs $1.44. This device has less than a 3-dB noise figure at 2 GHz, but only about 6 dB of gain. Now, 6 dB of gain when you have a snowy picture does not help much. For a location that is marginal, we have built two of these preamps in the same box. That gives about 12 dB of gain and also eliminates the need for two connectors. At this frequency, too many connectors in the line can add a lot of loss and is expensive. I am sure it would be possible to build more stages into one box if needed, but we have not yet tried this. We have had up to three of these double preamps together with short cables. This worked well and gave a lot of gain.

We built most of our preamps using double-sided printed circuit board. This is faster and much easier than brass. Be sure to solder together intersecting edges on the inside where possible. At this frequency, a good rf-tight box is desirable. WA9HUV's article gives two possible circuits depending on what kind of transistor is used. When using a MRF901, use the circuit on page 8 of the article, which is labeled Fig. 1. We show the method of coupling two stages together in Photo G here.

The preamp should be mounted as close to the feedhorn as possible, and it also will need to be enclosed in a weatherproof box. Power tapped from the downconverter can be used to power as many preamps as are found to be necessary.

Conclusion

In this article we have shown you details for building a cheap and easily-reproducible MDS receive system. Most of the circuits and ideas have been gleaned from previous construction articles and manufacturers' applications notes, so no originality is claimed. Although the system as described performs very well, if you find that you can make any significant improvements to the systems, we certainly would be interested in hearing of them.

Since the original design of the system, printed circuit boards have been laid out and are now being made. These boards, along with some of the harder-to-find components and complete antennas, are available from the authors. Send an SASE for details. ■

Acknowledgements

We would like to thank John Fox WØLER and Ernie Simon W9JCE for the help and encouragement they gave in completing this project.

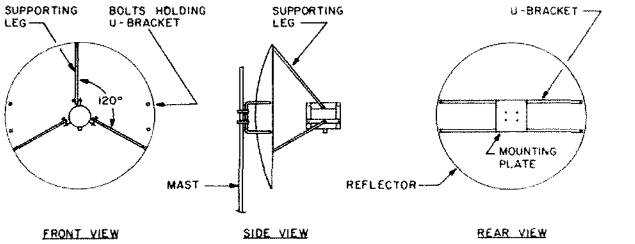


Fig. 10. Final construction of saucer sled antenna. The open end of the feedhorn should end up 28 cm (11 inches) from the surface of the reflector for proper focus.

Photo J. Here are snow saucers before modifications. Shown are the steel 69-cm (27-inch) model made by Flexible Flyer and the 64-cm (25-inch) aluminum Sno Coaster made by Mirro. Remove the handles before using as a reflector.

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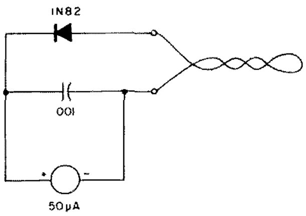

Fig. 11. A piece of test equipment called a signal sniffer. It can be used to tell if the oscillator is working. The meter movement should be a good quality 50-uA movement. The diode is a 1N82 or other high-frequency diode, and the pickup loop is about twelve inches of #22 hookup wire twisted together with a one-inch loop at the end. This sniffer works to 2 GHz or more.

Simple Dual-Voltage Supply

—power for many projects

A welcome addition to any shack.

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Why doesn't someone tell parts distributors and transformer manufacturers that *nobody* designs tube circuits anymore, let alone *builds* them. Catalog pages are full of filament transformers and they are being bought because nothing else is available. Manufacturers seem to be rushing to resupply this so-called great demand.

There are two dc voltages that I generally need supplies to provide: +5 volts for TTL and +13.6 volts as a car battery eliminator. A 12.6 V ac filament transformer will not work well for these dc voltages. Those of you who have tried were frustrated, I'm sure, by the attempt.

Take the +5-volt supply, for instance. Okay, full-wave rectification with the c-t grounded will yield a peak dc on the filter capacitor of $(6.3 \times 1.414) - 0.5 = 8.4$ volts. Now, an LM309K needs +7 volts to regulate (a 2-volt regulator margin). This means that the maximum ripple is 1.4 volts. Let's say you need 1 Amp from this supply and you chose a 1- or 2-Amp transformer. Now, to get the ripple to less than 1.4 volts, you start to pile on the capacitance and the full-load ripple comes down. Then as you add more capacitance, the ripple goes up! What is going on here? As you add more capacitance, the phase angle over which you draw current decreases. This means that you are not continuously drawing 1 Amp from the transformer, but, instead, you are drawing many Amps over a short time to yield a continuous load current of 1 Amp. Transformer core saturation and winding resistance drops are causing the problem. The truth is that this transformer will not work except for small currents. The +13.6-volt supply using a bridge rectifier will yield the same picture—not enough margin for the regulator to operate. The next highest filament transformer is 24 volts—too much voltage and too much power to be thrown away via the heat sink.

A switching regulator, Fig. 2, has some advantages inasmuch as the utilization of transformers is concerned. The pulse width is varied to the pass transistor to control the output voltage as the load current changes. The efficiency can be very high with this configuration. The disadvantages are formidable. Switching transients clutter up the spectrum so that much shielding and filtering is necessary. Transient load changes may generate output voltage variations amounting to ±20 percent or more. As you might gather, I don't recommend this circuit for the ham shack.

What we *really* need in a transformer is 18 V c-t. This voltage is perfect for both the +5-volt and +13.6-volt supplies. Few distributors stock them so you really have to look around. Fig. 1 shows a couple of ways to connect filament transformers to furnish the required voltage.

Fig. 3 shows a really great supply that uses easy-to-get parts. I have included the Radio Shack part numbers for your convenience.

Now, a word about the filter capacitor. It is as important not to have too much capacitance as it is to have too little. You should select a capacitor so that at maximum current you have enough margin for the regulator to work. In the circuit of Fig. 3, C1 is selected so that the ripple voltage is 5 or 6 volts. This allows the transformer to furnish the 3 Amperes of output current over a much wider phase angle. I have used the for-

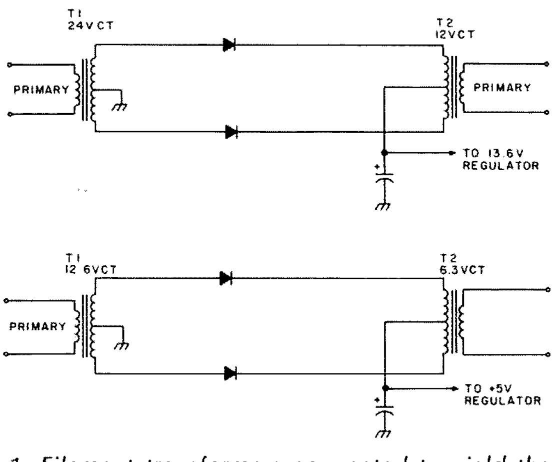


Fig. 1. Filament transformers connected to yield the required input voltages to the regulator.

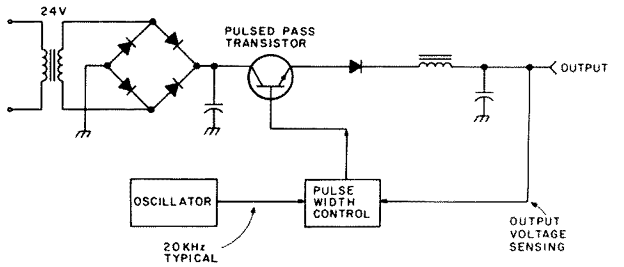
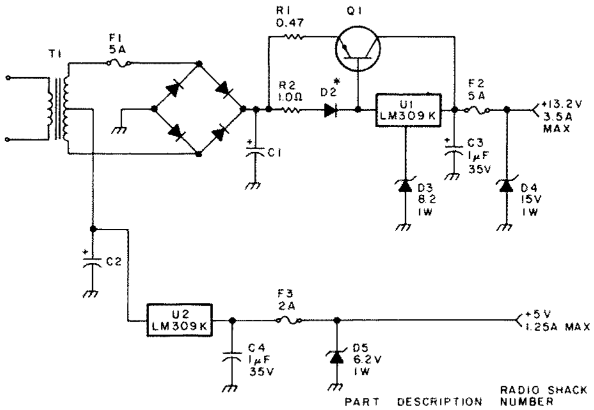


Fig. 2. Switching regulator showing basic functional blocks.



PART	DESCRIPTION	RADIO SHACK NUMBER
T1	18VCT 4A	273-1514
D1	BRIDGE 6A	276-1180
R1	0.47Ω 5W	271-130
R2	1.0Ω 10W	271-131
C1	5000μF 35V	272-1022
C2	2200μF 35V	272-1020
D2	50V 3A	276-1141
C3, C4	1μF 35V	272-1406
U1, U2	LM 309K	
Q1	PNP, 5A OR	RS 2006(GE) RS 2043(SIL)

Fig. 3. Power supply using easy-to-find parts.

mula E = I/120C with good results. E is the peak-to-peak ripple voltage, I, the dc current in Amperes, and C, the filter capacitor in farads. This formula is not exact but should be quite close for most applications.

Resistors R1 and R2 in the circuit of Fig. 3 cause the current to divide between the regulator and the pass transistor. For three Amperes at the load, two will flow through the pass transistor and one through the LM309K. If you use a germanium pass transistor, you can omit D2, as D2 compensates for the base-to-emitter junction voltage drop of the pass transistor. Zener diodes D4 and D5 form an overvoltage protection that will blow the output fuse in case of a regulator failure. If you don't put in this protection, you'll be sorry! An insulating washer is needed for U1 as the case is above ground by the drop across D3. The case of U2 can be bolted to ground. Use a common heat sink having a thermal resistance to ambient of less than one degree per Watt. The addition of panel meters to monitor the current would be a nice improvement. The fuses would not be expected to blow as the power supply is protected against short-circuiting and overload. Of course, you can't load both regulators to their full capacity at the same time, as this would overload the transformer.

This power supply should be a welcome addition to any ham shack.■

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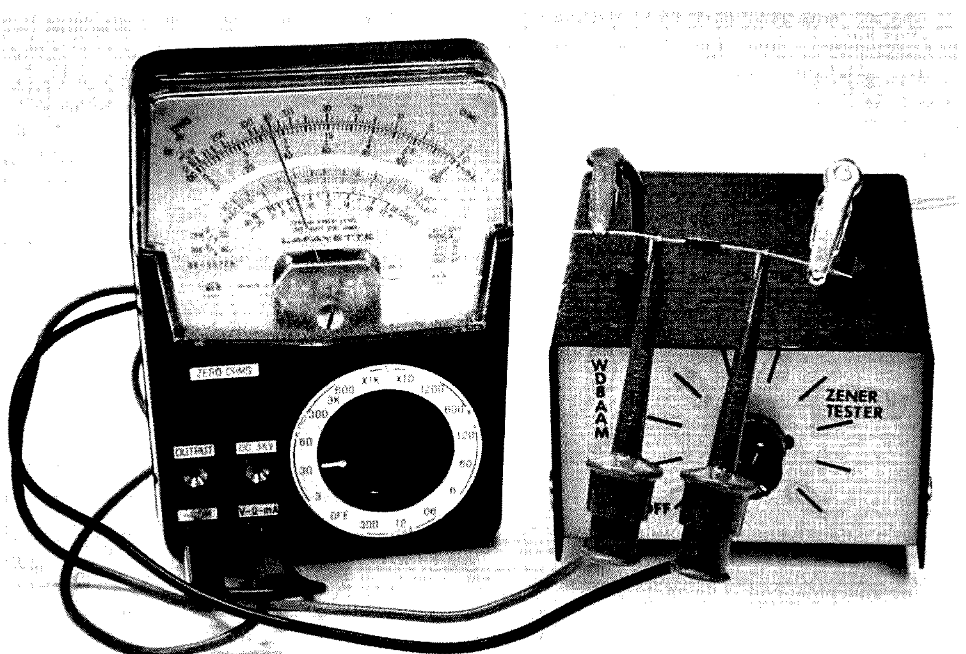
Bargain Zener Classifier

—Novice project

Enjoy.

Some time ago, I was building a low-voltage power supply which used a zener diode to regulate the base current of the regulator power transistor and found I didn't have the proper zener in my junk box. Checking my local parts store, I found that a single zener of the voltage I needed was about twice as expensive as a package of 20 miscellaneous zeners I had seen at my local Radio Shack store. As always, my frugal nature suggested I get the most for my money, so I built a simple circuit, which I am going to pass along, that enabled me to check the zener voltage of each diode.



Unit with a zener diode being tested and showing proper hookup to the VOM. Note that the VOM is indicating 8.6 volts even though the tester voltage output is 28 volts. Don't forget to set the VOM to measure dc voltage. It doesn't show up very well in the photo, but I used red wire for the plus alligator clip and black for the negative. These wires were then inserted into 2 phone tip jacks on the top of the case.

Simplicity

The circuit is as simple as they come. Follow Fig. 1 and the photographs and you should have no problem building a useful gadget which comes in very handy almost 90% of the time you build a new project. Looking at the schematic, you'll notice the power transformer is very important as it isolates the circuit from the ac line for safety. Next, the diode rectifies the ac into pulsating dc. The following 120k resistor drops the voltage to the potentiometer. The electrolytic capacitor smoothes out the dc ripple to provide a dc voltage of about 30 volts to the alligator clips. (It's the next thing to an instant project.)

Using the Tester

Place the cathode (the

end with the band) of the zener that you wish to classify in the plus voltage alligator clip, connect the VOM, as shown in the photograph, run the voltage up until the VOM needle stops, and that's the zener regulating, or breakdown, voltage. If you connect the zener backwards in the circuit, you should get very little, if any, indication on the VOM meter because the diode is conducting and presents a short circuit to the tester. This circuit passes very little current through the zener under test, so you shouldn't have any problems with zener burnouts.

If, after classifying all your diodes, you still don't have the correct value, try putting two or three of them in series. When I built my power supply, I needed a 12-volt to 13-volt zener. I put an 8.2-volt and a 4.3-volt zener together in series to obtain 12.5 volts and, because of this, I could also tap at the junction of the zeners to obtain a regulated 8.2 volts.

You'll find that regular diodes and transistors have a zener action as well. Although voltage values will be random and current capabilities small, they can often be used in place of a regular zener diode. When the transistor is bad anyway, it beats throwing it away.

You'll notice all parts have a wide tolerance, so you can use any of the old parts you may have in your junk box. Enjoy yourself.■

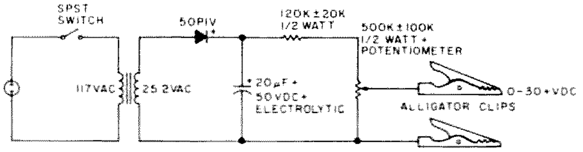
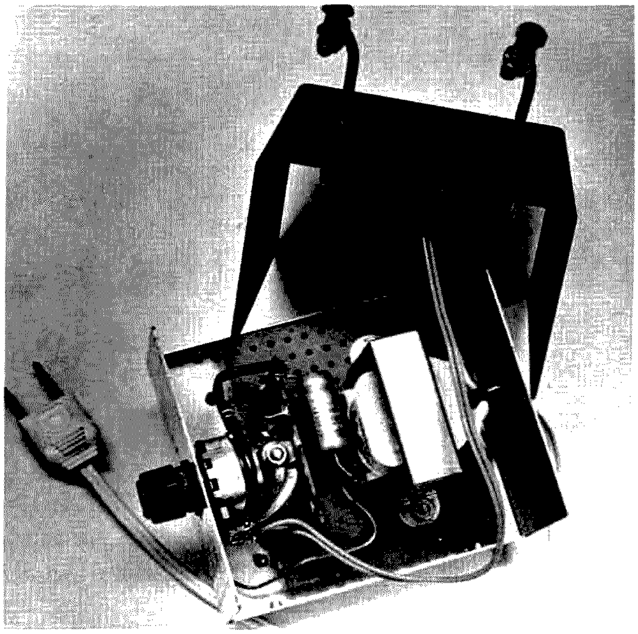


Fig. 1. Zener tester.



Interior view. All the parts came from my junk box with the exception of the case and power transformer which are Radio Shack stock items. A small piece of perfboard was used to mount the parts, and spacers were used to lift the perfboard off the metal chassis.

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What the Hell is a Decibel?

—1/10 of a bel, of course

Rationalizing the ratio.

I have always had a difficult time dealing with decibels. It is important to remember what a decibel is and what it isn't. First, the decibel (dB) is, itself, not a measure of anything. It is not a unit like a volt or an Ampere. Hams often have a problem with this. It is not a measure of the loudness of anything, nor is it the measure of the power in any signal.

The decibel is a ratio—that's all. It is ten times the base 10 logarithm of the ratio of two power levels.

Voltage (Current) Ratio	Power Ratio	dB
.32	.1	−10
.45	.2	−7
.50	.25	−6
.71	.50	−3
.89	.79	−1
1.00	1.00	0
1.12	1.26	1
1.41	2.00	3
2.00	4.00	6
2.24	5.00	7
3.16	10.00	10
4.47	20.00	13
7.07	50.00	17
10.00	100.00	20
14.14	200.00	23
22.36	500.00	27
31.62	1000.00	30

Table 1.

So a decibel only has meaning with reference to some other power. For example, 100 Watts bears the same ratio to 10 Watts as 10 Watts bears to 1 Watt. The ratio in each case is 10 to 1. Any two power levels having the ratio of 10 to 1 would have the same number of dBs relating them.

The basic unit is the bel. The bel is defined as: $n = \log (P1/P2)$, where P1 and P2 are the two power levels being compared and the base 10 logarithm is used.

The decibel is 1/10 of a bel, so there are 10 dB per bel, and: $m = 10 \log (P1/P2)$. You already know the equations for power: $P = IE$, $P = E^2/R$, and $P = I^2R$, where I and E are the current through and the voltage across the resistance, R.

Now, with a little fancy footwork and algebraic substitution, we can come up with the following: $m = 10 \log (E1^2/R1)/(E2^2/R2)$, which can be further reduced to: $m = 10 \log (E1^2/E2^2)$, *if and only if* $R1 = R2$. Further reduction yields: $m = 20 \log (E1/E2)$.

Using a similar process, we can derive the following equation: $m = 20 \log (I1/I2)$, and, tra-la! We have our complete set of equations for the mysterious decibel. The important thing to remember is that for the two equations involving voltage and current, the resistance that the voltage is across or that the current flows through must be identical for the two values to be compared. Otherwise the calculation is invalid.

Don't try to think in terms of a set of dB ratios for power as separate from a set of dB ratios for voltage. All ratios are in terms of power, and, since you already know that the power goes as the voltage (or the current) squared, you can deal with either quantity.

Table 1 lists working voltage (also current) and power ratios for various dB ratios. Note that the voltage-ratio numbers are simply the square roots of the power-ratio numbers.

The decibel is used for any one of three reasons depending upon which reference book you believe. I've added a fourth reason.

1. One decibel is the smallest perceptible change in loudness detectable by the human hearing system. The human ear is a logarithmic device and the decibel is a logarithmic number, so there is a better correspondence between the perceived loudness ratio and the decibel.

2. The decibel is used to express large ratios of powers with small numbers. For example, 30 dB is a power ratio of 1000.

3. The decibel is used so that any change in power by the same ratio will have the same decibel ratio. For example, a change from 1 to 2 Watts is a 3 dB change, as is a change of from 1000 to 2000 Watts. The effect on communications of these changes in levels will be the same.

4. The decibel is used to confuse radio amateurs.

OK, where are these dastardly decibels foisted on an unsuspecting amateur radio operator? Probably the most common use of the decibel in amateur radio is in relation to your receiver S-meter. The

S-meter is usually calibrated in S-units from zero through nine and then in dB above S-9. S-9 is supposed to correspond to a signal level at the receiver antenna terminals of 50 microvolts (although it rarely does). Each S-unit corresponds to 6 dB, so S-8 is 50 microvolts minus 6 dB. Refer to Table 1 or do the following calculation: $-6 = 20 \log (E1/50\ uV)$, $E1 = (50 \times 10^{-6}) 10^{-6/20}$.

This reveals that the signal level at the antenna terminals is now 25 microvolts. The calculation above is valid because the antenna input impedance of the receiver does not change. The denominator of the ratio is always the reference amplitude. So, every S-unit down corresponds to about one-half of the voltage at the antenna terminals of the S-unit above it.

Likewise, if the meter reads 10 dB above S-9, the voltage at the antenna terminals is 10 dB higher than 50 microvolts. $10 = 20 \log (E1/50\ uV)$; $E1 = (50 \times 10^{-6}) 10^{10/20}$.

This corresponds to a received signal of 158.1 microvolts. The unfortunate fact is that most receivers don't have S-meter readings which are significant in any absolute sense—about all you can tell is which signal is stronger at your QTH.

Another common use of the decibel is in the measurement of antenna gain. The important thing to note here is what kind of antenna is used as a reference. Remember that the decibel is only a ratio and that the goodness of an antenna as measured in decibels is only a goodness relative to some other type of antenna. The two most common reference antennas are the isotropic antenna and the dipole antenna. The isotropic antenna is a theoretical model of an antenna which radiates equally well in all directions. Dipoles are, of course, real antennas that have a radiation pattern which is not everywhere identical.

When talking about the gain of an antenna, we are talking about the increased power radiated in its direction of maximum radiation compared to the power radiated in the direction of maximum radiation for the reference antenna. Obviously no additional power is "generated" by the antenna. What the antenna does is tend to concentrate the available power in one direction at the expense of all other directions.

If the gain of an antenna is given in dB over isotropic and you want to know the gain of the antenna relative to a dipole, subtract 2.1 dB from the figure. Similarly, if you have the gain of an antenna over a dipole and you want to know the gain of the antenna over an isotropic antenna, add 2.1 dB. This follows from the fact that the gain of a dipole antenna over an isotropic antenna is 2.1 dB.

It is important to know that decibels can be added or subtracted as the gain of the system is increased or decreased. For example, say your transmitter puts out 1 Watt and that an amplifier boosts it to 10 Watts—that's a gain of 10 dB. Now, suppose you have another amplifier that boosts the signal to 500 Watts—that's 17 dB additional. So the total gain of the amplifiers is 10 dB + 17 dB = 27 dB.

Now, suppose you have an antenna with a gain of 12 dB over isotropic and you trade it in for an antenna with a gain of 18 dB over isotropic. You've bought yourself 18 dB − 12 dB = 6 dB gain.

Another antenna-related use of decibels relates to coaxial feed cable. You may be surprised to learn that the loss in RG-58/U coax is 6 dB per 100 feet at 150 MHz, and the loss in RG-8/U coax is less than 2.5 dB per 100 feet at 150 MHz. This means that if you're using a 10-Watt transmitter through 100 feet of RG-58/U, and you're operating on 150 MHz (out of the band), the power delivered to the antenna will be 2.5 Watts. The same setup with RG-8/U coax will deliver 5.6 Watts to the antenna—this is 3.5 dB better performance. So, as you can see, those dBs can sneak up on you.

Perhaps the most common use of the decibel is in the measurement of sound levels. I have heard, on occasion, people refer to a sound-pressure-level meter (SPL meter) as a "dB meter." There is no such thing. The SPL meter indicates the sound pressure relative to a reference acoustic pressure of .0002 microbars. So, 100 dB SPL is, in fact, 20 microbars of acoustic pressure. (Acoustic pressure is analogous to electrical voltage.)

It can be useful to practice some calculations using decibels. A good working knowledge of the use of the decibel can keep you from feeling left out the next time someone brags about his antenna with 10 dB gain. ■

References

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Doug DeMaw, "What Does My S-Meter Tell Me?", *QST*, June, 1977, pp. 40-42.

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Frosting for the FT-901DM

—simple improvements for Yaesu's superb performer

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One of the hottest and most exciting rigs presently on the amateur market is Yaesu's FT-901DM transceiver. The outstanding performance of this "no compromise" unit is rivaled only by the enthusiasm, interest, and technical prowess of its stateside representatives and distributors.

Before delving into the collection of 901 modifications I've gathered via several sources, I must emphasize that this unit is a star performer as it stands, and you can expect long-term enjoyment regardless of your decision whether or not to try any of these options. I'm complimenting the rig, not discrediting it in any way.

Speech Compressor

The FT-901DM's speech compressor does a superb job, but its response is tailored for high-pitched Japanese voices rather than the lower-pitched American voices.

If you would like to see the speech compressor become a real tiger, change C218 on PB1703 from a 100 pF to a .01-uF mylar™ or paper capacitor. PB1703, the ALC/speech compressor board, is located third from the rear on the rig's left side. C218 is located on PB1703's bottom center, and its solder connections are almost directly beneath the clear plastic-insulated jumper on the circuitry side of this board. This modification extends the compressor's low frequency range and allows it to operate more efficiently.

While discussing audio response of the 901, I might also suggest that amateurs searching for a quality mike try the Shure 526 (less transistor preamp) with the 901. I've tried a bundle of mikes with mine, and this one performed head-and-shoulders above all others.

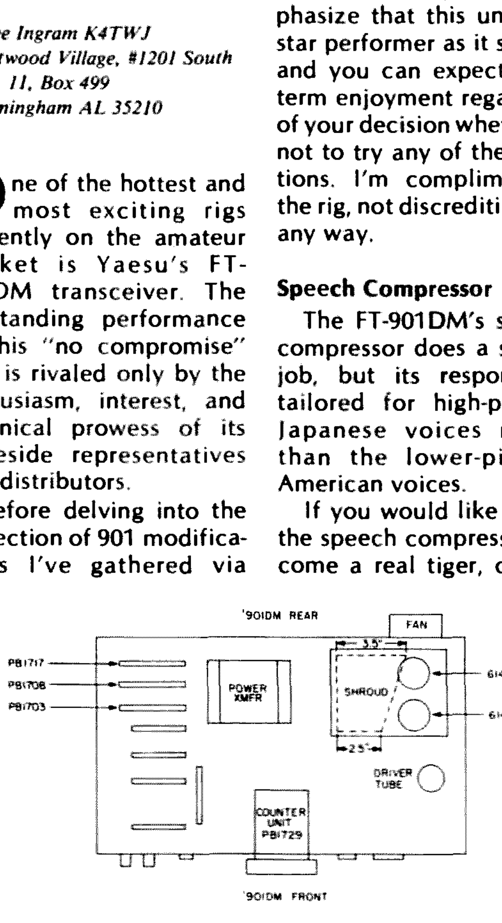

Fig. 1. Placement of 6146B cooling shroud and printed boards, as described in the text.

ALC

If you would like smoother ALC action (or if you've been concerned about meter readings in the green part of the ALC scale), this simple modification will ease your mind and produce very good results. Remove the 901's bottom cover and locate the socket for board PB1703. Connect a 68k, ¼-Watt resistor between the ground and pin 16 of this socket, then bypass the resistor with a 2.2-uF tantalum capacitor.

This is a good time to tweak dot-dash ratios on the Curtis Keyer, if desired. The keyer's PC board is also located on the 901's bottom side.

Low 40-Meter Output

If your 901 produces an output of less than the usual 100 to 120 Watts on 40 meters, try this simple procedure. Add a .01-uF 500-volt disc capacitor from C22 to ground. C22 is a feedthrough capacitor located in the power supply.

Flickering LEDs

The memory LED in some 901s (located above the digital frequency readout exhibits a very slight flicker when the unit is originally turned on and a frequency isn't loaded in

memory. There are two simple solutions to this situation: 1) Simply tap the memory button and load a frequency into memory, or 2) change C61 on the memory board from .33 uF to 4.7 uF. A tantalum capacitor is suggested.

Fan Noise

Since I'm accustomed to the total silence of Rotron Whisper fans, I found the Yaesu fan a mite loud for my sensitive ears. A close inspection of the fan revealed a slightly off-center armature. This situation was visible when holding the fan proper up to the light and looking through its rotating armature to assure symmetrical alignment. I found the most accurate way to adjust this fan involved carefully applying 110 volts to the removed fan and slowly positioning its armature for minimum noise. If you prefer an absolute death-quiet fan, Rotron's small Boxer fan can be substituted here. The fan in my 901 may have been one in a hundred, so use your own discretion with this modification. Fortunately, this fan unplugs and unbolts from the outside of the 901's rear, so you need not open the rig for this modification.

Cooling Shroud For 6146B Finals

While the Japanese are very proficient in electronic technology, they seem somewhat limited on air ducting and cooling techniques. Erskine Jackson W4CEC solved this problem quite easily. He cut a triangular sheet of aluminum 2.5 inches by 3.5 inches and installed it above the final amplifier compartment as shown in Fig. 1. This shroud prevents "short circuit" air being pulled from atop the tube compartment and alternatively pulls it *across* the 6146Bs from the compartment's sides. This superb technique also has been used with Kenwood gear.

6146 Finals

A problem has been noted with the GE-brand 6146Bs installed in many 901DMs. The screen grid would fall against the plate and apply +900 volts to the +210-volt screenline. Yaesu recently switched to Toshiba 6146Bs and this problem has been eliminated. If your 901 has GE finals, you would be wise to make this switch also. Pursuing this situation a step further, Yaesu has developed a modification to protect the 210-volt supply from this problem. Here's the information:

Install a diode as shown in Fig. 2. This is included in lots 006 and higher, with lot 007 using a new etch pattern that includes this modification.

Modification: (1) Remove the bottom cover on the FT-901; (2) attach a soldering post to the chassis with a tapping screw as illustrated; (3) solder a 10D10 diode to the post—*note the diode polarity*; (4) remove the yellow wire from the printed circuit board (PB-1715A) and solder it to the diode installed in step 3; (5) connect the other end of the diode to the printed board where the yellow wire was removed; and (6) replace the bottom cover.

Reducing Excess Baggage

Most of the 901's heat is generated in its left back corner. This heat comes from the bleeders on top of PB1717 and from the choke and components on PB1708. Since several capacitors and resistors are physically located above the choke on PB1708, they may become hot and change value and eventually fail. Realizing this problem, Yaesu suggests R13 (47k, ½-Watt) and R03 (470 Ohms, 1 Watt) on PB1708 be changed to the same resistance in 2-Watt resistors. Further investigation of this particular circuit revealed that its only function is as part of a filter section for a 160-volt line going to the 901's rear accessory jack. Since W4CEC and I have no immediate plans to use this jack, we disconnected our circuits by pulling one end of diode D03 loose from the board. We also removed our black plastic "board cover" to permit air flow. The results have been quite gratifying, and our 901s now run quite cool, even when used for long periods of time.

Counter Protection

It has been found that capacitor C2954 on the counter unit (PB1729) was installed backwards in early 901DMs, and this may lead to failure in various segments of the digital display. You can quickly check this in your unit in the following manner. Locate the counter unit behind the digital display and pry up its snap-on cover. C2954 is a small, blue capacitor on the unit's left side. Its markings should face the rig's rear (toward the power transformer). If the capacitor's markings face the rig's front, simply remove and reverse it.

You'll gain a wealth of knowledge on 901 construction when investigating this modification. The enclosed PLL unit (PB1709) and the rf unit (PB1702) must be removed before the counter unit and digital display can be slid back and removed. All screws on these units stay intact when freed, thus eliminating the lost-screws-or-spacers dilemma. You'll also notice that the plug-in digital displays are readily available, inexpensive units.

Conclusion

The modular construction of Yaesu's 901 makes servicing a relatively simple task. Few rigs offer this capability. That fact, coupled with the large number of technically-oriented amateurs owning 901s, has resulted in the modifications presented in this article. It's logical to assume that additional modifications or improvements on this rig will continue the collection presented here. This leads me to believe that the original "Fox Tango Club" may soon reach its greatest days. The FT-901DM is the most outstanding rig I've ever owned or operated.

I would like to thank Bernie Tower W6RNW of Yaesu and Don Langston WB4JVY of Long's Electronics for their support and assistance with information concerning the FT-901DM. A special thanks to Erskine Jackson W4CEC for his ideas, suggestions, and assistance as we modified our 901s. Thanks also to my XYL, Sandy WB4OEE, for typing this article.■

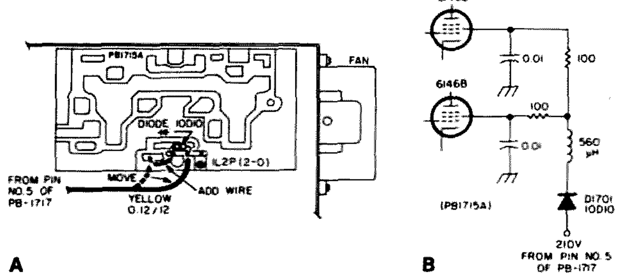

Fig. 2. (a) Illustration for screen-to-plate short protection described in the text. (b) Schematic for this modification.

Mods for the Mark

—desirable extras for your Wilson HT

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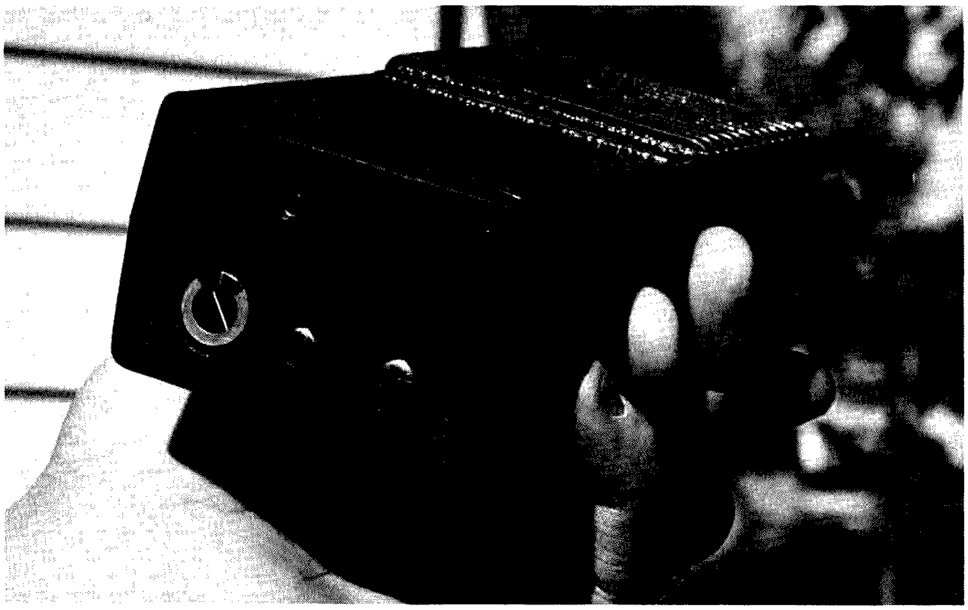
Many of the new Wilson Mark II handheld units are showing up on the many repeater systems. The HT is really a neat little package, but, as usual, it can be improved upon with a little ingenuity and time.

Battery-Level Indicator

The one thing that the Mark II really needs is a method for monitoring your battery level. Two systems can be used. The simplest is a new LED by Hewlett-Packard which has a comparator circuit built into a tiny LED. All you need is one resistor and a diode in series with it to set the threshold at your charged-battery voltage. Simply connect to the PTT line. Each time you transmit, the small LED will light. If it doesn't, your battery voltage has fallen off and caused the comparator not to turn on and light the LED. If you want, you can connect this comparator LED to the battery through the extra switch contacts on the squelch that Wilson provides for tone squelch additions. This new voltage-sensing LED is available from H-P as part #5082-4732.



S-Meter/Battery Level

I figured that since Wilson was nice enough to leave at least two square inches of circuit board space in the bottom of the Mark II for their optional tone squelch board, I would take advantage of this and build an S-meter circuit for receive and a battery-level indicator for transmit.

The meter used was purchased from Hy-Gain. It is the same one they used in their #3086 HT. It mounts in the bottom of the Wilson on that same little plastic end piece that houses the battery-charging contacts. This works out so that you

don't have to cut any holes in the main case. A touch of epoxy cement holds the little meter in place. Be sure to recess it a little so the HT will sit level in the charger.

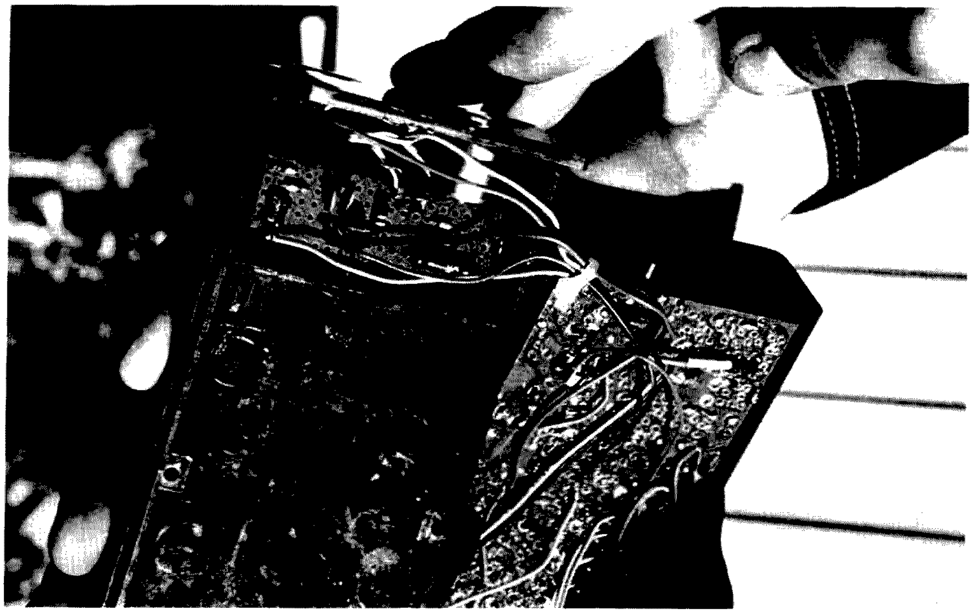
The S-meter circuitry is very simple. Just about any NPN transistor can be used as an amplifier to drive the meter. A part of the output of the second i-f amplifier is detected with D1 and fed into the meter amplifier.

The battery-level indicator circuit is simply one diode connected to the junction of two resistors to form a voltage divider off the PTT line. This allows the meter to function only during transmit. You also could connect the level meter circuit directly to the battery through that spare switch contact on the squelch control that was originally planned for a tone squelch circuit. Using this method, one can check the battery level at any time, not just during transmit. Personally, I prefer using the meter to monitor during my transmit periods since that is when the current drain is the heaviest.

Easy Construction

For the purists, a printed circuit board could be laid out, but with such a simple and small circuit, vectorboard can be used quite effectively. The board measures 2-1/4" × 7/8". Mount the parts, solder all connections, and leave about 5" of all wires so easy connections can be made to the main Wilson PC board. The only problem you may have is in making certain you observe the diode polarities. The rest is very straightforward, and it should all go together quickly and easily.

An easy method to secure the board is to use some small, 1/8"-wide tape along the sides of the board, and simply tape it in place. Works out great!



Only 4 Connections

The circuit board uses only four connections to the main circuit board of the Wilson: B+, ground, PTT line, and the receiver limiter. Extra sensitivity can be achieved in the S-meter circuit by adjusting R1. For transmitter hunts or weak signal hunting, you may want to play with the resistor.

Cut the four wires to their necessary lengths, trim, and solder in place. Your S-meter/battery-level indicator is ready for action!

External Headphone Jack

There may be times when you desire to use your Mark II with a small earplug so as not to disturb anyone else; install a micro-jack in that bottom plate so that the speaker line is disconnected when the earplug is plugged in.

Improving the Transmit Audio

Being in the professional audio business, I tend to be a bit "picky" about the audio we, as amateur radio operators, hear. After comparing the Mark II transmit audio to many other handheld units, it became apparent that improvement was necessary. The improvements are also very simple to achieve.

New Mic Cartridge

First and easiest is to replace the Mark II micro-

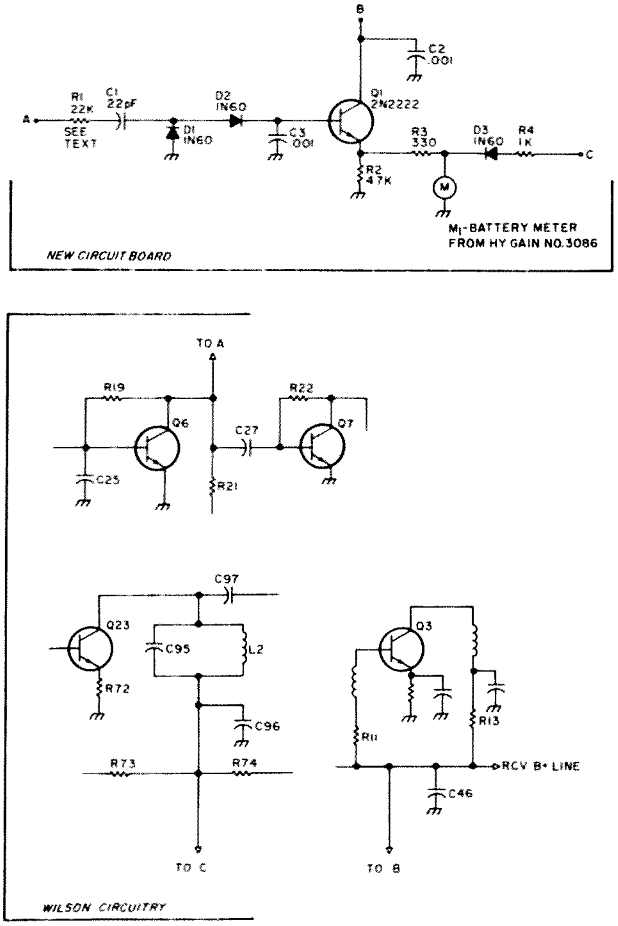


Fig. 1. Mods for the Mark. Pick-off points A, B, C are easily located by referring to p. 18, "Circuit Board Overlay," of the operating and service manual.

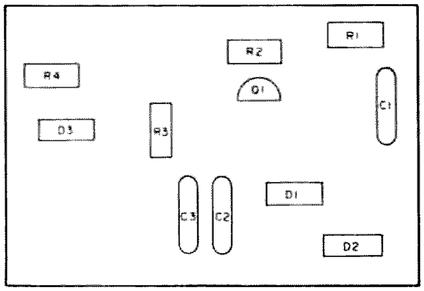


Fig. 2. PC card layout for Mark II. Complete kit with all components, PC board, and wire harness, but without meter (available from Hy-Gain) is $8.00 from Melco, P.O. Box 26, Marissa IL 62257.

phone with a Knowles BA1501 (Knowles Electronics, 3100 N. Mannheim, Franklin Park, Illinois 60131). This really helped the audio response as noted on an audio analyzer. A few component changes also are in order to achieve better audio. Change R78 from 3.3k to 1.5k, C111 from 0.1 to .47, and C118 from 0.15 to .47.

Try this audio mod and I can guarantee that your friends will think you are on a full-sized mobile transmitter! We might also point out to Mark II owners that by simply changing the driver transistor, Q24, to an MRF 515, you will have a Mark IV. Use care when tuning the collector coils of Q24 so that no parasitics are present in the output. The change is easy and will give you about 4 Watts out. ■

Reader Service—see page 179

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The History of Ham Radio

—part IX

Reprinted from QCC News, a publication of the Chicago Area Chapter of the QCWA.

In the early 1920s, in order to be truly portable a radio receiver had to be fairly light in weight, have a degree of efficiency, and be designed so that it could be moved about with ease. It was dependent, above all, on some type of portable antenna. *Reliable operation and portability were the basic criteria.* The antenna was of the loop type, of modest dimensions, and foldable. Dry "A" cells were the only source of sufficient current required for the filaments of the vacuum tubes. The plate supply depended on "B" batteries. The batteries contributed the major weight. The older UV 200 and UV 201 tubes were replaced by UV 199 and the WD11 tubes which did not require as much filament current, thus lengthening the operating life.

Using a loop for reception posed somewhat of a problem. The loops used had distinct directional characteristics. A loop had variation coverage as much as five to one forward compared to the sides. During the summer months, general activity among radio amateurs was not only down, but rather drab and unenthusiastic. QRN and static prevailed with regularity, and activity was carried on the assigned wavelength of 200 meters (plus or minus).

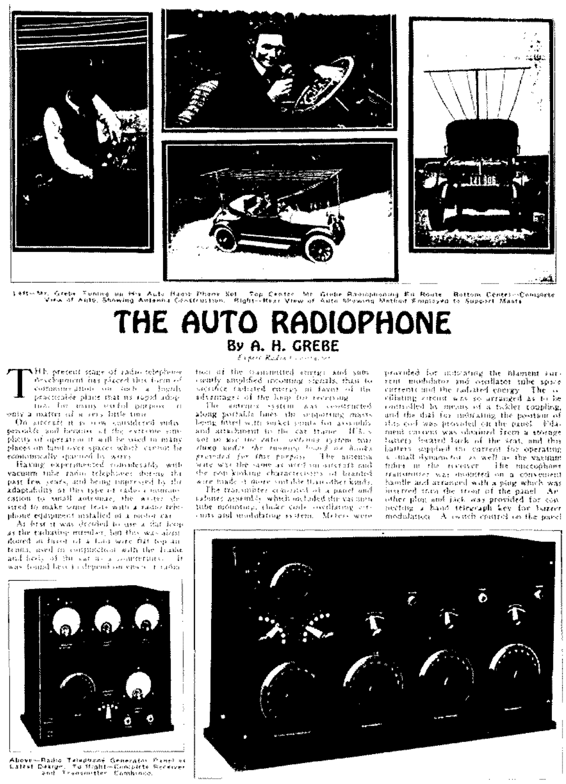

Fig. 1.

Fig. 2.

The broadcast listeners had the evening hours with little or no amateur QRM to contend with. The agreed upon hours of silence were regularly observed by the amateurs. Summer activity was usually looked upon as putting a damper on most ham transmitting. It was a time to take inventory of equipment, to rebuild and update for the coming winter season.

Whenever radio amateurs were involved in a project, ingenuity prevailed. A. H. Grebe, the well-known inventor and manufacturer of the CR line of receivers known and used by most amateurs during the twenties, went portable in a big way by giving the loop advocates an eyeful. He preferred to stay with the usual design—flat top, multiwire model—in spite of the limited cruising mobility (Fig. 2).

The aerial with auto-body-counterpoise configuration was preferred over a loop to avoid specific directivity. When ready to dismantle the outfit, what did Mr. Grebe devise? The entire overhead system was slung under the running board (cars had large running boards in them days) on hooks provided for that purpose. Instead of using dry cells, a storage battery was available for the heavy drain required for the tubes.

Fig. 3 illustrates what was available for radio entertainment while visiting the famous boardwalk at Asbury Park, NJ: the Roller Chair Special. The apparatus consisted of a radio chair so compact that three persons could sit comfortably side by side in the seat. A loop of the flat type was connected to the detector-amplifier held in the laps of the travelers. No coils were used, all tuning being accomplished solely with the variable condenser. Signals from stations over 200 miles distant were heard. Such sets were effective for wavelengths of 300 to 500 meters, and good results were often had at wavelengths up to 800 meters.

A more practical and somewhat more compact, all-around enclosed model of portability consisted of a receiver using a popular circuit known as a Grimes "Inverse Duplex" (Figs. 4, 5), having four tubes of the WD11 type. The set had a wavelength tuning capability of 200 to 3500 meters. The particular instrument shown in Fig. 4 was transported to the Philippine Islands in 1924 and served a lumbermill owner for years. It traveled by motorboat and other sundry conveyances over the broad island and mainland areas, giving the owner contact capability with his home base. The receiver was used in connection with a kW spark transmitter.

Legislation Problems Unsolved

The very rapid expansion of radio broadcasting during 1922/1923, together with the great demand for receivers and the need for some semblance of interference control, pressured legislators in Congress to come up with an urgent solution. The folks back home demanded action.

As a result of the first radio conference, held in Washington in the spring of 1922, Congressman White of Maine introduced a bill, known as the White Bill, HR 11964. For almost a year thereafter the bill was periodically under discussion, often under review, but constantly in the minds of the radio amateur.

On January 2, 1923, almost a year after the White Bill was introduced, the ARRL President, Hiram Percy Maxim, went to Washington for a hearing on the bill. He was instrumental in bringing to bear on the legislation the opinions and recommendations of the amateur fraternity. It was the ARRL up in front, promoting action and showing great interest in bringing about an equitable solution to the problems confronting listeners, the broadcasters, the commercial operators, and the thousands of amateurs. But speaking in behalf of radio amateurs in particular, it was Mr. Maxim's foremost objective to ensure that amateur radio would continue to have its rightful place.

The White Bill contemplated legislation to broaden the wave band for broadcasting so that the service could grow, expand, and perform in an orderly fashion, an action that was required so that Secretary of Commerce Hoover could be given authority to properly regulate radio in the United States. The bill was carefully analyzed, several recommendations and amendments were proposed, and suggestions were offered in an attempt to bring the listener and the radio amateur into accord. It was hoped that commercial interests would not be the dominating influence in this free and open domain, the ether.

However, in the End, What Happened?

The White Bill, HR 11964, passed the House on January 31, 1923, went to the Senate, and there was referred to the Committee on Interstate Commerce. Because of considerable outside opposition to various provisions, the bill languished and finally remained to die with the expiration of the 67th Congress on March 4, 1923.

Sensing trouble, and knowing the general attitude taken by many interests in the bill, White introduced a new bill on January 11th, with certain modifications proposed. It included provisions somewhat more palatable to the

Fig. 3.

objectors. The new bill was introduced as the White-Kellogg Bill. It also died in the face of considerable opposition. This virtually ended the hopes of all concerned to patch up the old 1912 radio law and bring order out of a simmering and ongoing chaotic situation.

On March 20, 1923, Secretary Hoover called his Radio Telephone Conference members to review the situation, hoping that a solution could be found to administratively cope with a defiant muddle. It was paramount that a way be found to open up more wavelength channels for broadcasting. The second National Radio Conference thus came to order.

In the meantime, amateurs, again caught in the middle but constantly cooperative, commanding the staunch support of the Secretary, had devised a so-called "Rochester Plan." The plan specified that in communities where QRM would be considerable and above normal in volume, quiet hours would be observed between 7 and 10:30 in the evening in all zones throughout the country, especially in the more heavily populated areas. At the conclusion of this second conference and after months of deliberation, a schedule evolved and was recommended. (See Table 1.)

Amateur Activities on the Rise

Amateurs were beginning to discover, through their constant experimenting, that wavelengths below 200 meters had possibilities not to be denied. The vacuum tube and the associated circuitry developed led the experimentally-minded amateur into unexplored fields. He discovered that by using vacuum tubes instead of spark gaps he was able consistently to span distances with ease and much less power on his assigned wavelengths Dropping down below 200 meters had tremendous possibilities. All of the early tests engaged in between individuals in various parts of the country were usually planned in advance and followed a schedule. Practically no one was listening below 200 meters. Nobody had a receiver at this stage of radio progress, nor the capability, to tune down much below 200 meters. With no signals on the air except by prearrangements between individual operators, there was only static to be heard. The ether was just an empty void below 200 meters and was generally avoided.

As the amateur slowly ventured into the lower unexplored regions, he faced one common question, namely, "Will the efficiency of the tubes I have available decrease as the wavelengths become shorter?" He knew that the larger tubes were still quite inefficient in design and the circuitry lacking in development. Many amateurs could not be convinced that "below 200 meters" was a fertile field in which to risk expensive "bottles." This area also was unsuited to the tuners used, and besides . . . the antenna he was using was too long, and nobody could be heard with whom to communicate. The League at Hartford had a great deal of convincing to do and a great many illusive misgivings to overcome among

Fig. 4.

Fig. 5.

the majority of hams. Most amateurs were unwilling to let down their old multi-element aerials, disconnect the ammeter from the antenna lead, or trust the plain Hartley transmitter circuit. There was still an amount of extraordinary experimenting ahead.

Wavelength Vs. Frequency

Another major stumbling block in the way of progress was evident. This was the fact that nobody knew or was seriously concerned about how to make wavelength measurements. Up to this time, very little reference had been made to the term *frequency*, nor much attention paid to conversion from wavelength to frequency. Conversation among radio men held rather tenuously to *meters*. Not until the League convinced the radio division of the Bureau of Standards that by transmitting measured frequencies over their Washington station, WWV, for amateurs to copy and adjust circuits to conform to, would the ice be broken. So, from this time on, the wavemeter gradually became the most important laboratory instrument in the ham shack. Schedules were now arranged to have transmissions from WWV appear periodically, set for eleven pm, EST, on specified wavelengths and frequencies. They provided calibration settings for all home-built wavemeters, permitting the receiving tuners to be modified or rebuilt or redesigned for receiving the higher frequencies. A new and important era in amateur radio was now set in motion with vigor. ■

Below 130 meters	Available for special licensing.
130 meters	Government, CW, exclusive.
130-143 meters	Available for special licensing.
143 meters	Government, CW, exclusive.
143-150 meters	Available for special licensing.
150-200 meters	Amateur, CW, ICA, phone, spark, exclusive.
200-222 meters	Special amateur, technical & training schools, CW, exclusive.
222-231 meters	Aircraft, CW, ICW, phone, nonexclusive.
231-286 meters	Class B broadcasting, phone, nonexclusive.
286-288 meters	Reserved.
288-300 meters	Class A broadcasting, phone, exclusive.
300 meters	Marine, CW, ICW, spark, nonexclusive.
300-450 meters	Class A broadcasting, phone, exclusive.
450 meters	Marine, CW, ICW, spark, exclusive.
450-545 meters	Class A broadcasting, phone, exclusive.
545-674 meters	Marine & aircraft, CW, ICW, spark, exclusive.
674 meters	Government, CW, nonexclusive.
674-800 meters	Marine & aircraft, CW, ICW, spark, exclusive.
800 meters	Radio compass, CW, ICW, spark, exclusive.

Table 1. Schedule evolved from the 2nd National Radio Conference. Class A and B broadcasting stations were assigned a wave band of 10,000 cycles, none closer together than 20 kilocycles in frequency. Within each area zone there would be ten stations separated by 50 kilocycles.

Add-On Keyboard for Your Keyer

—the "a la carte" design

Easier than you think.

Edward J. Faber K4BZD
554 Sulgrave Drive
Columbia SC 29210

If you have an electronic keyer in your shack, you can go the complete keyboard route more easily than you think. This project is recommended to all who have home brewed or constructed an electronic keyer. However, even if it is your first time for an IC project, you should have little trouble. The cost of this project can be negligible if you can find an old keyboard and a handful of diodes. Only three ICs are required to get you started.

Your existing keyer is used as a functional part of the Morse keyboard . . . a la carte (you can make one your way without a lot of fuss). Your keyer should be of a semiconductor design, preferably containing a +5-volt supply. If your keyer uses 12AT7s, please read on; it may still be easy to get rid of the bug! Chances are your keyer already has many of the circuits required to make the a la carte design work. If your keyer has any of the below listed features or functions, that part of your Morse keyboard is ready to operate.

- Power supply with off/on switch
- Timing and weight circuits for dot/dash elements
- Monitor, volume, and possible tone controls
- Transmitter keying circuits
- Operator test-tune controls
- ROM or PROM message readout options

To build this additional hardware would cost you a buck-two-eighty, so why bother to do it again?! The nice thing about the a la carte design is that your keyer remains usable at any instant you desire to cease sending via the keyboard. In most cases, no modification or changes are required within your keyer, although getting into it may be desirable to achieve the simplest interface to the keyboard circuits.

So what does it take to order up one a la carte keyboard? Take a look at the menu in the parts list. Items 1 through 5 you'll need for the main course. Item 6 is the dessert and, therefore, optional, depending upon your application and keyboard design.

How to Get Rid of the Bug

In this design, I used a diode matrix to establish the Morse coding elements (dots and dashes—forget about the spaces; your keyer takes care of that). In Fig. 1, the diodes forming the dot elements connect to a "dot" 8-bit shift register (U2), and the dash diodes connect to the "dash" shift register (U1). Examples of the diode arrangement to form the letters Q, S, and T are provided. The diodes may be wired all on one assembly to simplify wiring. The 8-bit shift registers store the "dot" and "dash" characterization for each letter in the order sent. There is no requirement to characterize the elemental spaces because this function resides in the logic of your keyer.

When a keyboard switch is depressed, a logic zero (≈ 0V) appears on the output (pin 9) of U1 or U2. If the character being sent begins with a dash, pin 9 of U1 goes low. If the character begins with a dot, pin 9 of U2 goes low. The transition from a high to a low causes one of the terminals on your keyer to see a ground; thus it (the keyer) begins to do its thing, and it sends a beautiful dot or dash.

If the shift registers were not clocked, a second dash or dot would follow the first just as if you were holding down the key on your keyer. If both of the shift register outputs are high, the keyer again does its thing by doing nothing. When your keyer is idle, the a la carte keyboard assumes you have completed sending a letter, and it awaits the suggestion that you desire to send another letter. The letter-space oscillator (U3) controls this timing (Fig. 2). It sends a pulse (C) to the

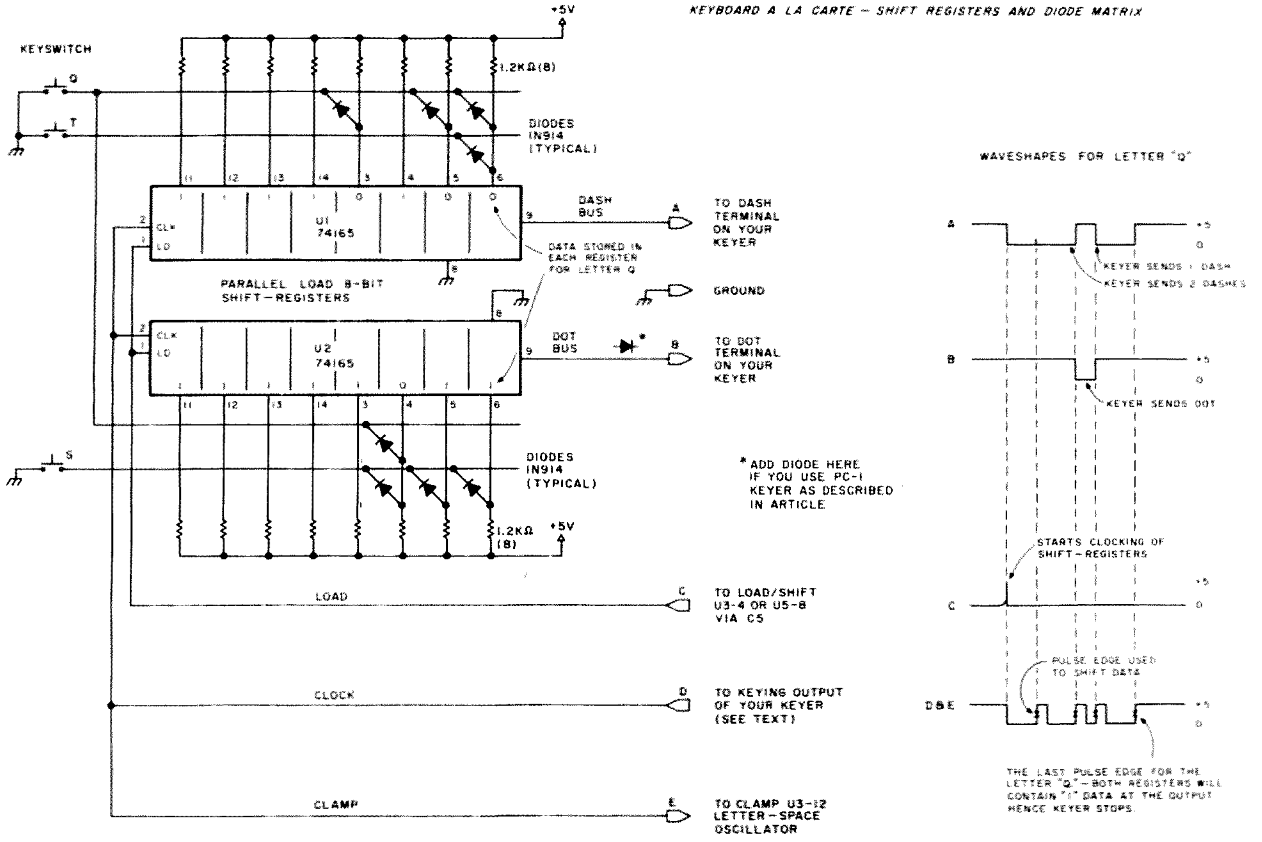

Fig. 1. Keyboard a la carte—shift registers and diode matrix.

shift register's load/shift input (pin 1) so that you can load in the next character from the diode matrix. If this pulse arrives at the shift registers when a key is being depressed, the next dot or dash instantly is on its way to the proper input of your keyer. Fig. 1 shows logically how the letter "Q" is loaded into the registers.

When your keyer is sending the letter, an output signal similar to the waveshape shown in Fig. 1 (D and E) is routed to the shift registers (pin 2). This is a true representation of the Morse code as sent to your transmitter. It serves as a clock to advance the data stored in each of the eight locations in the shift registers. The 74165 clocks on the positive-going pulse at the end of each dot or dash element formed in your keyer. With the generation of the letter "Q", the data is shifted four times after the initial start by the letter-space oscillator. The clock signal must be of the phase shown in the diagram or your keyer will send extraneous signals. In my keyer, a signal was acquired at the base of one of the transmitter keying transistors and routed through a 7400 logic gate to invert the signal to the desired phase. Check around your keyer; you'll find an appropriate loaction. The signal should measure about +5 volts when off, and near 0 volts when a dot or dash is present. There are all kinds of ways to capture this output. You can even use one of your transmitter keying outputs with an appropriate interface to give you the proper clocking signal. Here's your chance to apply some of your own talents to the design.

The Main Menu

If you just connect U1, U2, and U3, the diode matrix, and the keyswitches, as shown in the diagrams, you will have a very versatile system. The variable resistor network provides a full range of adjustments to control the speed or timing of the letter-space oscillator. R2 and perhaps R5 should be mounted as operating controls. The other variables may be fixed or trimmed one time to achieve the adjustment ranges desired. With these controls and those on your keyer, you can establish a keyboard fist of your very own style.

My keyboard performed with spectacular success. Speed was controllable from 4 to 50 wpm. The shift registers provided one full letter of memory. No problems with keybounce, transmitter RFI, EMI, or other intermittent operation occurred. Besides all the letters and numbers, the shift registers can store up to eight code elements, so you can send $\overline{AR}$, $\overline{AS}$, $\overline{BT}$, $\overline{SK}$, ?, /, $\overline{CQ}$, error, and any other procedural signals you can invent. However, remember that the registers will not store space data.

Several additional features were added to my keyboard to aid in the operating pleasures of the device. One is a "test" switch to effectively short the "V" keyswitch to ground. This permits the continuous execution of "Vs" for adjustment purposes. An LED was also added on the control panel to give a visual indication that the keyboard is active and ready to load the next character. Timing this light when sending Vs will give a good indication of sending speed on the keyboard. The LED is connected at U3, pin 6 in the simple version and at U5, pin 8 in the optional space-bar version.

The keyboard should work with just about any keyer. You can test the en-

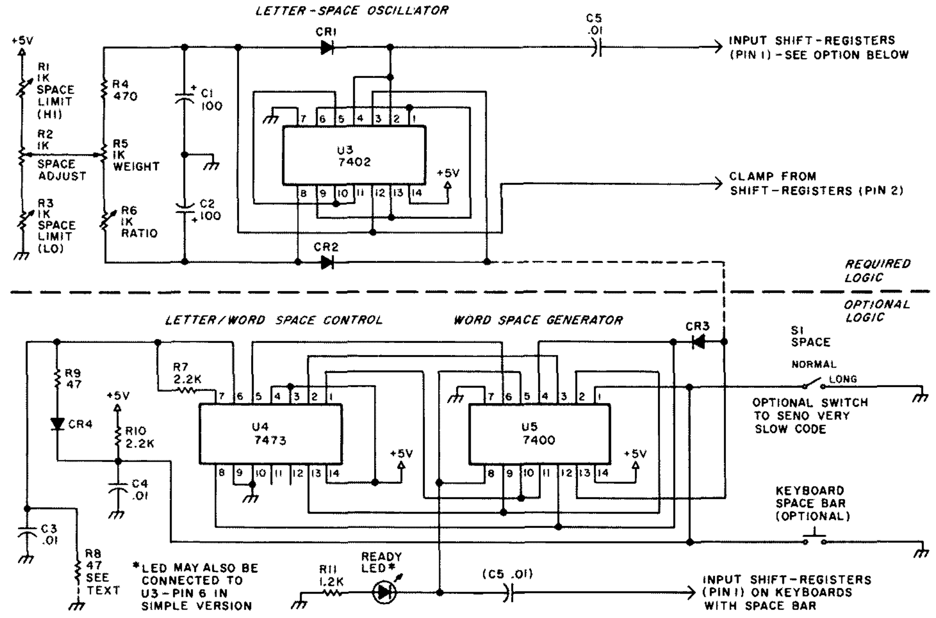

Fig. 2. Keyboard letter/word space-timing circuits.

tire concept on your keyer with a couple of push-button switches before you invest in a keyboard. This approach is recommended in your prototype design. Regardless, I see no complication in going keyboard a la carte with popular keyer designs such as the Accukeyer and the more recent micro-to-keyer concepts. The only test equipment used during many hours of experimenting was a multimeter and several LEDs. No ICs or other parts failed for any reason whatsoever.

Here's the Dessert

If the keyboard you have selected to use contains a space bar, you can add an optional circuit, shown in Fig. 2. It consists of a 7400 gate and a 7473 flip-flop. For most parts, it is a reproduction of the Data Signal, Inc., keyer (described at the end of this article) less the monitor circuits and transmitter keying transistors. It is shown here with permission of Data Signal, Inc.

The circuit sends controlled letter-space and word-space pulses which activate the shift registers at the start of the next letter or next word being keyed from the keyboard switches. When R8 is grounded (this is a dot input for the circuit when it is used as a keyer), the space oscillator, U3, starts to run. This sets U4. Also, when U3 starts its cycle, a 1 is placed on U5, pin 8, and a positive pulse is sent to the shift registers to permit loading of data from the diode matrix. Once this occurs, the oscillator and flip-flop must complete the cycle before a second pulse can be sent to the shift registers. Thus, the "letter" space timing is generated. When the space bar on the keyboard is depressed, R10 is grounded (the dash input to the keyer circuit) and flip-flop U4 extends the rest period to the full word-space timing as determined by the variable adjustments at the oscillator. A convenient letter/word spacing switch fixes the spacing at its maximum set length. The addition of this switch is useful if the keyboard is to be operated at very low speeds for teaching purposes or when operating on the Novice band.

The Author's Keyer

For my design, I used a Data Signal, Inc., PC-1 keyer. It was constructed from a kit which cost about $16.00. The kit consisted of four ICs, transistors, diodes, pots, capacitors, speaker, PC board, and wire. The keyer was mounted in a small utility box with a simple power supply. The entire kit could be incorporated into the keyboard package without difficulty. The circuit shown in Fig. 2 is the basic keyer (you could buy two and use one for the keyer and one for the space-word timing circuit). The design of the PC-1 keyer was such that I was required to insert a diode in the dot input terminal (Fig. 1) to eliminate a low-impedance path to the dash bus.

I am grateful to Data Signal for permission to use this part of their keyer design in the a la carte keyboard. Those interested in further information should correspond directly with the company. I have no relationship, responsibility, or interests in the business activities of Data Signal, Inc. Their address is 2403 Commerce Lane, Albany, Georgia 31707, (912)-883-4703.

Construction Hints

Construction of the a la carte design will be dependent upon the keyboard you are able to use. Remember, you may use push-button switches to fabricate a keyboard design if the cost of a purchased unit is out of the question. Regardless, switch contacts should be normally open if you follow these schematics. The diode matrix can be mounted on a block of wood about one-half an inch thick by 3½ to 4 inches wide and 7 or 8 inches long. In my keyboard, the block was sized to fit under the keyswitches. The diodes are inserted into predrilled holes in the board such that the body of the diode is hidden from view and the diode leads extend out through each side of the board. The proper polarity of the diode must be observed when inserted (see Fig. 3). Also, remember that pin 6 of U2 and U3 is the first-in, first-out data line for each chip. Reversing the order of the data lines will result in operational failure.

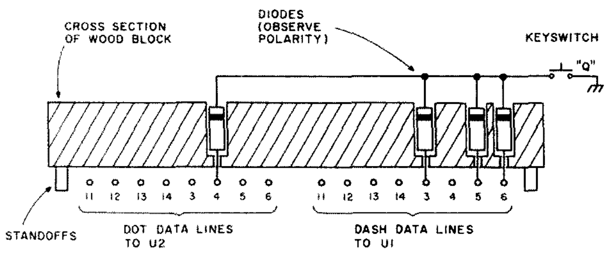

Fig. 3. Diode matrix assembly (wiring for the letter "Q" shown).

Parts List

Item	Qty.	Description	Approx. Cost
1.	1	Keyer, yours—if you don't have one, see text	---
2.	1	Keyboard (45 or more keys, microswitches will work)	don't pay over $19
3.	2	Dot/dash shift register ICs (74165)	$1.25
4.	1	Dot/dash matrix, you'll need about 200 signal diodes	$4.00
5.	1	Letter/space oscillator—7402 IC, plus misc. parts	$3.00
6.	1	Word/space generator—7400 and 7473 ICs	$1.00

The matrix board also contains the sixteen pull-up resistors. They are connected to the sixteen data lines at one end of the board. The other resistor leads are all common to the +5-volt source. A layout for the diode matrix should be started by preparing a template on graph paper. Mark the hole pattern for each diode so that they can be connected between each of the 16 data lines according to the code elements of each character. Locate the holes for the pull-up resistors at one end of the board. Wrap a piece of tape around the bit you intend to use to drill out the diode holes so that the bit will stop before going all the way through the board. Another piece of tape should be wrapped around a needle or bit of the appropriate size of the wire leads of the diodes. Use the needle to extend the hole for the diode leads to pass completely through. In this case, the tape helps to center the needle in the existing diode hole.

Small crimp-on contacts of an unknown variety were used to provide a mating interface between the wires of the matrix and the wiring coming from the keyswitches and logic. The leads, however, could be soldered if consideration in the layout is made for disassembly and repair. The matrix board was mounted on four standoffs, as shown in the diagram, to insulate it from the keyboard housing.

The ICs can be mounted on just about any old vectorboard. I used sockets, but they were not necessary. Figs. 1 and 2 are arranged to show a wiring configuration for the ICs. The true schematic representation is not shown in detail to make the drawings more useful in the assembly of the project. Refer to appropriate data books for schematic details. The control panel design, again, is a function of the keyboard used, and the control options selected from the text.

Bypassing and filtering of the power source is desirable at several places to ensure reliable performance. Recommendations here are a function of the power source used and the effectiveness of the ground system and, therefore, are left to the builder to determine. In the cabling between the keyboard and your keyer, use shielded wire if possible. These lines should be kept as short as possible. The use of connectors and plugs might be more appropriate than terminal strips to help prevent false triggering from rf in the radio shack.

One final warning about the operating effects of your new keyboard . . . Your SSB friends will wonder what happened to you. You'll be a born-again CW man, this time without the bug. ■

Little Extras for the Century 21

— easy add-ons

Make a good rig a little better.

Bob Borum KN4JJG
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Tampa FL 33610

Recently, I bought a Ten-Tec Century 21 80-10 meter CW-only transceiver. I used it for a couple of weeks just as it came from the box, and all in all I was very happy with the ease of operation and the fine signal reports I was receiving. But, being the typical ham, I thought I would change things a bit.

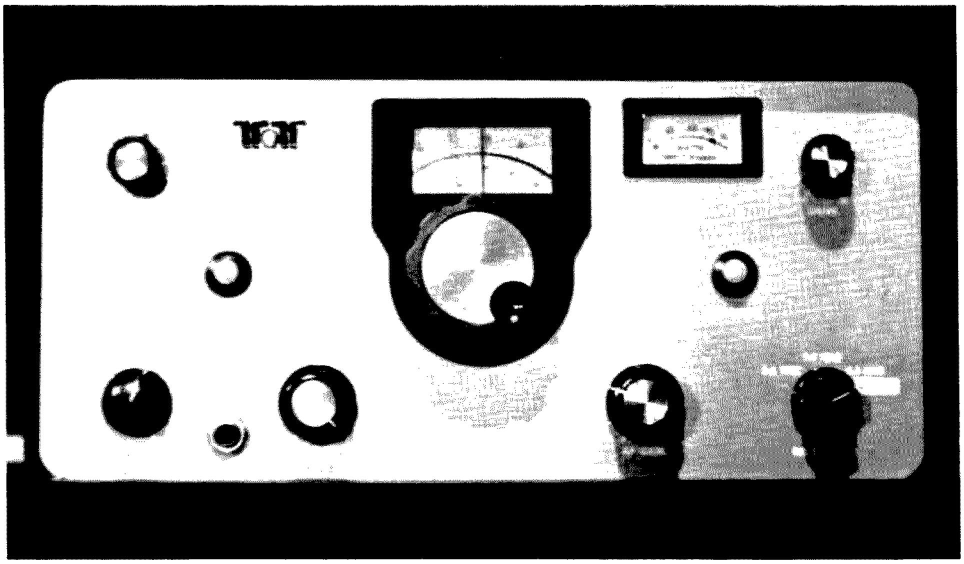
Little Things

The first things that bothered me were the prop-up feet and the size of the control knobs. If you have small fingers the knobs are okay, but they got lost in my big fingers. Digging through my junk box, I came up with a matched pair of knobs for the band-change and selectivity switches, and another pair for the rf and af controls. The ease of operation greatly increased. As for the feet, I had a couple of 1¼-inch feet left over from another project.

Bigger Things

Everything was all right for about a week, and then the sidetone began to get to me. It sounded like a frog was living in the radio. The note was about 350 Hz and my ear is tuned to around 700 Hz, so out came the schematic and off came the bottom cover. R1, a 68k ½-W resistor (47k in my unit) on board the 80356, controls the frequency of the sidetone. If this resistor is decreased in value, the tone increases in frequency. I paralleled another 47k resistor with R1 and the tone was just about right. So I removed R1 and installed a wire to one of the solder pads and a 22k ½-W resistor to the other. I found a space on the rear panel to mount a 25k linear pot in series with the wire from the other solder pad. Now I have variable sidetone.

As long as I had the board out and the bottom off, I looked around for solder whiskers, cold solder joints, etc. I noticed that the selectivity switch had several unused connections, and, sure enough, the selectivity switch had other positions available by turning the switch to the left from the 2.5 position. This made me think that if 500-Hz selectivity is good, wouldn't 200-Hz be better? The present active filter circuit in the Century is a good one, so I just dupli-



The new, larger knobs installed, with the selectivity switch in the .2-kHz position.

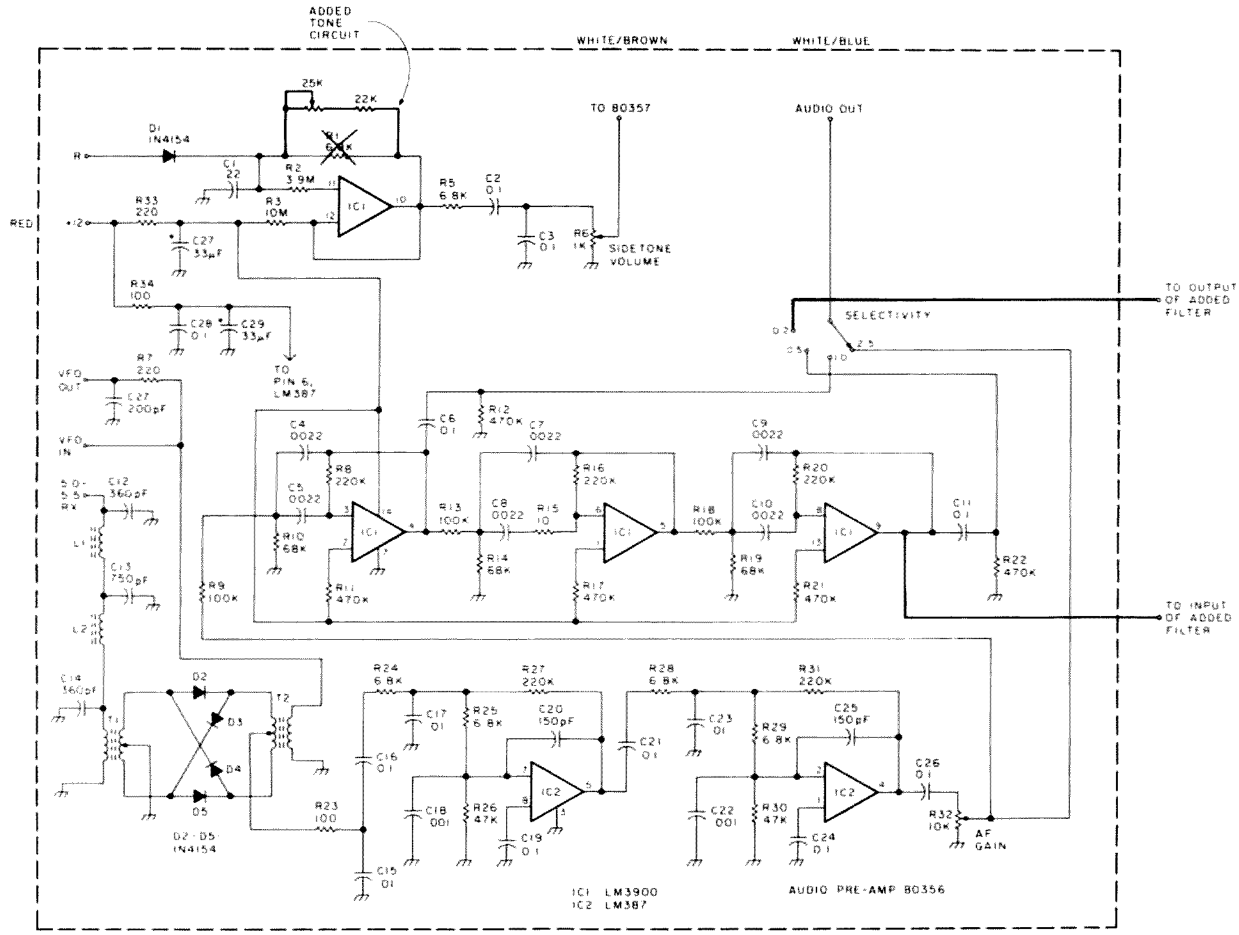


Fig. 1. 80356 audio preamp.

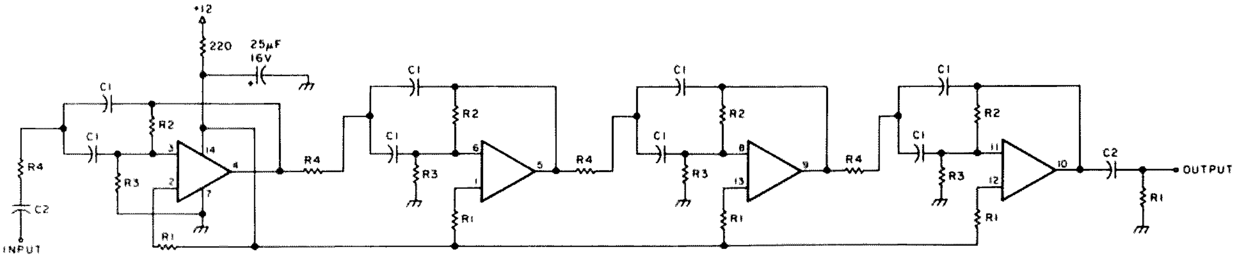
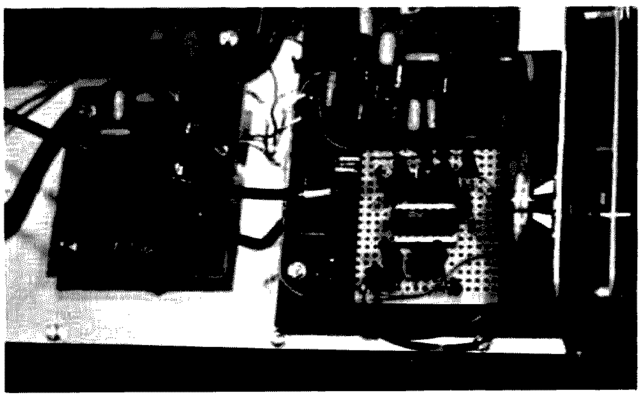
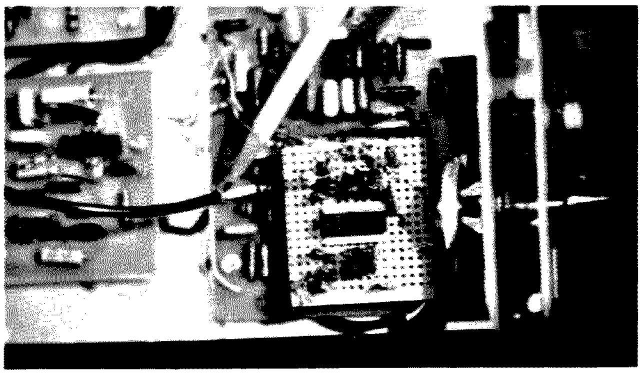


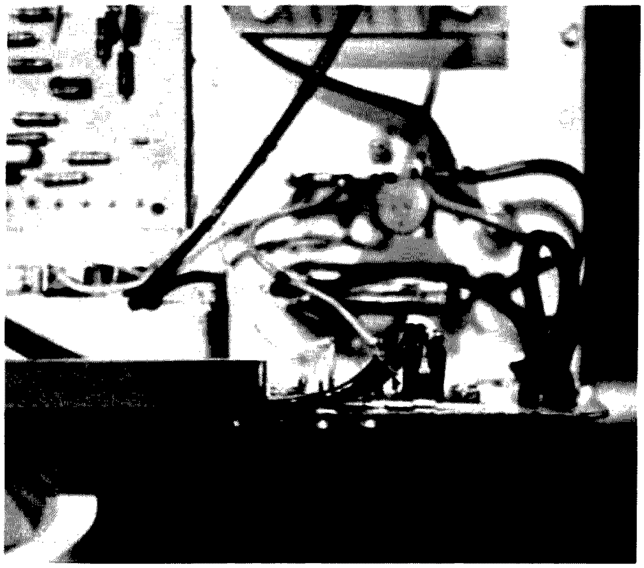
Fig. 2. Audio active filter. R1—470k. R2—220k. R3—68k. R4—100k. C1—2200pF. C2—.1uF. IC—LM3900.



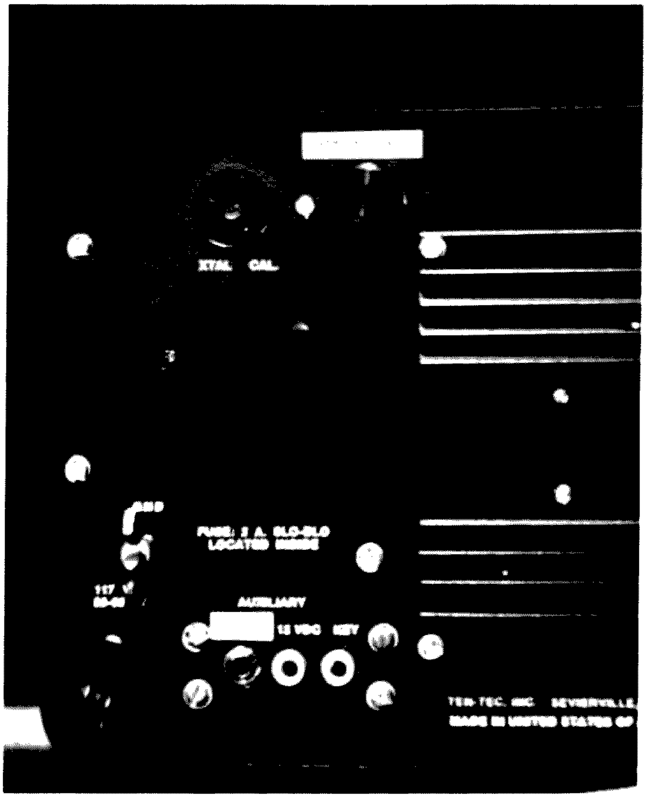
Added CW filter mounted behind selectivity switch.



Pencil points to the wire going to the sidetone control—also shown is the added filter on vectorboard.



Bottom view of placement of auxiliary speaker jack.



Mounting of the sidetone control and the auxiliary speaker jack.

cated it by using all 4 of the amps in the LM3900 chip. Construction is straightforward, using a small square of vectorboard. I used a wire-wrap 14-pin IC socket, and it really simplified construction. With Super Glue™, I mounted 2 fiber standoffs to the 80356 board to mount the new active filter on after construction. I Super Glued the vectorboard to these standoffs.

The selectivity knob is the setscrew type, so by moving the connections on the board the knob can be rotated so the dial still reads correctly. A small Dymo™ label slightly to the right and down a bit from the .5 position is the .2 position. This modification is very simple, works well, and can be removed to have the circuit made normal, with no indications that it was ever done. Now, talk about single signal selectivity! The signals just leap out at you when the tone of the signal is tuned to 750 Hz.

Last but not least, I installed an external speaker jack on the back in place of one of the 12-V accessory phono jacks. I used a miniature phone jack of the shunting type. If an external speaker is plugged in, the internal speaker is cut off. Care should be taken so that the other 12-V accessory jack is not shorted to the phone jack you install. I will be glad to answer any letters concerned with these modifications if there is an SASE enclosed. Let's see . . . amplified agc would be nice, maybe a vernier control for the offset tuning, and SSB shouldn't be too hard. Well, that will come later; I'll enjoy what I have for awhile.

All parts for these modifications can be bought at Radio Shack for around $15.00.■

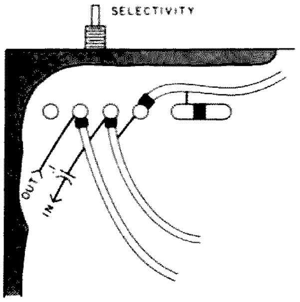


Fig. 3. Bottom view of 80356 audio preamp board. Cut foil as indicated by heavy black areas. Add jumpers as indicated by heavy black lines. In/out indicates wiring to added filter.

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Scott AFB IL 62225

The Many-Talented 723

—how can regulated supplies get much simpler?

Design your own voltage regulator.

Whenever you need a regulated power supply for the test bench or for that special IC project you're working on, consider the 723 integrated voltage regulator. This handy little device is inexpensive (priced around 70¢), simple to use, and offers a lot of capability in a small package. With it, you can build a quality regulated power supply using very few parts. Read on and I'll show you how easy it is to custom design your own regulator around the 723 to suit your particular application.

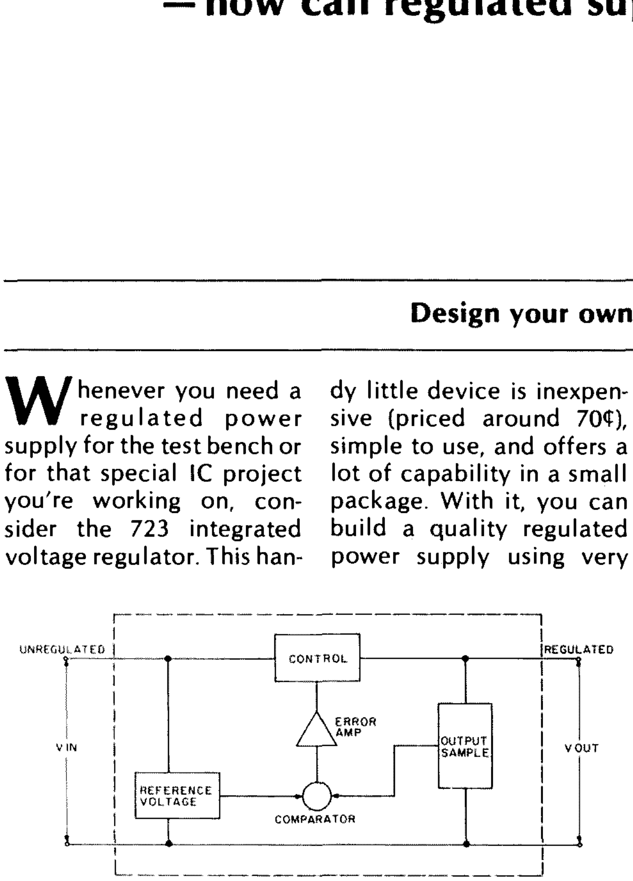


Fig. 1. Functional block diagram of a series voltage regulator.

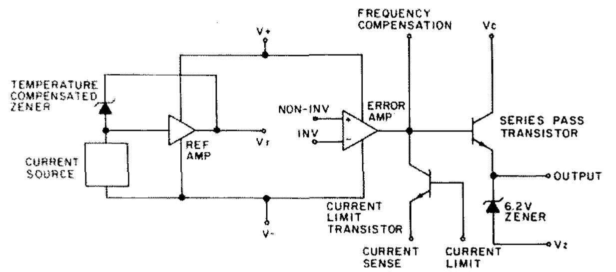


Fig. 2. Internal 723 functional block diagram.

Before we begin, let's look at a few characteristics of the device itself. The 723 operates with a rectified and filtered input voltage in the range of 9.5 volts to 40 volts. The output voltage is adjustable from 2 volts to 37 volts with .01% line and load regulation.

In case the terms "line regulation" and "load regulation" are unfamiliar to you, line regulation is the percentage change in the regulator output voltage for a change in the input voltage; load regulation is the percentage change in the regulator output voltage for a change in the regulator output current. Ripple regulation, which is defined as the ratio of the peak-to-peak input-ripple voltage to the peak-to-peak output-ripple voltage, is typically 45 dB.

As you can see, the regulation characteristics of the 723 are excellent. Note, however, that the 723 has two disadvantages that we must deal with. The first of these is that this IC can provide a maximum output current of only 150 mA. This limitation can be overcome by adding a single external pass transistor, as we will see later. The second disadvantage pertains to the value of the internal reference voltage of the 723, but I'll discuss this later and show you how to overcome it as well.

To illustrate how easy this device is to use, let's look at the 723 internal structure and then design a few regulator circuits with it. Fig. 1 shows the essential functions of a typical series voltage regulator. The reference voltage element provides a known stable voltage which is

compared with a sample of the regulated output voltage at the comparator. The comparator subtracts the sampled output voltage from the reference voltage. This difference voltage (or error voltage) is then amplified by the error amplifier to provide drive for the control element. The control element behaves similarly to a valve in a water line in that it conducts more or less to adjust its resistance, and hence its voltage drop, to yield the proper output voltage across the load.

Now compare the internal features of the 723 (Fig. 2) with the regulator block diagram (Fig. 1). The 723 contains all the necessary regulator components except the output sampling element. The reference amplifier, current source, and zener diode comprise a stable temperature-compensated voltage source. Other internal functions include an error amplifier, a series pass transistor (the control element), an adjustable current limiter, and a 6.2-volt zener diode. The input of the error amplifier functions as a comparator by taking the difference between the voltages applied to the inverting and noninverting inputs. Note that the current limiter and the 6.2-volt zener diode are features that are not essential to the operation of the regulator. However, the current limiter is extremely useful for setting the maximum (short circuit) current output from the regulator, and the 6.2-volt zener diode can be used in floating or negative voltage regulator applications. One caution should be noted here—the 6.2-volt zener diode is only accessible in the 14-pin dual-in-line package. The flat pack and the 10-lead metal can packages do not have enough pins to accommodate all the internal functions of the 723, so the Vz output is not accessible. The pin outputs for the various packages are shown in Fig. 3.

High-Voltage Regulator (7.1 volts to 37 volts)

A typical 723 regulator circuit is shown in Fig. 4. In this figure, the temperature-compensated zener, the reference amplifier, and the current source are represented by an equivalent independent voltage source (a battery) to simplify the diagram. Vr may vary somewhat from device to device (6.6 volts to 7.5 volts), although it is typically 7.1 volts. The value of Vr establishes the lowest possible output voltage obtained from this circuit.

R1 and R2 form a voltage divider network from which the output sample (Vx) is taken. Therefore $Vx = VoR1/(R1 + R2)$. If Vx is greater than Vr, the error voltage (which is $Vr - Vx$) will be negative and the output of the error amplifier will decrease, causing the series pass transistor to conduct less. This, in turn, causes Vo to decrease until Vx is equal to Vr. At this point, the error voltage is essentially zero and the output voltage (Vo) remains steady at a value equal to $Vr(R1 + R2)/R1$. Should the output voltage begin to decrease, Vx will begin to decrease proportionally. As Vx attempts to drop lower than Vr, the error voltage becomes positive, causing the output of the error amplifier to increase. The pass transistor then conducts harder, which causes Vo to increase until $Vx = Vr$ once again. As before, $Vo = Vr(R1 + R2)/R1$.

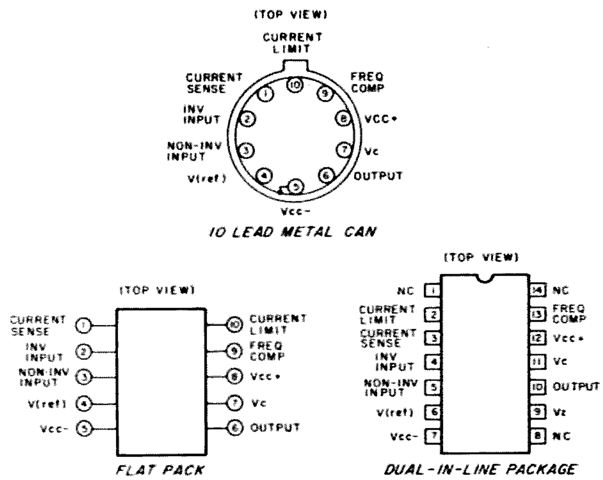


Fig. 3. 723 IC pin outputs.

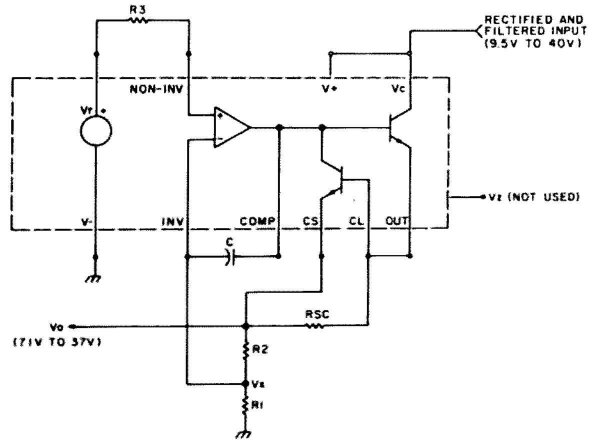


Fig. 4. High-voltage regulator (7.1 V to 37 V). To select component values:
1. *Choose Vo*
2. *Measure Vr (or assume $Vr = 7.1$ V)*
3. *$R1 = Vr/Ib$ (Ib is between 0.1 mA and 5 mA)*
4. *$R2 = (Vo - Vr)/Ib$*
5. *$R3 = R1R2(R1 + R2)$*
6. *$Rsc = 0.65$ (Isc = max. output current limit)*
7. *C = 100 pF to 500 pF*

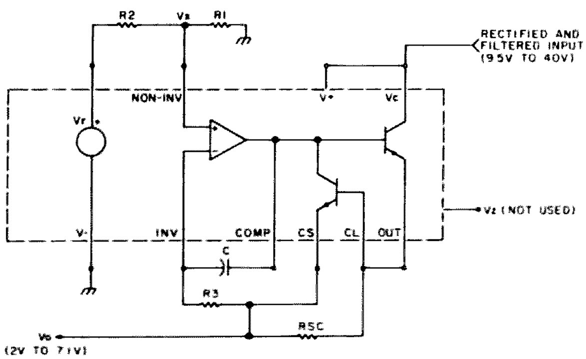


Fig. 5. Low-voltage regulator (2 V to 7.1 V). To select component values:
1. *Choose Vo*
2. *Measure Vr (or assume $Vr = 7.1$ V)*
3. *$R1 = Vr/Ib$ (Ib is between 0.1 mA and 5 mA)*
4. *$R2 = R1(Vr - Vo)/Vo$*
5. *$R3 = R1R2/(R1 + R2)$*
6. *$Rsc = 0.65/Isc$ (Isc = max. output current limit)*
7. *C = 100 pF to 500 pF*

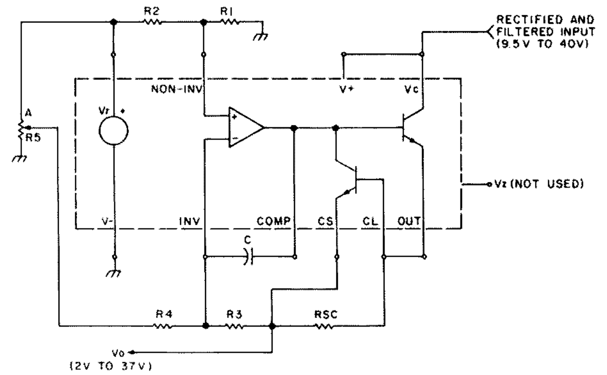


Fig. 6. Variable voltage regulator (2 V to 27 V). To select component values:

1. *Choose Vo (here, Vo is the max. output voltage)*
2. *Measure Vr (or assume Vr = 7.1 V)*
3. *R5 = Vr/Ib (Ib is between 0.1 mA and 5 mA)*
4. *R1 = VrVo/Ib (Vr + Vo) (Ib is between 0.1 mA and 5 mA)*
5. *R2 = R1(Vr/Vo)*
6. *R1 = R3*
7. *R2 = R4*
8. *Rsc = 0.65/Isc (Isc = max. output current limit)*
9. *C = 100 pF to 500 pF*

Rsc is a series current-limiting resistor which is selected to limit the maximum current the load can draw (Isc). Since this resistor is connected between the base and emitter of the current-limiting transistor, the load current through Rsc forward biases this transistor. Note, however, that the current-limiting transistor does not conduct until its base-emitter junction potential is overcome (approx. 0.65 volts). For example, select Rsc = 0.65/0.10 = 6.5 Ohms. When the load attempts to draw more than 100-mA output current, the current limiter conducts and robs the series pass transistor of drive current from the error amplifier. The result is that the output voltage begins to drop off to restrict the current to the limit set by Rsc. Rsc is often selected so that the current capability of the regulator and power supply components is not exceeded. Therefore, you can short the output leads of the power supply without damaging the power supply or regulator.

Follow the steps in Fig. 4 in selecting components for this circuit. First, choose R1 so that the current drawn by the voltage-divider network (R1 and R2) is between 0.1 mA and 5 mA, and let's call this current Ib. Suppose we let Ib = 1 mA; then R1 = Vx/Ib. But note that we previously stated that regulator action tends to maintain Vx = Vr, so R1 = Vr/Ib = 7.1/.001 = 7100 Ohms. Next, the selection of R2 is dependent upon the output voltage you want; R2 = (Vo − Vr)/Ib. Finally, R3 is chosen to balance the impedances seen by the input of the error amp. This improves error amp stability and accuracy. Therefore, R3 should be equal to the parallel combination of R1 and R2. If you want to keep the parts count to an absolute minimum, then just connect Vr to the noninverting input of the error amp and leave R3 out altogether. In most applications, you'll never notice a difference. The capacitor (C) in most 723 regulator applications should be 100 pF to 500 pF. This capacitor prevents the error amplifier from oscillating.

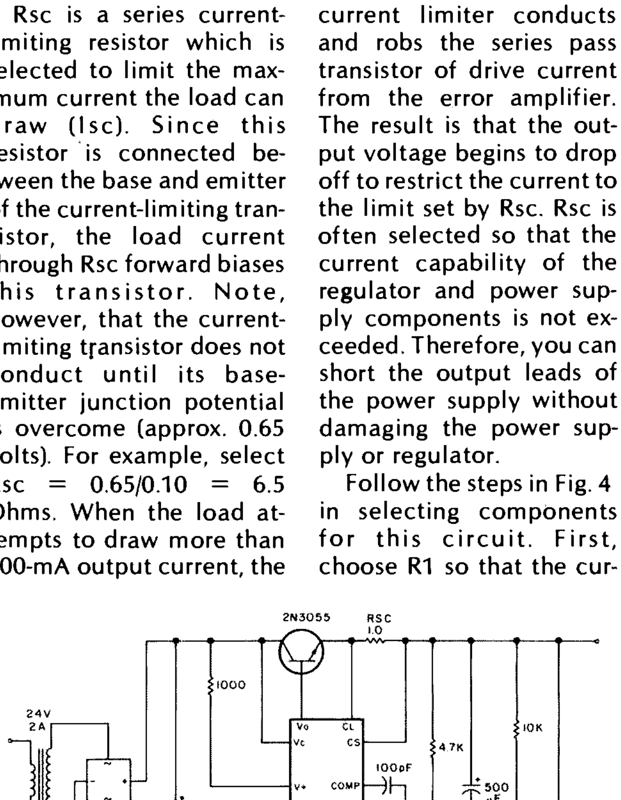


Fig. 7. Variable regulated power supply.

Low-Voltage Regulator (2 volts to 7.1 volts)

The circuit of Fig. 4 has one primary disadvantage in that the lowest output voltage obtainable from the regulator is limited by Vr. Therefore, this circuit cannot produce a regulated output voltage of less than 7.1 volts. If you need a 5-volt regulated output for TTL operation, you're out of luck. All is not lost, however, since we can get less than 7.1 volts out of the regulator by rearranging the components as shown in Fig. 5.

In this configuration, Vr is divided by R1 and R2 to obtain a lower reference voltage (Vx) for the error amplifier. The regulated output voltage is sampled via R3 at the inverting input of the error amplifier. Regulator action is similar to that previously described. In this case, the error amplifier adjusts the conduction of the pass transistor until Vo = Vx. First select R1 for a voltage divider bias current (Ib) of from 0.1 mA to 5 mA as before, (R1 = Vo/Ib). Rsc functions as previously described.

Variable-Voltage Regulator (2 volts to 37 volts)

The regulator circuits in Figs. 4 and 5 have fixed output voltages. Both of these regulators could be made variable by replacing R1 or R2 with a potentiometer, but we still have the disadvantages previously mentioned in that the output of the circuit in Fig. 4 is limited to an output voltage range of 7.1 volts to 37 volts, and the regulator of Fig. 5 is limited to an output voltage range of 2 volts to 7.1 volts. This is a particular disadvantage when working with differing logic families because TTL circuits require 5 volts, while transistor and MOS circuitry require higher voltages. Therefore, if you're building a variable power supply for your test bench, it is desirable for the supply to be variable over the entire range of the 723, if possible. The regulator configuration in Fig. 6 will do this quite nicely.

R1 and R2 form a voltage divider for the reference voltage (Vr), while R3, R4, and R5 form an adjustable network which samples both Vo and Vr. Together, these two networks comprise the input circuitry for the error amplifier. For good bias stability, let R1 = R3 and R2 = R4, so that, when the wiper of R5 is at point A, the voltage from the error amplifier, and hence Vo, is at a minimum (usually around 2 volts).

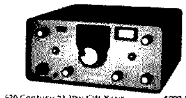
Now let's determine the

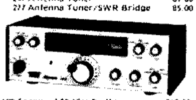
component values for this circuit. We can begin by choosing R5 so that the current drawn from Vr is less than 5 mA (Vr is normally capable of supplying 15 mA max.). Once R5 is determined, choose R1 + R2 so that this combination draws from 0.1 mA to 5 mA from Vr. Continue with the steps outlined in Fig. 6 to complete the circuit.

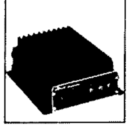
Since the internal series pass transistor is only capable of 150 mA, you may want to consider an external pass transistor. Almost any good NPN power transistor capable of dissipating sufficient power for your current requirements will be suitable. An external pass transistor can be employed in the circuits of Fig. 4, Fig. 5, or Fig. 6 by connecting it just as shown in Fig. 7. The internal pass transistor now becomes a driver for the external series pass transistor.

The circuit I use for various IC projects is shown in Fig. 7. The components for this circuit were chosen from the formulas given in Fig. 6. This regulated power supply provides a variable output of approximately 2 volts to 15 volts. Rsc was selected so that the maximum output current is approximately 1.2 Amps.

So there you have it! Now it's your turn, so give it a try. Just follow the steps given in each figure to build a regulated power supply to your own specifications. Since the selection of the bias current (Ib) is not critical, the component values selected can vary over a rather wide range so that you have plenty of flexibility in using parts you may already have on hand. ■







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One-Chip Tone Decoding

—how simple can it get?

The MK5102N.

Mostek Corporation of Dallas, Texas, has produced the latest in microcomputer control of phone systems. The MK5102N integrated tone receiver chip became available in engineering prototype models in January, 1978, and will revolutionize the use of tones to control remote equipment and improve the interface of phone and radio systems. The chip accepts the high- and low-group tones from the standard DTMF (touchtone™) pads, and provides outputs of either a 4-bit binary code or a dual 2-bit row/column code.

I'll begin with a short introduction to the tone system. The phone companies introduced the 8 standard tones for dialing their touchtone™ phones in 1963. Previously, the dialing was performed by interrupting the 20 milliamps (mA) of direct current. The current was interrupted at 10 Hz with a switch on the dial as it spun back to its spring-loaded position. Dialing the number 5, for example, would give 5 pulses. This has the disadvantage of requiring excessive amounts of power (using enough voltage to drive the 20 mA through miles of phone line), and it introduced bothersome clicking into the phones of other users whose phones were connected through the same bundle of wires to the central switching exchange. The tone system was developed to help overcome these problems. The eight tones fall in the audio frequency spectrum from 697 Hz to 1633 Hz. They have been carefully chosen to not be harmonically related to one another, and are spaced approximately 10% apart. This spacing allows for some margin of error so that one tone is not mistaken for another.

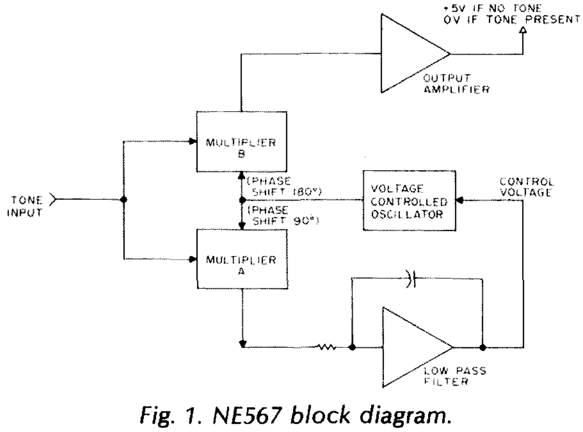

Fig. 1. NE567 block diagram.

The phone company requires that the tones be within 1.5% of their center frequency to be properly decoded. This requires that the tone transmitter be well controlled in all conditions of temperature, humidity, and power supply voltage. I'll bet that some of you have heard a tone generator fail in the cold winter weather because it failed to meet the ±1.5% tolerance. Another of the phone company's requirements is that the two tones can have no more than a two dB difference in amplitude. This means that the two voltage amplitudes must be in a ratio of less than 1.6 to 1. For example, if the low-group tone is 1.0 volts root mean squared (rms), the high-group tone must be less than 1.6 volts rms, but greater than .625 volts rms. The actual amplitudes of the signals are normally measured on a 600-Ohm impedance standard audio line, where 1 milliwatt (mW) of power across the line is designated 0 dBm. The specification for tones on the phone lines is that the nominal levels be −4 to −6 dBm, with the low-group minimum of −10 dBm, and a high-group minimum of −8 dBm. The maximum level of the two combined tones is +2 dBm. These levels will not be important for the decoder chip, but will enter into the discussion when we regenerate

the tones to be placed on the phone line. Also, the phone company specifies that the tones should have a minimum duration of 50 milliseconds (ms), with at least 45 ms between digits.

When Mostek set out to perform the decoding with a digital chip, they faced stiff competition. Most of the decoding today is done with a circuit like the NE567, phase-locked-loop, tone-decoder chip. The chip has a voltage-controlled oscillator (vco), which will phase-lock onto tone frequencies within a small range of its free-running frequency. When the loop locks onto the incoming tone, it multiplies the incoming sine wave by the vco's output in two different multipliers. One multiplier (A in Fig. 1) output is fed through a low-pass filter to the control voltage of the vco. Any error between the vco and the incoming tone sine wave will change the dc voltage on the control input to the vco. This changes the vco's frequency to match that of the incoming tone. This locks the vco 90° out of phase from the incoming sine wave. The other multiplier (B) receives the vco output an additional 90° out of phase from the first multiplier. This will produce a large negative dc voltage at the second multiplier's output. Multiplying two sine waves 180° out of phase will produce a negative dc component. The second multiplier's output is filtered and fed to the output pin of the 567. This pin will go from +5 volts to ground when it locks onto the incoming tone.

The phase-locked-loop decoding scheme requires that many resistors and capacitors keep their values in all environmental conditions. Each decoder (one is used for each of the eight tones) has one resistor and one capacitor which must be stable to keep the center frequency of the decoder accurate. This is the major disadvantage of the phase-locked-loop technique of decoding.

The MK5102N integrated-tone receiver uses a different scheme to decode the tones. After the high- and low-group frequencies are separated to their respective input pins on the chip, the zero crossings are counted in a specified time period. A number of these counts are taken and averaged over a longer time period. If the number of crossings matches that of a valid tone in both inputs, the digit's code is put onto the output latches (memory flip-flops that will not change after the tone has been removed). At the same time, the strobe pin (pin 4) goes high to signify that a valid tone is present. When the tone is removed, the strobe returns to a logical low, but the data pins (pins 7 through 10) will not change until the next tone is entered. Thus, one can use the strobe line to provide the interrupt to the microprocessor to stop whatever is in progress and pay attention to the receiver.

Instead of 16 frequency-determining elements of the phase-locked-loop system, the MK5102N uses an inexpensive, 3.579545 MHz, color-burst oscillator crystal as a frequency reference. The crystal is connected directly to the input and output pins of the oscillator (pins 2 and 3), with no additional components. This is an inexpensive temperature-stable crystal, which can be easily obtained and needs no fine tuning. Tests of the frequency-detection bandwidth of the receiver resulted in reliable detection of the tones ±3% of their center frequencies. This is one of the disadvantages of the receiver chip in that the detection width cannot be adjusted as it can for the 567 tone decoder. However, the receiver chip will decode well within the phone company's frequency tolerance, and thus should work well on all properly adjusted phone pads. The chip responded to tones within the 40 ms specified by Mostek, and required 35 ms between tones to successfully detect the sequential dialing of the same digit (such as hitting two 5s in sequence).

The real trick to operating the receiver is the prefiltering of the audio tones before they are injected into the integrated circuit. The standard tones consist of two groups. Each digit activates one frequency of the low group and one frequency of the high group, allowing for 16 possible combinations. Table 1 shows the digits and their frequency pairs.

The filter must separate the low-group tones to the low-group input (pin 11), and the high-group tones to the high-group input (pin 12). The tones are separated by low-pass filters separating the low group, and high-pass filters separ-

	High group (Hz)			
Low group (Hz)	**1209**	**1336**	**1477**	**1633**
697	1	2	3	A
770	4	5	6	B
852	7	8	9	C
941	*	0	#	D

Table 1.

Digit	**4-bit binary (V_C = 5 V dc) D8 D4 D2 D1**	**Duai 2-bit row/column (V_C = 0) D8 D4 D2 D1**
1	0 0 0 1	0 1 0 1
2	0 0 1 0	0 1 1 0
3	0 0 1 1	0 1 1 1
4	0 1 0 0	1 0 0 1
5	0 1 0 1	1 0 1 0
6	0 1 1 0	1 0 1 1
7	0 1 1 1	1 1 0 1
8	1 0 0 0	1 1 1 0
9	1 0 0 1	1 1 1 1
0	1 0 1 0	0 0 1 0
*	1 0 1 1	0 0 0 1
#	1 1 0 0	0 0 1 1
A	1 1 0 1	0 1 0 0
B	1 1 1 0	1 0 0 0
C	1 1 1 1	1 1 0 0
D	0 0 0 0	0 0 0 0

*Table 2. Because of the unfortunate definition of the 0, *, and #, the above code does not match the standard hexadecimal code.*

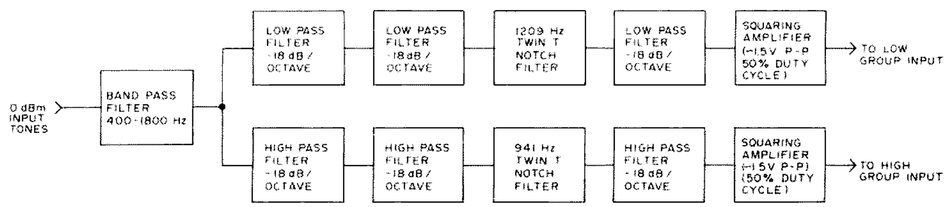

Fig. 2. Prefilter block diagram.

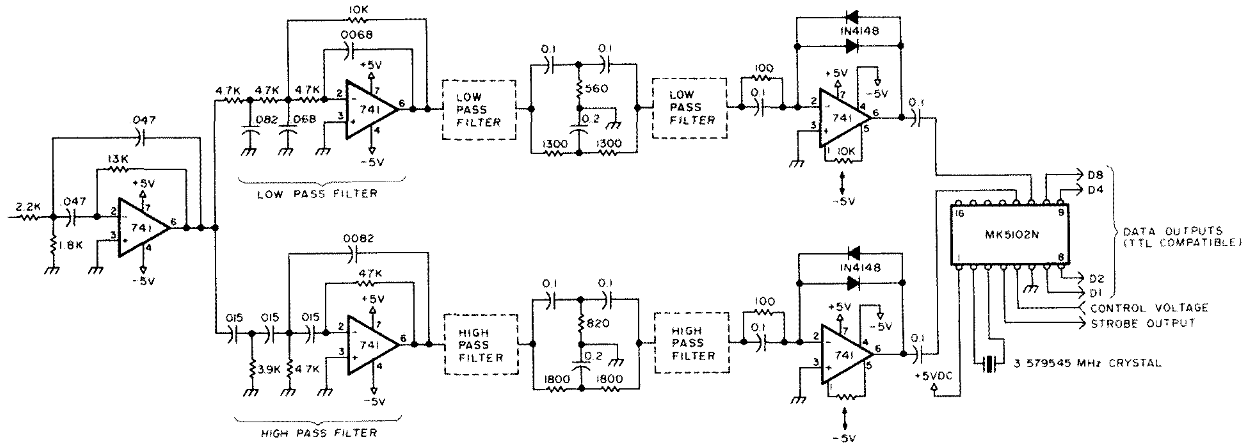

Fig. 3. System schematic.

ating the high group. The filters must separate the tones (which are input at approximately equal amplitudes, remember) by at least 33 dB (38 dB in the first-run engineering prototype chips). 33 dB is a voltage ratio of 45 to 1. Roughly, if the high tone is 1 volt rms, the low tone on the high input must be less than 20 millivolts rms. The prefilter block diagram is shown in Fig. 2.

The major filtering is done using active audio filters in a crossover filter. The crossover point was chosen at 1075 Hz, midway between the two groups. Each filter is a Butterworth filter with a roll-off of −18 dB per octave, and a 3-dB point at 1075 Hz. To sharpen the band edge, and also to help isolate the closest tones, the high-group high-pass filter string includes a twin-T notch filter between the second and third operational amplifiers. Similarly, the low-group low-pass filters include a notch filter in the same location. The notches are set to the closest tone of the other group. Therefore, the high-group notch filter is set to 941 Hz, and the low-group notch filter is set to 1209 Hz (approximately).

The prefiltering network begins with a bandpass filter with its gain down 3 dB at 400 Hz and 1800 Hz to eliminate noise and distortion products. The input is designed to take standard 0-dBm (across 600 Ohms) tones from the source. The gain of the input amplifier can be adjusted to meet these input levels, or the input bandpass filter can be redesigned to take other levels from the source. Lab tests of the filters shown in Fig. 3 showed successful decoding for tones from −½ dBm to +3 dBm. The output of each filter string is put through a squaring amp which should be adjusted for 50% duty cycle of the square wave into the receiver chip. The chip also includes two onboard operational amplifiers which were not used in this design. Production models of the onboard amplifiers should make them useful in the prefiltering network.

Fig. 3 is the complete schematic of the receiver system from audio input to digital output. All component values should be ±5%, and care should be taken to use high quality operational amplifiers. In Table 2, I have given the input and output characteristics of the system. The 4-bit binary code will be given at the data pins if the control pin (pin 5) is connected to the +5 volts dc, and the dual 2-bit row/column code will be given if the control pin is left unconnected. If the control pin is grounded, the output data pins will go to a high impedance state. This allows connection of many devices to a common data bus. If the other devices are in a high impedance state on their outputs, only the activated chip (i.e., raising the control pin voltage to +5 volts) will put data on the bus. This allows the same four wires to be connected to all the devices and saves a lot of wiring.

The design here uses ±5-volt dc power-supply voltages to be compatible with the repeater here at the University of Minnesota, WRØAQU. The 5102 will operate with a positive supply voltage of 4.5 to 5.5 volts dc. Use of higher supply voltages for the operational amplifiers may be desirable to prevent flat-topping of the tones by overdriving the amplifiers. This can occur if the tones come into the system at an especially high amplitude. This brings up one of the severest limitations of the receiver chip. If the audio system which delivers the tone to the prefilter distorts the tones, the first harmonic of the low-group tone will invade the high-group bandpass and cannot be filtered out. For example, twice 770 Hz is 1540 Hz, well within the high-group bandpass. Care must be taken that no clipping of the audio occurs, and that the audio system response from 500 Hz to 1700 Hz be reasonably flat. This will assure that the two tones arrive at the input to the prefilter at the same amplitude with little distortion.

The specification sheet gives a requirement of 12-dB signal-to-noise ratio, which I assume means that the noise must be at least 12 dB below the valid tones. To test this, a third sine wave was introduced, together with a valid tone at 0 dBm. The decoding became marginal with the third tone above −10 dBm. This easily meets the specifications of the 12-dB signal-to-noise ratio.

As a further test, I hooked the system to the speaker audio of an Icom 22A and monitored the output of a popular local repeater (WRØALU, 16/76) for a day. This repeater is very active and frequently used for autopatches. False detections were very infrequent (2 per day), and the dialed tones were decoded with good reliability. The number of false detections may seem excessive, but you must remember that chances are slim that the access code will be detected (1 in 8 per day for a single-digit access code), and that I was monitoring the audio after it had passed through the

repeater's transmitter and my receiver, essentially doubling the distortion of the tones. Tones sent simplex (i.e., not through a repeater) were decoded with excellent reliability (no observed errors).

I find the possibility of further computer control of the repeater exciting. The 16-digit DTMF code allows direct entry of hexadecimal code into a microcomputer system. The 16-tone pads are available for the stations which desire special control functions not on the 12-digit pad (which does not include the A, B, C, or D digits). We can use any phone booth on the street to call the repeater and issue control commands to the system. This is especially valuable when the receiver is faulty and will not respond to VHF signals.

The next challenge will be to complete the phone interface and the tone dialing system. Mostek has already marketed the 5086 tone-dialer chip, which will be used to regenerate the tones to meet the phone company's requirements. Circuitry and description of this system will follow in another article. I hope that you find the challenge of this technology interesting, and will join us in the world of the microprocessor.

I would like to thank Mr. Joe Jarrett of Mostek, Inc., for his help in getting this system running. ■

References

1. *Audio Handbook*, Dennis Bohn, ed., National Semiconductor, Inc. (filters).
2. *The Radio Amateur's Handbook*, ARRL, Newington CT (tones and phone company specifications).
3. *Electronics*, June 7, 1971, pp. 86-89 (active bandpass filters).

Reader Service—see page 179

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Computerize That Mailing List

—club secretaries, this is for you

Most amateur radio clubs produce some type of newsletter or bulletin on a more or less regular basis. These are usually generated by the efforts of a few members who have the desire, time, and other necessary resources to produce, reproduce, and distribute the club rag. Although some clubs simply hand out copies at each regular meeting, most of the larger, well-organized clubs maintain a complete and detailed membership list and mail their newsletter to all members on record a few days prior to the monthly meeting. Many of these clubs utilize the services of someone who has access to a computer system to keep their records and to print membership lists and even mailing labels each month. (Anyone who has had the dubious honor of addressing club bulletins by hand (month after month) can readily appreciate the convenience of using preprinted, peel-off, stick-on address labels.)

This article presupposes that your club has one or more people who either have their own microprocessor system or have access to a commercial system where time can be

Membership File Maintenance program.

```
DEFINED SIZE:  8192 BYTES        8 SECTORS      DISC: 0   SECTOR: 7863
PROGRAM SIZE   4674 BYTES       19 PAGES

0010 REM "ARCMFM".   ARCMF FILE MAINTENANCE

0020 CLEAR
0040 IOLIST N1$,N2$,A1$,A2$,A3$,Z1$,P1$,C2$,C1$,D1$,D2$,D3$
0050 DIM N1$(16),N2$(16),A1$(32),A2$(16),A3$(2),Z1$(5),P1$(10),C2$(1),C1$(8),D1
0050:$(16),D2$(16),D3$(12),C9$(8),P9$(3),S9$(5),K$(8)
0060 DIM S$(32," "),F$(32,"
0100 OPEN (1)"KCCMF"
1000 PRINT 'CS','SB',@(26,0),"ARCMF FILE MAINTENANCE",@(70,0),DAY
1010 PRINT @(1,2),"I CALL SIGN: ",@(31,2),"2. CLASS: ",@(1,4),"3 LAST NAME: ",@(1,6
1010:),"4 FIRST NAME: ",@(1,8),"5. ADDRESS: ",@(1,10),"6. CITY ",@(1,12),"7. STATE/Z
1010:IP. ",@(1,14),"9. TELEPHONE: ",@(0,16),"11 DATA CODES: ",@(0,18),"12 OTHER DAT
1010:A: ",@(0,20),"13. RACES DATA: ",'SF',
1500 PRINT 'CF'
1510 CLEAR
1550 DIM N1$(16),N2$(16),A1$(32),A2$(16),A3$(2),Z1$(5),P1$(10),C2$(1),C1$(8),D1
1550:$(16),D2$(16),D3$(12),C9$(8),P9$(3),S9$(5),K$(8)
1560 DIM S$(32," "),F$(32,"

2000 REM -----------CALL SIGN-----------

2005 PRINT 'SF',@(15,2),F$(1,8),S$(1,5),
2010 INPUT @(15,2),C1$
2015 IF (C1$="END") OR (CTL=4) THEN GOTO 9090
2020 LET L=LEN(C1$)
2025 IF (L>8) THEN GOTO 8010
2030 IF (L>1) THEN GOTO 2050
2035 LET S=1
2040 LET C2$=". "
2045 GOTO 2300

2049 REM -----------BUILD KEY-----------

2050 LET N=1
2051 SETERR 2070
2052 LET A=NUM(C1$(N,1))
2053 RESET
2060 GOTO 2090
2070 SETERR 2110
2071 LET P9$(N,1)=C1$(N,1)
2075 LET N=N+1
2080 IF (N>L) THEN GOTO 8010
2085 GOTO 2051
2090 LET S9$(1,(L-N))=C1$((N+1),(L-N))
2095 LET K$=S9$(1,(L-N))+C1$(N,1)+P9$(1,(N-1))+S$(1,(8-L))
2100 PRINT @(50,2),'SB',"KEY  ",K$,'SF',
2105 GOTO 4000
2110 RESET
2120 LET N=LEN(C1$)
2125 IF (N<8) THEN LET K$=C1$+S$(1,8-N)
2130 IF (N>7) THEN LET K$(1,8)=C1$(1,8)
2140 GOTO 4000

2200 REM -----------CLASS---------------

2205 RESET
2209 PRINT @(39,2),S$(1,5),'RB',
2210 INPUT @(40,2),C2$
2220 IF LEN(C2$)>1 THEN GOTO 2200
2230 IF C2$="N" OR C2$="T" OR C2$="G" OR C2$="A" OR C2$="E" OR C2$="B" OR C2$="
2230 X" OR C2$=" " OR C2$="?" THEN GOTO 2280
2240 GOTO 8020
2280 PRINT @(40,2),C2$,
2290 IF (S=2) THEN GOTO 6000

2300 REM -----------LAST NAME-----------

2301 SETERR 2310
2310 PRINT @(15,4),F$(1,16),
2320 INPUT @(15,4),N1$
2321 IF (LEN(N1$)<3) THEN GOTO 1000
2330 IF (LEN(N1$)<17) THEN GOTO 2370
2340 GOSUB 8030
2360 GOTO 2300
2370 IF (S=2) THEN GOTO 6000

2400 REM -----------FIRST NAME----------

2401 SETERR 2410
2410 PRINT @(15,6),F$(1,16),
2420 INPUT @(15,6),N2$
2421 IF (LEN(N2$)<2) THEN GOTO 2410
2430 IF LEN(A3$)<>2 THEN LET A3$="TX"
2432 IF (LEN(N2$)<17) THEN GOTO 2435
2433 GOSUB 8030
2434 GOTO 2400
2435 SETERR 8040
2440 IF (S<>I) THEN GOTO 2499
2445 LET N=LEN(N1$)
2450 LET M=LEN(N2$)
2455 IF (N<4) THEN LET N1$=N1$+S$(1,4-N)
2460 IF (M<4) THEN LET N2$=N2$+S$(1,4-N)
2470 LET K$=N1$(1,4)+N2$(1,4)
2480 PRINT @(50,2),"KEY= ",K$,
2499 IF (S=2) THEN GOTO 6000

2500 REM -----------ADDRESS-----------

2510 PRINT @(15,8),F$,
2520 INPUT @(15,8),A1$
2521 IF (LEN(A1$)<5) THEN GOTO 2510
2530 IF (LEN(A1$)<33) THEN GOTO 2570
2550 GOSUB 8040
2560 GOTO 2510
2570 IF (S=2) THEN GOTO 6000

2600 REM -----------CITY-------------

2610 PRINT @(15,10),F$(1,16),
2620 INPUT @(15,10),A2$
2621 IF (LEN(A2$)<5) THEN GOTO 2610
2640 IF (LEN(A2$)<17) THEN GOTO 2690
2650 GOSUB 8040
2670 GOTO 2610
2690 IF (S=2) THEN GOTO 2800

2700 REM -----------STATE-------------

2710 PRINT @(15,12),F$(1,2),"  (2-LETTER CODE)",'RB',
2720 INPUT @(15,12),A3$
2740 IF LEN(A3$)<>2 THEN LET A3$="TX"
2790 IF (S=2) THEN GOTO 2860

2800 REM -----------ZIP CODE-----------

2810 PRINT @(15,12),A3$," ",F$(1,5)," (ZIP CODE)",'RB',
2820 INPUT @(18,12),Z1$
2825 SETERR 2810
2830 LET N=NUM(Z1$)
2840 IF (N<1) OR (N>99999) THEN GOTO 2810
2860 PRINT @(15,12),A3$,S$(1,2),Z1$,S$(1,20)
2890 IF (S=2) THEN GOTO 6000
```

had for little or nothing. Frankly, I doubt that there are many companies with their own computer system which wouldn't give a little free computer time to such a worthwhile and public service-oriented organization as an amateur radio club. I am talking about an amount of time on the order of ten to twenty minutes a month, depending upon the size of the club, the speed of the typist, and the kind of system used. Most companies should be happy to provide this kind of computer time in return for the goodwill and possible publicity.

Printer paper would be insignificant since most computer operators and programmers waste more paper in one day than your club would use each month. About the only expense that would have to come from the club coffer would be the special mailing labels with gummed backs. These will cost somewhere between $40 and $60 for 20,000 labels, depending upon the kind used and the particular supplier. That's enough to last a club with 300 members more than five years.

The primary goal of this article is to provide the necessary programs for anyone wishing to establish and maintain an amateur radio club membership file on any computer system that supports the BASIC programming language. The ham radio club membership system presented here consists of three programs. The first provides for the data entry and file maintenance functions necessary to add, change, and delete members' records. The second program prints a membership list, and the third program produces the mailing labels for the club bulletin.

Another goal of this article is to spark your imagination with a few examples of what else can be done for the club and its members by using spinoffs from the original membership list and mailing label programs. For example, suppose your club is located in a rather large metropolitan area and many of the club members would like to share rides with each other going to the club meetings (or carpool to work or to sidewalk sales, hamfests, and so on). Since all the address information is in the computer, why not have the computer print a special list of all the members in a particular sequence, such as by city? Even better, how about printing the list in zip-code order? Since zip codes are smaller divisions of cities and towns, a zip-code-sequenced list would show all of the hams who lived in the same part of town grouped together in the list.

Another interesting and useful way to print the membership list is by license classification. This would show all Novices, Technicians, Generals, and so on, grouped together by their respective classifications. This could be a valuable tool for the officers of the club in planning classes or special events, and could even save money in postage fees (something to consider carefully lately) if a special newsletter needed to be mailed only to those in a

```
2900 REM -----------AREA CODE----------

2910 PRINT @(15,14),F$(1,3),"  (AREA CODE)",'RB',
2915 SETERR 8090
2920 INPUT @(15,14),P1$(1,3)
2925 SETERR 8090
2930 LET N=NUM(P1$(1,3))
2940 IF (N<100) OR (N>999) THEN GOTO 8090

3000 REM -----------PHONE NUMBER-------

3005 RESET
3010 PRINT @(14,14),"(",P1$(1,3),") ",F$(1,7),"      ",'RB',
3020 INPUT @(20,14),P1$(4,7)
3030 PRINT @(14,14),"(",P1$(1,3),") ",P1$(4,3),"-",P1$(7,4),
3090 IF (S=2) THEN GOTO 6000
3095 LET D1$="               R"
3096 GOTO 6000

3100 REM -----------CLUB CODES--------------

3101 LET D1$=""
3110 PRINT @(15,16),F$(1,16),
3120 INPUT @(15,16),D1$
3130 IF (LEN(D1$)<17) THEN GOTO 3190
3140 GOSUB 8030
3150 GOTO 3110
3190 IF (S=2) THEN GOTO 6000


3200 REM -----------OTHER DATA--------------

3201 LET D2$=""
3210 PRINT @(15,18),F$(1,16),
3220 INPUT @(15,18),D2$
3230 IF (LEN(D2$)<17) THEN GOTO 3290
3240 GOSUB 8030
3250 GOTO 3210
3290 IF (S=2) THEN GOTO 6000

3300 REM -----------RACES DATA--------------

3301 LET D3$=""
3310 PRINT @(15,20),F$(1,12),
3320 INPUT @(15,20),D3$
3330 IF (LEN(D3$)<13) THEN GOTO 6000
3340 GOSUB 8030
3350 GOTO 3310

4000 REM -----------READ ARCMF RECORD-------

4001 RESET
4002 PRINT @(0,3),'CL',
4005 IF (S=4) THEN GOTO 5000
4008 LET S=0
4009 PRINT @(15,2),C1$,S$(1,5)
4010 READ (1,KEY=K$(1,8),DOM=2200)IOL=0040

4020 REM -----------OLD RECORD-------------

4030 LET S=2
4040 LET C9$=C1$

5000 REM -----------DISPLAY DATA------------

5005 RESET
5020 PRINT 'CF',@(15,2),C1$,@(41,2),C2$,@(15,4),N1$,@(15,6),N2$,@(15,8),A1$,@(1
5020 5,10),A2$,@(15,12),A3$,@(19,12),Z1$,@(14,14),"(",P1$(1,3),") ",P1$(4,3),"-
5020 ",P1$(7,4),@(15,16),D1$,@(15,18),D2$,@(15,20),D3$,
5050 IF (S=4) THEN PRINT @(11,3),"NEW CALL SIGN",'RB',

6000 REM -----------REQUEST ? -------------

6005 SETERR 6010
6010 INPUT @(15,22),"ENTER # TO CHANGE, OR CR TO CONTINUE  ",'RB',R$
6020 IF (R$="END") OR (CTL=4) THEN GOTO 7000
6030 IF (R$="0") OR (R$="DELETE") OR (CTL=3) THEN GOTO 7800
6035 IF (LEN(R$)>2) THEN GOTO 6100
6040 LET F=NUM(R$)
6050 LET S=2
6060 ON F GOTO 7000,7100,2200,2300,2400,2500,2600,2700,2800,2900,2900,3100,3200
6060 ,3300,6010

7000 REM -----------WRITE RECORD------------

7010 WRITE (1,KEY=K$)IOL=0040
7020 LET S=0
7030 GOTO 1500

7100 REM -----------CALL SIGN CHANGE--------

7110 PRINT @(0,22),'CL',
7120 INPUT @(15,22),"CHANGE CALL SIGN (YES/NO) ?  ",R$
7130 IF (R$="YES") THEN GOTO 7200
7140 GOTO 5000
7200 LET S=4
7210 GOTO 7830

7800 REM -----------DELETE RECORD-----------

7810 PRINT @(15,22),'CL','RB',"DELETE ",C9$," ? ",
7811 INPUT @(33,22),R$
7820 IF (R$<>"YES") THEN GOTO 5000

7830 REMOVE (1,KEY=K$)

7840 GOTO 1500

8000 REM -----------ERROR ROUTINES-----------

8001 PRINT @(13,3),'RB',"NON-LICENSED MEMBER ? ",
8002 INPUT @(35,3),R$
8003 IF R$="Y" THEN GOTO 4000
8005 PRINT @(0,3),'CL',
8006 RESET
8011 PRINT @(15,2)," I N V A L I D   ",'RB',
8012 WAIT 3
8013 GOTO 1500
8021 PRINT @(31,3),"MUST BE N,T,G,A,E, OR ?",'RB',
8022 WAIT 3
8023 PRINT @(0,3),'CL',
8025 GOTO 2200
8031 PRINT @(35,11),"TOO LONG",'RB',
8032 WAIT 2
8033 PRINT @(0,11),'CL',
8035 RETURN

8040 REM -----------NAME TOO SHORT FOR KEY-----

8041 IF (LEN(N1$)<4) THEN LET N1$=N1$+S$(1,4-LEN(N1$))
8042 IF (LEN(N2$)<4) THEN LET N2$=N2$+S$(1,4-LEN(N2$))
8043 GOTO 2440
8091 PRINT @(15,15),"MUST HAVE AREA CODE",'RB',
8092 WAIT 3
8093 PRINT @(0,15),'CL'
8094 GOTO 2900
9000 CLEAR
9090 CLOSE (1)
9997 PRINT 'CS',"CLEAR    "

9998 REM "ARCMFM"  ARCMF FILE MAINTENANCE

9999 END


NUMBER OF STATEMENTS: 215

END
```

```
DEFINED SIZE  2560 BYTES     10 SECTORS     DISC 0     SECTOR 6283
PROGRAM SIZE  2445 BYTES     10 PAGES

0010 REM "KCCMFL" KCC MEMBERSHIP FILE LIST
0020 CLEAR
0040 IOLIST N1$,N2$,A1$,A2$,A3$,Z1$,P1$,C2$,C1$,D1$,D2$,D3$
0050 DIM N1$(16),N2$(16),A1$(32),A2$(16),A3$(2),Z1$(5),P1$(10),C2$(1),C1$(8),D1$
0050 (16),D2$(16),O3$(16),K$(8),K1$(8)
0060 DIM S$(32," "),F$(32,"-")
0100 OPEN (1)"KCCMF"
0105 OPEN (5)"LP"
0200 LET S=0
0201 LET P=1
0300 PRINT 'CS','SB',@(26,0),"KCCMF FILE LISTING",@(70,0),DAY,'SF'
0310 PRINT @(10,10),'RB',"CREATING SORT FILE"
0500 ERASE "ZASORT"
0501 SORT "ZASORT",23,500,0,6293
0502 OPEN (2)"ZASORT"
0510 PRINT @(0,10),'CL','RB'
2000 PRINT (5)'FF','EP',"FORT WORTH KILOCYCLE CLUB ROSTER",@(38),DAY,@(60),"PAGE
2000  ",P
2001 LET P=P+1
2005 PRINT (5)@(2),"CALL",@(7),"CLASS",@(14),"LASTNANE",@(28),"FIRSTNAME",@(48),
2005 "ADDRESS",@(78),"CITY, STATE, ZIP CODE",@(103),"TELEPHONE",@(116),"AFFILIAT
2005 ION"
2006 PRINT (5)@(0),"------- --- -------------- ----------------",@(45),"-------
2006 ----------------------------",@(78),"------------ -- -----",@(101),"----------
2006 --",@(115),"----------------"
2020 LET L=0
2030 IF (S=2)GOTO6100

4000 REM
4001 LET C1$=""
4002 LET K1$=KEY(1,END=6000)
4010 READ (1,KEY=K1$)IOL=40
4015 PRINT @(10,3),C14
4020 LET Z1$=Z1$+"00000"
4030 LET Z14=Z1$(1,5)
4040 LET A4$=A1$+"          "
4050 LET A4$=A4$(1,10)
4060 LET K2$=Z1$+A44+K1$
4100 WRITE (2,KEY=K24)
4500 IF (C2$="A")A=A+1
4510 IF (D1$(13,1)="C")B=B+1
4520 IF (C2$="E")E=E+1
4530 IF (C2$="G")G=G+1
4540 IF (C2$="N")N=N+1
4550 IF (C2$="T")T=T+1
4560 IF (D1$(13,1)="F")F=F+1
4570 IF (D1$(13,1)="L")M=M+1
4580 IF (C2$="?")O=O+1
4590 IF ((C2$=" ")AND(D14(13,1)<>"C"))U=U+1
4600 REM
4605 IF (C2$=" ")GOTO4001
4610 SETERR 4660
4620 LET X=NUM(C1$(2,1))
4630 RESET
4640 LET C1$=(" "+C1$(1,2)+" "+C1$(3))
4650 GOTO 5020
4660 LET C1$=(C1$(1,3)+" "+C1$(4))

5000 REM
5020 PRINT (5)@(0),C1$,@(9),C2$,"  ",N1$,@(28),N2$,@(45),A1$,@(78),A2$,@(91),A3$
5020 ,@(94),Z1$,"  (",P1$(1,3),")",P1$(4,3),"-",P1$(7,4)," ",D1$(1,13)
5030 PRINT (5)""
5035 LET L=L+2
5040 IF (L<50)GOTO4001
5050 GOTO 2000

6000 REM
6010 CLOSE (1)
6020 OPEN (1)"KCCMF"
6030 LET S=2
6100 READ (1,END=9000)IOL=40
6101 IF (C2$<>" ")GOTO6100
6102 PRINT @(10,3),'CL',N1$
6120 PRINT (5)@(2),C1$,@(9),C2$," ",N1$,@(28),N2$,@(45),A1$,@(78),A2$,@(91),A3$,
6120 @(94),Z1$,"  (",P14(1,3),")",P1$(4,3),"-",P14(7,4)," ",D1$(1,13)
6130 PRINT (5)""
6135 LET L=L+2
6140 IF (L<50)GOTO6100
6150 GOTO 2000

9000 REM
9100 PRINT (5)'LF','LF','EP',"STATISTICS."
9110 PRINT (5)'LF',E," EXTRAS, ",A," ADVANCED, ",G," GENERALS, ",T," TECHNICIANS
9110 , ",N," NOVICES, ",U," UNLICENSED MEMBERS "
9200 PRINT (5)'LF',M," LIFE MEMBER, ",F," FAMILY MEMBERS, ",B," ASSOCIATE MEMBER
9200 S (CLUBS,ETC.) "
9209 IF (Q<1)GOTO9250
9210 PRINT (5)'LF',Q," UNKNOWN LICENSE CLASS."
9250 PRINT (5)'LF','EP',(E+A+G+T+N+B+U+O)," TOTAL MEMBERS."
9400 PRINT (5)'LF','EP',"QRT"
9410 PRINT (5)'FF','FF'
9901 CLOSE (1)
9902 CLOSE (2)
9905 CLOSE (5)
9997 LET S=4
9998 RUN "KCCMLP"
9999 END

NUMBER OF STATEMENTS. 83
```

Membership File List program.

particular group.

Other interesting, if less practical, ways of listing the members of a radio club include listings by first name (ever wonder how many Eds or Jims there are in your group?), by telephone number, or even in order of street address. Anything that is put into the computer record can be used as the "key" for any sorting sequence desired. But enough of that. Let's get back to the main subject.

The programs behind the mailing labels and membership list are very straightforward. The main idea is to provide the user with a fast and easy method of entering the necessary information into the computer. I have seen many systems that do not place much importance on that word "easy." All I can say is, if it's not easy to use, it's not going to get used.

File Maintenance Program

The first program is called the File Maintenance program. As previously mentioned, this program allows the operator to enter new members into the computer and to change any information already on file. It also allows the operator to delete members who don't pay their dues.

As with the other programs to be described, it is designed for use on an interactive computer system with a video display terminal (VDT). Punched-tape systems, as everyone knows, are now obsolete. Obviously, most 8-bit microprocessors fit in the interactive category, so don't think that you have to use a big time-sharing system. All you need is a computer (CPU), VDT, printer, and a disk storage device with enough capacity to hold all your data.

The File Maintenance program writes all membership data on the data storage disk. This information includes the usual: name, address, city, state, zip code, telephone number, and each member's callsign and license class. There also are three additional data items included in each member's record on the system described here. These may be used to record membership status or affiliations with other clubs or organizations (RACES, ARES, etc.). There is enough room for office telephone numbers or special remarks regarding type of equipment and operating capabilities. This part of the system is entirely open for whatever use your club might want for it.

One character position, for example, can indicate whether a member is "active," "inactive," "sponsor," "complimentary," "family member," or "life" member. By using, say, twelve character positions in the first "extra data" field, each member can be identified with twelve different groups in addition to the primary club. Obviously, this makes it possible for more than one club in an area to be supported by the same computer system using the same data file and programs.

Another type of information the club might wish to maintain could be the emergency capabilities of the members—subject, of course, to the consent of each member. (You gotta be careful what you put into the machine, lest it permit some unscrupulous use.)

Since the membership list is usually made available to the members, some of the "extra" data need not be printed on anything except the master listings used by officers of the club. Each club is different, and each one must choose whatever features are deemed most useful and desirable for its own purposes.

The File Maintenance program uses a direct-access disk file with the callsign used as the "key" to each record. The File Maintenance part of the operating system software automatically keeps each record in its proper sequence as each new record is added to the file. The callsign was chosen as the KEY simply because hams invariably use it for identification and each callsign is unique. A random-access data file must have a unique KEY for each record in the same file.

For those members who

```
DEFINED SIZE  2560 BYTES     10 SECTORS     DISC 0     SECTOR 6273
PROGRAM SIZE  2410 BYTES     10 PAGES

0010 REM "KCCM.P" KCC MAILING LABELS
0020 CLEAR
0040 IOLIST N1$,N2$,A1$,A2$,A3$,Z1$,P1$,C2$,C1$,D1$,D2$,D3$
0041 IOLIST N3$,N4$,W2$,X2$,Y2$,Z2$,P1$,C2$,C3$,D1$,D2$,D3$
0042 IOLIST N5$,N6$,W3$,X3$,Y3$,Z3$,P1$,C2$,C4$,D1$,D2$,D3$
0043 IOLIST N7$,N8$,W4$,X4$,Y4$,Z4$,P1$,C2$,C5$,D1$,D2$,D3$
0050 DIM N1$(16),N2$(16),A1$(32),A2$(16),A3$(2),Z1$(5),P1$(10),C2$(1),C1$(8),D1$
0050 (16),D2$(16),D3$(16),K$(8),N3$(16),N4$(16),N5$(16),N6$(16),N7$(16),N8$(16),
0050 W2$(32),W3$(32),W4$(32),X2$(16),X3$(16),X4$(16),Y2$(2),Y3$(2),Y4$(2),Z2$(5)
0050 ,Z3$(5),Z4$(5),C3$(8),C4$(8),C5$(8),F$(30,"$")
0101 OPEN (1)"KCCMF"
0102 OPEN (2)"ZASORT"
0105 OPEN (5)"LP"
1000 PRINT 'CS','SB',@(26,0),"KCCMF FILE LISTING",@(70,0),DAY,'SF'

2000 REM -----------FORMS-ALIGNMENT----------
2005 FOR X=1TO3
2010 FOR Y=1TO4
2100 PRINT (5)F$,@(33),F$,@(67),F$,@(101),F$
2105 NEXT Y
2110 PRINT (5)""
2120 PRINT (5)""
2200 NEXT X
3000 PRINT 'RB','LF',"ARE FORMS PRINTING OK ? (Y/CR)  ",
3010 INPUT C1$
3020 IF (C1$<>"Y")GOTO2000

4000 REM ------------READ KCC RECORD-----------
4010 LET K$=KEY(2,END=9000)
4011 READ (2)
4012 READ (1,KEY=K$(16,8))IOL=40
4013 IF (A1$=W4$)GOTO4010
4014 LET N=N+1
4015 IF (D1$(13,1)="C")GOTO6110
4020 LET K$=KEY(2,END=7041)
4021 READ (2)
4022 READ (1,KEY=K$(16,8))IOL=41
4023 IF (W2$=A1$)GOTO4020
4024 LET N=N+1
4025 IF (D1$(13,1)="C")GOTO6120
4030 LET K$=KEY(2,END=7042)
4031 READ (2)
4032 READ (1,KEY=K$(16,8))IOL=42
4033 IF (W3$=W2$)GOTO4030
4034 LET N=N+1
4035 IF (D1$(13,1)="C")GOTO6130
4040 LET K$=KEY(2,END=7043)
4041 READ (2)
4042 READ (1,KEY=K$(16,8))IOL=43
4043 IF (W4$=W3$)GOTO4040
4044 LET N=N+1
4045 IF (D1$(13,1)="C")GOTO6140
5010 PRINT (5)C1$,@(33),C3$,@(67),C4$,@(101),C5$
5015 IF (LEN(N8$)<15)GOTO5020
5016 LET N8$=N8$(1,16)
5020 PRINT (5)N2$," ",N1$,@(33),N4$," ",N3$,@(67),N6$," ",N5$,@(101),N8$," ",N7$
5025 IF (LEN(W4$)<31)GOTO5030
5026 PRINT (5)A1$,@(33),W2$,@(67),W3$,@(101),W4$(1,31)
5027 GOTO 5040
5030 PRINT (5)A1$,@(33),W2$,@(67),W3$,@(101),W4$
5040 PRINT (5)A2$,@(21),A3$," ",Z1$,@(33),X2$,@(55),Y2$," ",Z2$,@(67),X3$,@(89),
5040 Y3$," ",Z3$,@(101),X4$,@(123),Y4$," ",Z4$
5050 PRINT (5)""
5060 PRINT (5)""
5999 GOTO 4000
6110 LET N9$=N1$
6111 LET N1$=N2$
6112 LET N2$=N9$
6113 GOTO 4020
6120 LET N9$=N3$
6121 LET N3$=N4$
6122 LET N4$=N9$
6123 GOTO 4030
6130 LET N9$=N5$
6131 LET N5$=N6$
6132 LET N6$=N9$
6133 GOTO 4040
6140 LET N9$=N7$
6141 LET N7$=N8$
6142 LET N8$=N9$
6143 GOTO 5000
7041 LET N3$="",N4$="",W2$="",X2$="",Y2$="",Z2$="",C3$=""
7042 LET N5$="",N6$="",W3$="",X3$="",Y3$="",Z3$="",C4$=""
7043 LET N7$="",N8$="",W4$="",X4$="",Y4$="",Z4$="",C5$=""
7044 GOTO 5000

9000 REM
9010 PRINT (5)'EP',N," LABELS PRINTED ",DAY,@(35),N," LABELS PRINTED ",DAY,@(70)
9010 ,N," LABELS PRINTED ",DAY
9020 PRINT (5)N," LABELS PRINTED ",DAY,@(35),N," LABELS PRINTED ",@(70),N," LABE
9020 LS PRINTED ",DAY
9810 BEGIN
9820 LET S=4
9888 RUN "HAM"
9999 END

NUMBER OF STATEMENTS  86
```

Mailing Label program.

do not yet have their callsigns, the program simply uses the first four characters of their last name plus the first four characters of their first name for the actual KEY for those members.

By the way, much consideration was given to exactly which method should be used to "sort" the callsigns. One of the best known listings of callsigns is, of course, the *Callbook*. The sorting technique used for the *Callbook* is to take the call area number as the primary "sort field," followed by the suffix, and finally, the prefix. Actually, the *Callbook* uses a rather arbitrary and non-alphabetical sequence for the prefix in order to get the calls to come out by "age" of license. Now, with old 1 x 2 and 1 x 3 callsigns being reissued to recent upgrades, however, this method is becoming less meaningful and justified. Anyway, for sorting such a large national listing, I think almost everyone would agree that this technique is okay. I have found, however, that for smaller lists, a modified version works much better.

Since the members of any one club are usually local residents, their callsigns generally will all have the same area number. It doesn't make much sense, therefore, to separate a local listing by call area the way we would a national listing. With this system, each callsign entered is rearranged by the File Maintenance program so that the suffix comes first, followed by the prefix and the call area number. (No provision was made here to take care of foreign callsigns, by the way.) Thus, the actual KEYs in the data records are not exactly the actual callsigns but rather a special arrangement of callsigns which allows the computer to store the records in the sequence we want.

Some advantage was taken, when writing these programs, of the extensions to the BASIC language on our own system. Other systems which do not support these features can be used with only a few minor modifications, however, due to the general compatibility of BASIC from one machine to another.

Once a callsign has been entered, the File Maintenance program reads the disk file immediately to see if that callsign had been entered previously. If so, the information is displayed on the VDT. The user is asked what data, if any, should be changed. Thus, the program "assumes" that since the member is already on file, the operator must want to look at or change something in that member's record. If, on the other hand, that callsign is not already on file, the program proceeds by prompting the user to enter the next data item (the license classification). Each separate data item is entered in turn until all items have been filled in. At this point, the program asks if any corrections need to be made before continuing. If there are no errors on the screen, the user simply indicates "no"; the program writes that record on the disk and then asks for another callsign.

Club members who do not yet have callsigns are handled as follows: When the program requests the next callsign, the VDT operator simply presses the "CR/ENTER" key without entering any characters at all in the callsign field. The program then skips over the callsign and license classification fields and goes directly to the last name field.

The operator enters the last name of that member, then the first name, just as usual. As soon as the program has received both the last and first names, it combines the first four letters of the last name with the first four of the first name and uses this "string" of characters as the KEY for that member's data record in the disk file.

In any one club, there probably won't be more than one person with these same eight characters, taken the same way, who also don't have callsigns. Hence, these members can be assigned a unique KEY that not only gets them on file, but also even ensures that they will be listed alphabetically later, as we shall see.

There is some amount of "editing" performed on each data item entered. This is done merely to help ensure the validity of the data entered into the computer. For example, an address is usually more than three or four characters long. Any attempt to enter an address shorter than that will be considered a mistake. In case the user attempts to skip the address, the program will ignore such a silly thing and, instead, will repeat the request for a realistic address. If a member's address is temporarily not available, the missing data should be "flagged" by entering a long string of asterisks (or any other special character). That should attract the attention of anyone proofreading the list later, and they can collect the missing information. Similarly, the only valid license classes are N, T, G, A, and E. In addition to these five letters, the program also allows the operator to enter a "B" to indicate a club station or sponsor or a "?" to indicate that the class of the licensee is unknown.

Periodically, the Fort Worth Kilocycle Club runs a special program which changes all "?" to "N". This always gets an immediate response from those members who have failed to notify the KC Club of their actual license class.

Other items worth verifying include the state, zip code, and telephone number. Again, if this information is unavailable at the time, the operator should fill in these fields with something to catch the eye of the proofreader. The KC Club uses a string of 9s for missing zip codes and all 0s for missing telephone numbers.

When all items have been entered, the File Maintenance program writes the new (or modified) member's record on the disk and requests another callsign. If a member is to be deleted, the user keys in that member's callsign, the program displays the information on that member on the display screen, and requests the user to "ENTER ITEM # TO CHANGE, OR 'CR' TO CONTINUE:". The operator then enters the word "DELETE." The program will respond with the question, "DELETE WB5UTJ?" This gives the user one last chance to verify that this member is to be deleted. If the user enters the word "YES," the program will remove that record from the data file. Any other response will abort the delete request and the program will ask for another callsign.

For those members without callsigns, the user may either enter that special string of characters (first four characters of the last name plus the first four characters of the first name) in the callsign field or skip the callsign and enter the last and first names in the usual manner to display or delete members.

During data entry, if a mistake is made on any line, the user always has a chance to correct the error before going to the next line by backspacing to the mistake and retyping the data. If an error is not caught in time, the program gives you one last chance to correct any line, after all lines have been entered and before the data is written on the disk. (Entering the letter "X" in the class field indicates to the program that you want to reenter a mistyped callsign.) And, finally, entering END in the callsign field terminates the File Maintenance program.

I might mention here, for the curious, the purpose of the two different types of input statements used in the File Maintenance program. The READ statement and the READRECORD statement both get information input from the device specified (or implied), such as the disk or the VDT. The READ statement looks for "null entry" (CR) as the indication that the operator has entered a complete data item. The READRECORD statement is used whenever an entry of a specific length is expected, such as in the license class (one character only) or the state code, zip, code or telephone number. This statement also has the ability to verify that certain letters or characters have been entered. If the data entered via the READRECORD statement does not match the allowable response, the program automatically generates an error condition and the same statement (in this instance) is executed again and again until the operator enters a valid response.

The READRECORD statement also saves a few keystrokes by not requiring the user to hit the CR key after entering the appropriate number of characters for that input. While this feature may not save much time in this particular application, it is a good idea to use it wherever it would be appropriate for good programming practice. When large volumes of data are considered, this type of statement does indeed save a significant amount of time as well as reduces the probability of error.

Again, if these features are not available on your system, the program can easily be changed to accomplish the same purpose by simply using READ statements throughout, followed by the desired editing statements. By reducing the chances of the user entering bad data, the overall efficiency of the system can be increased greatly.

Membership List Program

The second program is simple and almost self-explanatory. It reads the membership file sequentially and prints the information that was recorded by the File Maintenance program. Since the callsigns were used as the KEYs to the data records, and since the system we use allows us to read direct-access files without specifying the actual KEYs, the members come out automatically in alphanumeric order by callsign. Those members without callsigns also come out in the proper order.

For readability, a space is inserted between the prefix/area and the suffix of each callsign. This makes it even easier to scan the list looking for a particular suffix or callsign.

The Membership List program prints the licensed members first, then prints those members without calls. This is done by the simple expediency of reading the file twice, passing over those members without callsigns on the first pass and skipping the others on the second pass. Although not the most efficient method according to professional programming standards, it is the easiest. Remembering how the unlicensed members were KEYed, you can see how they happen to come out in alphabetical order.

At the end of the job, the Membership List program prints a summary of the club's membership showing the total number of members broken down by license class. Thus, the club can see at a glance just how many Novices, Techs, Generals, Advanceds, and Extras they have. The summary information also includes totals for all family members, life members, sponsors, unlicensed members, and courtesy mem-

bers.

Mailing Label Program

The mailing labels are printed using a modified version of the Membership List program. The Fort Worth Kilocycle Club uses standard gummed-back labels arranged four-across on continuous form stock. This program reads four records at a time and then prints these four callsigns, names, and mailing addresses, four labels at a time.

The Mailing Label program first prints a few test lines for alignment, then, when the operator has adjusted the printer for correct alignment, begins printing the labels. This program arranges the callsign back into the correct format and even puts the first names in front of the last names before printing, for a more natural appearance. Clubs, sponsors, and other such "affiliated" members are printed last names first since they are usually entered differently than the others.

In order to save postage costs, the KC Club wanted to send only one bulletin to any household where more than one member lives. To accommodate this, the Mailing Label program was changed slightly to "sort" all records by zip code and address before printing the labels. Actually, as the Membership List program prints its own list, it also creates a new and separate file consisting of keys only. These keys are made up of the zip code plus the address of each member. When the Mailing Label program runs, it reads this special "sort" file sequentially to get the records, one at a time, in the proper order.

To eliminate duplicate mailings to the same address, the Mailing Label program simply skips any record having an address identical to the last one printed.

And Much, Much More

In addition to the regular membership list and mailing labels, the KC Club is getting some of the other benefits mentioned earlier. Once every year, the KC Club receives a copy of three separate listings. One is the usual roster with all members listed by callsign. One is an alphabetical listing of all the members by last name. And the third listing is in order of zip code for all those who might want to carpool or just want to know how many other hams there are in their neighborhood.

Recently, this particular listing turned out to be quite useful during a local emergency. On a Sunday afternoon, the elderly grandmother of a young lady ham radio operator walked away from the nursing home where she was a resident. The granddaughter and her husband (also a ham) requested the assistance of other area hams on the Fort Worth 34/94 two-meter repeater.

As usual, hams were both quick and numerous in response. Mobile operators thoroughly searched every area where possible sightings of the elderly grandmother were reported. The search continued day and night for five days.

When Jean Price WA5JCQ, the secretary-treasurer of the Fort Worth Kilocycle Club, heard of the situation, she realized that the many areas being reported as possible search areas might be covered much more quickly by hams who actually lived in those areas. And since she had that zip-code-sequenced list, complete with callsigns and telephone numbers of all the KC Club members, she volunteered to call all those members who lived in or near the areas where people reported seeing the missing lady.

Unfortunately, the woman had died the same day she left the nursing home, after walking less than a mile. At least one search party had covered a large area on foot and by helicopter not more than a mile away from where her body lay in the tall grass.

Although this search ended tragically, we all learned some valuable lessons during the ordeal. Perhaps one of the most useful lessons was the fact that we could use a computer listing of amateur radio operators, sorted by zip code, to reduce the time and effort required in search and rescue operations. Perhaps the same type of listing could be used in other situations as well.

Some of the extra information maintained on the KC Club's records includes which members have RDF capabilities. By "pressing a button" (or two), other programs not shown here can be run to give an up-to-date listing of all those members equipped to track down a jammer or bootlegger. This list goes to the local "SWAT" team commanders for use in coordinating RDF drills and, occasionally, the real thing. Fort Worth, Dallas, and the surrounding cities have some of the cleanest two-meter repeaters in the country. This fact may be due primarily to the nature of Texans, but credit must go to the well-equipped and well-organized T-hunters in the "metroplex," who have excellent track records.

These are only a few of the extra goodies (bells and whistles) available when a computer is used for the benefit of amateur radio. Future applications are endless.■

Joel Eschmann K9MLD
132 Ohio Street
Racine WI 53405

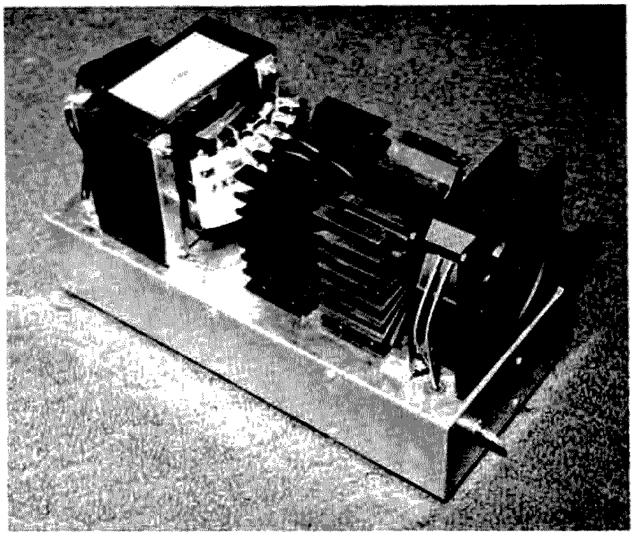
More Power to You

—12-V supply has current limiting, overvoltage protection, the works

With all of the solid-state transmitters, receivers, and transceivers on the market, power supplies to provide the proper voltage and current are sometimes complicated. There has been a need for a simple power supply design that provides overcurrent and overvoltage protection. Good components and design considerations are important if you are to have a reliable power unit.

The design which I will describe will allow you to adjust it to fit your needs. Most of the parts used are available from your junk box or local parts store. The hardest item to locate at a reasonable cost is a transformer. The voltage requirements for a good 13.5-V dc supply are a minimum of 36 V ac, center-tapped, or a single 18-V ac winding (see Fig. 1). For a 13.5-V dc regulator to perform, we have an upper voltage-sag limitation of 18 to 18.5 V dc under a maximum load. What we are asking the regulator to do is to maintain regulation at 13.5 V dc with a difference voltage of 4 to 5 V dc (13.5 V dc regulated + 5 V dc = 18.5 V dc unregulated). Keep in mind that this is the minimum voltage needed to maintain regulation. If you choose a transformer that yields a higher voltage difference (regulated to unregulated), the product of this difference voltage and load current, in power (heat), must be dissipated in the regulator, which we will discuss later.

If you have a solid-state rig you wish to power, check the manufacturer's specifications for current consumption. Choose a transformer which will handle that load current with a voltage level sufficient enough to maintain the unregulated supply requirements we discussed earlier.



Top view of completed supply.

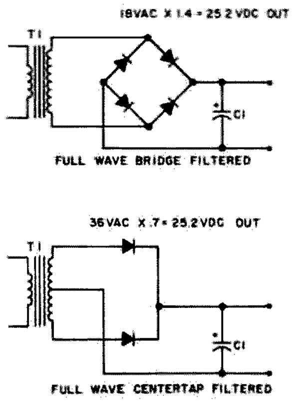


Fig. 1.

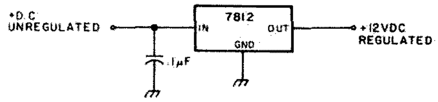


Fig. 2.

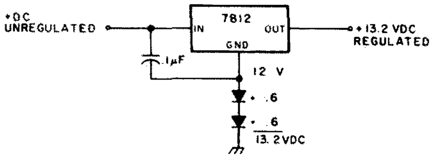


Fig. 3.

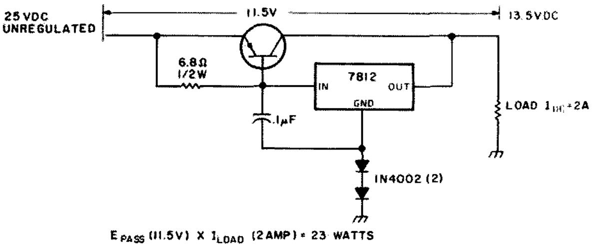


Fig. 4.

Select a diode assembly which will handle the I_{dc} output. My requirement was a maximum of 20 Amps to power a repeater and amplifier. My diode assembly will therefore have to handle 20 Amps. Each diode used will have a voltage drop of approximately 1 volt across it, and, at 20 Amps, P = I × E, or 20 Amps × 1 volt = 20 Watts. Heat-sink these devices well to dissipate this energy.

The filter capacitor may be gauged by a simple rule of thumb. For every Amp (I_{dc}) delivered, a minimum of 3000 µF of capacitance is required. You can have ripple in your supply and never notice it at the output of the regulator as long as the maximum ripple component never drops below the minimum unregulated voltage of 18 to 18.5 V dc. This capacitor value is arrived at mathematically, but, for simplicity, let's stick to the rule of thumb.

Now let's get to work on the heart of the supply. The key part of our regulated supply is a simple 3-lead positive regulator, an MC7812 that you can get at Radio Shack. This device will handle a maximum of 1 Amp alone, and has designed-in current limiting and short-circuit protection. See Fig. 2.

There are many manufacturers of this device who use prefixes other than MC, but 7812 is the device number. 78 is the design series and 12 is the regulated output voltage. You are about to ask a question! If I want 13.5 V dc, what am I doing with a 12-V dc fixed regulator? It is very simple. To increase the voltage of the regulator, we add one diode in series with the ground lead for every .6-V dc increase desired. See Fig. 3. These regulators vary slightly in regard to their actual regulated output voltage, but the additional diodes will allow us to select the actual voltage needed.

In Figs. 2 and 3, I have used a .1-µF capacitor. This capacitor is needed to stabilize the regulator from ground loops. Attach this capacitor as close to the regulator chip as possible.

As I mentioned earlier, this 3-lead regulator is capable of 1-Amp maximum output current. To achieve a higher current capability, we add a pass transistor. This device will give the current gain needed in the design. The pass transistor, or transistors, must handle the total output current of the supply. For this 20-Amp supply, I selected two 15-Amp PNP power transistors to do the job. One 20-Amp device would do it, but for a heat-dissipation safety factor, I used two.

Let's stop for a moment now and talk about the difference voltage I mentioned earlier. If we have an unregulated dc supply voltage of 25 V dc and a regulated output of 13.5 V dc, the difference voltage will be 11.5 volts. The product of the difference voltage and the load current will be the power dissipated, in Watts, by the pass transistor. For example, 11.5 volts × 2 Amps (load current) = 23 Watts of heat in the transistor. See Fig. 4.

My supply circuit requirement was 20 Amps. Now, 20 Amps × 11.5 volts is 230 Watts! That is a lot of power! The transformer is going to help in this dissipation, though. Fortunately, the unregulated voltage will sag, and we have selected a transformer that will only deliver 18.5 volts unregulated at 20 Amps. The difference between 13.5 volts regulated and the unregulated 18.5 volts is 5 volts. So, a 5-volt difference × 20 Amps = 100 Watts, which is a big difference! Using two pass transistors, we can dissipate 50 Watts in each device. With 50 Watts of heat to get rid of, you must use a good heat sink to pass this power into the air effectively. We must keep the junction temperature of the transistor below its maximum rating to keep from destroying the device. In this 20-Amp design, I used a 120-CFM muffin fan and two heat sinks that would handle 80 Watts using natural convection. By using forced air instead of natural convection, I could mount the heat sinks in any position. For natural convection, position the heat

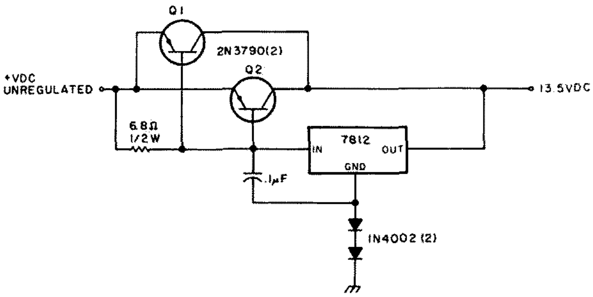


Fig. 5.

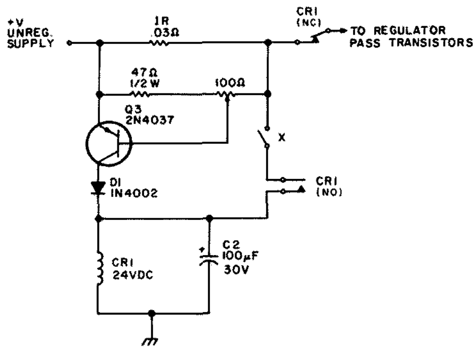


Fig. 6. Current limiter.

sink fins in a vertical direction.

Heat-sink considerations should be given to the 7812 regulator, also. At 20 Amps, and a maximum beta per transistor of approximately 50, we will have to handle a combined base current of 400 mA. The difference voltage of 5 volts will require a power dissipation of .4 Amps × 5 volts = 2 Watts.

Fig. 5 illustrates the complete regulator, including the 6.8-Ohm, ½-Watt resistor which is used to establish the bias of the regulator and pass transistors. Using collector feedback with this regulator chip proves to be very effective and stable. The supply will even be free of rf instability unless the regulator chip is involved in a concentrated rf field.

In the area of wiring, the only point of note is to use the proper size wire to handle the current in the high-current areas. Also, keep the two wire leads to the emitters of the pass transistors equal in length to allow balanced emitter current.

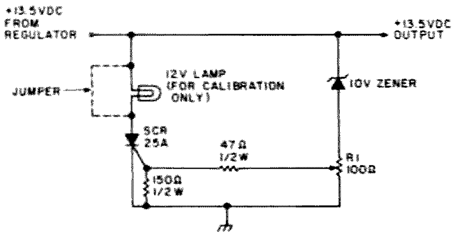


Fig. 7. Crowbar circuit.

We have discussed the regulator; now let's examine a current limiter. See Fig. 6. This current limiter operates instantaneously and it will only reset after the power is turned off and the supply bleeds down, or a reset push-button, normally closed, is added at point X. C2 should be sized to allow a delayed dropout, so relay CR1 does not buzz when it reaches the current limit. Resistor "IR" is selected so that the current-limit relay will trip at 20 Amps and higher, depending on the setting of the 100-Ohm pot. To operate, a .6-V dc drop is needed between the base and emitter of Q3. This voltage provides bias current which permits collector current to flow which, in turn, energizes CR1. CR1 must handle the total current of the supply even if it means paralleling contacts. To select resistor IR, use .6 V/20 A = .03 Ohms. This "resistor" turned out to be a coil of 14-gauge nichrome wire. By adjusting the 100-Ohm pot, we may now select a slightly higher current limit. If your supply is smaller, use .6 V/your current = IR. For example, .6 V/5 A = .12 Ohms. This resistor will drop some voltage, so rate the power carefully: P = .6 × 5 = 3 Watts, and remember the voltage drop. This .6 volts may not seem like much, but the minimum unregulated voltage is 18 V dc.

The last control circuit to design is called a "crowbar" circuit. Its intent is to protect your gear from overvoltage due to a regulator failure. See Fig. 7. In this circuit, we will select an overvoltage of approximately 15 volts. This is done by adjusting control R1 until the lamp just lights, and then backing the control off slightly until the lamp does not light. Remember, to turn off the lamp you must reset the SCR by momentarily disconnecting the lamp or turning off the supply. After this calibration, remove the lamp and connect the anode of the SCR directly to the output of the supply. If, during use, an overvoltage condition occurs, the SCR will conduct, the output will be short-circuited, and the current-limit circuit will turn off the supply.

In Fig. 8, you can now examine the whole circuit as I am using it in my 20-Amp supply. You may tailor your supply to the level of your needs with the information we have discussed. ■

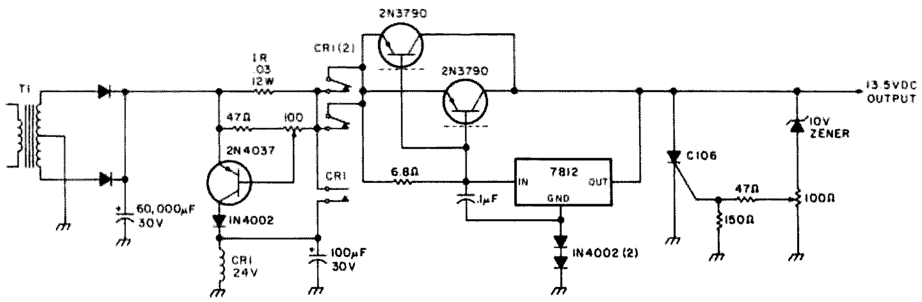
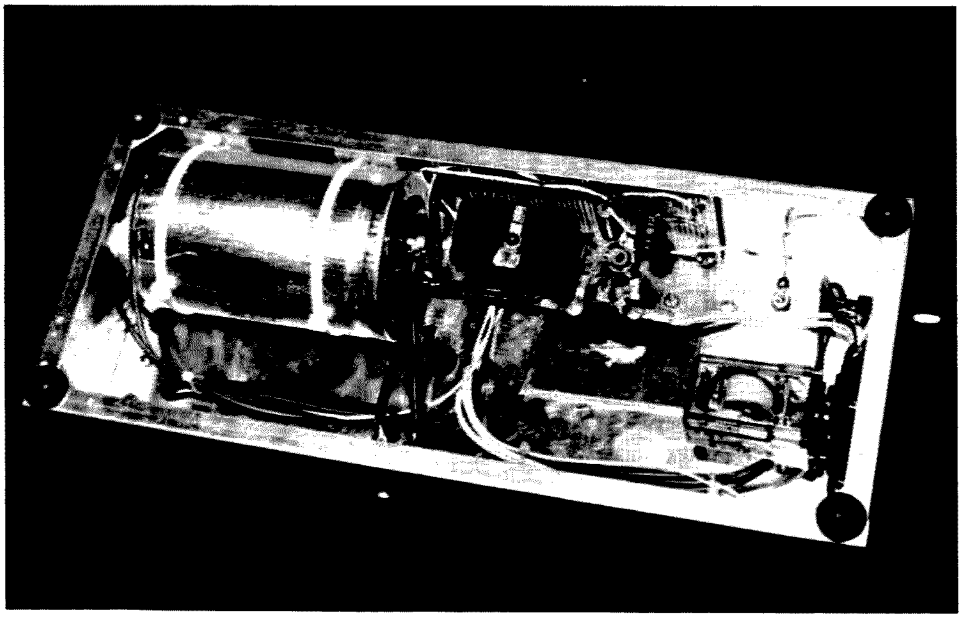


Fig. 8. Complete power supply schematic diagram.



Bottom view of completed supply.

Frank Bates AA6C
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San Jose CA 95131

Hit the Panic Button!

—a kill-switch system protects you and your shack

What would you do if you were operating away and noticed a wisp of smoke coming out of your new linear amplifier? Or if you were working on some gear and felt a whole lot of electrons running between your fingertips and your toes? Or if you were going on vacation and wanted to make sure your station wouldn't be operated in your absence?

You'd want to kill the power (I hope!), and in at least the first two cases, you'd want it off *fast*. And it might be even nicer if this could be done easily by somebody else, such as one of the kids—or even the dog—if you got into trouble and couldn't kill the power yourself. Aside from these situations, there are times when it is merely convenient to know that all your shack power is off.

A properly-engineered kill-switch system thus has a number of advantages, and if you have not yet installed this basic safety/convenience feature, you might consider it. In most cases it is a simple thing to do, it is economical, and whether or not you ever plan on using it, just getting it in place is guaranteed to give you a good feeling. At the very least, your station will have a new touch of class.

The basic circuit for a kill switch is shown in Fig. 1. It consists of three parts: a contactor (relay) in series with the main power line, one or more kill switches, and a reset switch. This last is nice if you ever wish to restore power once it has been killed. The circuit also shows a transformer, the purpose of which will be explained shortly.

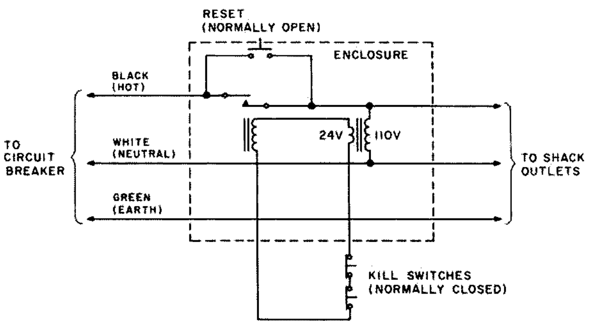

Fig. 1. Schematic for the kill-switch system. Only the hot wire may be interrupted—the neutral and earth wires must not be broken. Check with local authorities to verify respective wire colors in your locality.

The contactor is the heart of the system. It should have high-current-capacity contacts at least equal to the trip point of the circuit breaker feeding the shack, and preferably twice that. The reason is that the contacts will carry all the current your shack is using, and if it is necessary to kill power at a time of high-current draw, you will want the contact to open cleanly without arcing. Good reliable contactors (UL listed) are available from your friendly local electrical distributor.

The contactor should have a low-voltage coil; 24 V ac is a readily-available standard. This is so you won't have any unnecessary high voltage running around the shack to the kill switches. The transformer secondary voltage should match the contactor coil voltage; 24-volt bell transformers are readily available at low cost. You also can use 12 V ac, which is a standard and readily available, but the current draw by the contactor coil will be about twice as much and it will tend to get warm. Whatever you use, the contactor should be rated for continuous duty, both in the coil and in the contacts.

The kill switches are normally-closed push-button switches, and they should be located so they are easy to get to and easy to operate. I prefer industrial-grade actuators with big red push-buttons (3" or so in diameter) so they can be hit easily with an entire hand—literally, "panic buttons." On my own service benches, kill switches are located so they also can be hit easily just by moving a knee. If you use more than one kill switch, they're just wired in series, as shown in Fig. 1. Industrial-grade switches are highly recommended because what is most important is reliability. It would be mortifying, to say the least, to smash one in panic and then discover it didn't work because you broke it!

The reset switch is a

Mark Stephens W6RON
933 Robin Lane
Campbell CA 95008

A Powerful Plus For Your TR-2200A

—improved supply/charger is a first-rate addition

Two versions available.

After using my new Kenwood TR-2200A for a few days, I discovered that its standard battery power and charging setup was rather inconvenient for a heavy usage cycle. It was not possible to listen or transmit while charging the batteries, and I found that, invariably, the batteries were always near complete discharge whenever I had an important use for the transceiver.

I am sure other hams who monitor 2 meters extensively have run into this same problem of running down the batteries on receive, with no power to spare for a needed transmission. The charging cycle naturally takes about 16 hours, which uses up 8 hours of daytime activity as well as 8 hours at night. The net result is at most 8 daily hours of operation, provided the batteries stay charged that long.

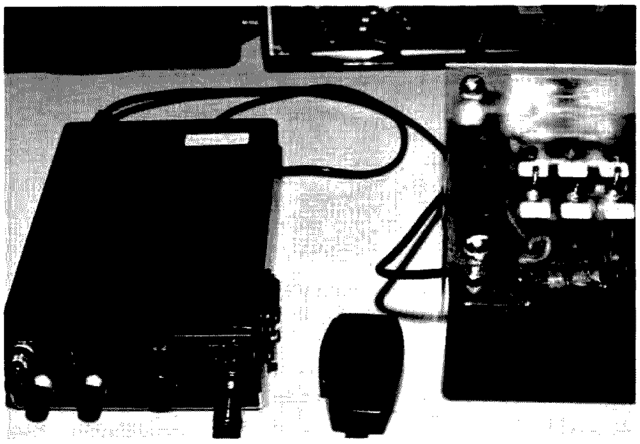
Photo A.

The Solution

To help myself out of this frustrating situation, I developed the circuit shown in Fig. 1. It consists of a regulated 12.6-V-dc source rated at 1 Ampere, a battery-charging source, and an automatic charger shutoff circuit. The 12.6-V supply is used to continuously power the TR-2200A for receive and transmit. During operation on the 12.6-V supply, the batteries also can be simultaneously charged by the flick of a switch (SW3). The charger source provides a current of roughly 45 mA (.1C) into a nominal battery voltage of 13 volts, which is the same current provided by the Kenwood charging unit. As an additional feature to avoid that nagging mental question, "Are my batteries charged yet?", I added a voltage sensing circuit that automatically terminates the battery charging when the battery voltage reaches a predetermined level. The charging shutdown voltage is adjustable and set by the trimpot, R4. Battery charging and automatic charging shutdown can be used regardless of whether the TR-2200A is switched on or off. Three LED indicators constantly monitor the regulated dc output and the charging circuit. LED L3 glows when the batteries are up to the voltage set by R4, indicating that charging has been completed.

Circuit Operation

The transformer, T1, in conjunction with D1-4 and C1-2, provides a raw dc source of approximately 17 volts. C1 and C2 have a total capacitance of 16,000 uF to assure minimal ripple and droop in the 17 volts when large amounts of current are being drawn from IC1. Remember that the TR-2200A draws about .7 of an Amp during transmit in the high power mode. The raw 17-volt source is used to power both the IC regulator and the charge circuit. IC1 provides a stable 12-V supply, and diode D5 acts as a booster to give a total regulated output of 12.6 V. C3 and C4 are high-frequency bypass capacitors and are necessary to ensure stability in

 Aug 1979

normally-open push-button switch, but can be any other type of switch as well. It needn't be especially reliable or easy to get to, but it should not be located far from the contactor because it will have high voltage (110 V ac) on it. Like the kill switches, the reset switch need have no great current-carrying capacity.

The contactor should be mounted in an enclosure, UL-approved, of course, near where the power line first enters the shack. The transformer and reset switch can be mounted near the enclosure, or on it, using knockouts, depending on the enclosure you get. The whole thing can be placed inside a locked box, if desired, to prevent unauthorized access to the reset button. The 24-volt line (or whatever low-voltage line you have selected) just runs out of the box/enclosure. Very simple.

When wiring up the contactor, a few safety precautions are in order. First, make sure power is off at the circuit breaker, and *verify* that it is off by means of a portable lamp or circuit-tester inside the shack at the point you plan to cut into the power line. Secondly, make sure you insert the contacts into the hot side of the power line, not the cold or "neutral" side. In most localities, the black wire is the hot and the white wire is the neutral. You never, ever, want to put a switch or any other kind of interruption into the neutral.

If you find a green wire also, don't cut it! It is the earth wire, and if it gets broken, you may have all kinds of problems in all sorts of places where you don't want them when you don't want them. (You may even find your trusty soldering iron is frying you as well as the solder, for instance. Not much fun.) If you have any doubts about the color coding, check with your local power company or a local electrical contractor. Note: In some communities it may be required that a licensed electrician actually make the connection for you and/or that the result be inspected by the local building inspector.

Once the contactor is wired up, just run the low-voltage line through the kill switches and you're in business. Now, and only now, you can turn shack power back on at the circuit breaker. The shack will still be dead, however, because the contactor contacts are open and thus there can be no voltage on the coil to energize it. Pressing the reset button applies 110 volts to the transformer, which supplies the low voltage to the contactor coil (through the kill switches), energizing the contactor and closing the contacts. The contactor will remain energized when the reset button is released because the transformer—like all the other equipment in the shack—is now getting its primary power through the contacts.

And there you are! With luck, you've got a nice new convenience for the shack. With somewhat less luck, you've got a simple system that'll keep you from having no luck at all. Just one final point: Teach the family how to kill power if they ever need to. If you ever need assistance, smashing one of the prominent red buttons should be the first thing they do, and such a time is definitely not the time to explain the system to them. ■

the 7812 regulator. Fuse F2 and zener D6 act as a crowbar circuit to open up the dc source to the TR-2200A, should the voltage rise above 15 V. This could happen, for example, if IC1 shorted and provided 17 volts to its output terminal. F2 and D6 protect the TR-2200A from exceeding its maximum input voltage of 15.8 V, since D6 will draw enough current to blow F2 at elevated voltages. At a normal output level of 12.6 volts, D6 does not conduct enough current to affect the circuit.

The battery-charging current is provided by R2 in series with the 17-volt source. When SW3 is switched on, current flows through R2, SW3, and the normally-closed contacts of K1 to the battery in the TR-2200A. Note that the battery pack is disconnected from the rest of the TR-2200A circuits when the power cable is plugged into the back of the transceiver. This allows simultaneous but independent operation of the rig and charging of the batteries.

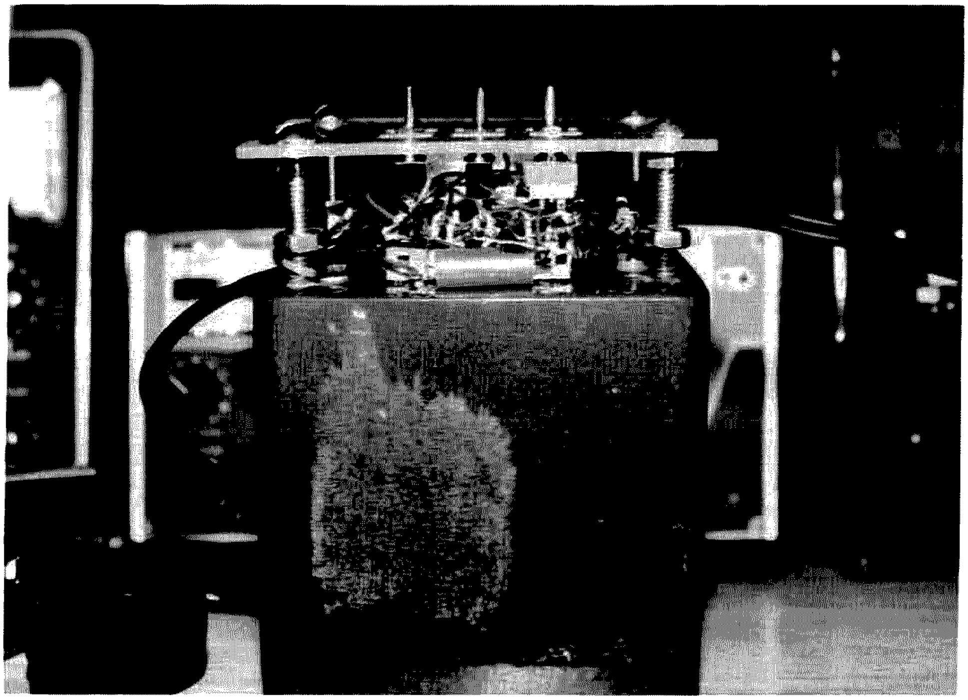

Photo B.

The automatic charging shutdown is provided by the differential amplifier (Q1, Q2, Q3) and the relay, K1. If switch SW3 is turned on when the nicad battery voltage is less than the voltage set at the base of Q2, then Q3 and K1 are held off and the contacts of K1 remain closed. When the battery voltage rises during charging to within about 10 mV of the "set-point" voltage at Q2, Q3 will conduct enough to turn on K1 and open the charging circuit. The shutdown has a positive latch since opening the contacts of K1 causes the voltage at the base of Q1 to be pulled up to 17 volts by R2, which guarantees that K1 will remain energized. While K1 is being driven, indicator L3 will glow, showing that the battery charge cycle is complete. R5, R4, D7, and C5 form a reference set-point voltage for the differential amplifier. R8 is a protection resistor to prevent high current burnout of the batteries should Q1 and Q2 develop shorts. D8 prevents L2 from glowing when SW3 is in the off position. Without D8, L2 can glow due to breakdown current flowing in the reverse biased base-emitter junction of Q1.

Switch SW2 defeats the automatic charge circuit by shorting the contacts of K1. Note that in this manual charge mode, indicator L3 still glows whenever charging is complete and the battery voltage is up to the set-point level. SW2 also has another important practical function. When the TR-2200A is used for transmitting, the auto shutdown circuit tends to get falsely triggered when the battery is close to the final set-point voltage. This is due mostly to the sagging of the 17-volt supply during transmit, which changes the voltage at the base of Q2. Although I managed to eliminate this problem electronically, the additional transistors, etc., that were required could not compete with the simplicity or the cost of the single toggle switch, SW2. In addition, the manual mode seemed to be a worthwhile feature for certain charging situations.

Construction Details

I used a free-form chassis-less technique to build up the dc supply/charger circuit. This was mostly due to a lack of a chassis in my junk box, but it was also due to an unwillingness to complicate a simple project with a lot of sheet metal work. The circuit will work with just about any construction technique, so you can use epoxy PC boards and painted cabinets if that makes you feel more comfortable.

There are a few construction items that deserve special attention. The regulator package will dissipate about 3.5 Watts under full transmit load and thus needs to be mounted on a heat sink. The thermal resistance of the heat sink should be less than 20° C/Watt. I used a small piece of scrap aluminum (2" × 3") bent into an L shape, which runs fairly cool under all conditions. The builder can experiment with any heat sink materials he has available to keep the regulator temperature down.

It should be noted that the mounting tab of the 7812 regulator is not at ground potential and will have to be insulated if a metal chassis is used. Also, bypass capacitors C3 and C4 should be mounted very close to the 7812.

Photo A shows a picture of the completed supply unit with the TR-2200A. The power transformer provides a mounting base for all components, including a Plexiglas™ panel for the toggle switches and LEDs. Nearly all of the circuit was built up on two terminal strips which were epoxied along with the heat sink and fuse holder to the top of the transformer case. Cable ties were used to mount the 8,000-uF electrolytics to

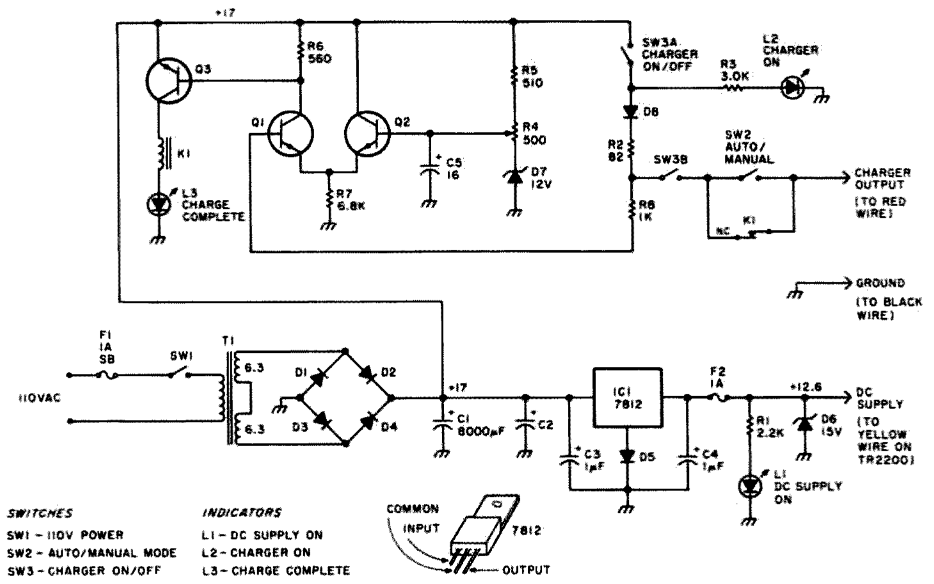

Fig. 1.

the back of the transformer. Hardware that mated with the mounting studs of the transformer was used to support the Plexiglas switch panel. The components in the differential amplifier were "space wired" to simplify construction.

About the Parts

The parts to build this unit are fairly noncritical and should be available at a low cost from your neighborhood surplus dealer. I managed to build up my supply from junk box components.

There are three parts items that deserve discussion. Relay K1 must be operable at a coil voltage between 5 and 12 volts and a current of <10 mA. This is due to the 17-volt supply used and the current available from Q3. My relay was a reed type and had a coil resistance of 3k. The builder should be able to find a surplus relay that will do the job. Remember, however, that normally-closed contacts are used in the circuit, so an SPST type will not work.

The transformer secondaries should be rated at more than 1 Ampere to ensure low IR drops in the windings. The total drop in ac voltage with a 1 Amp load on the secondary should be less than .5 V below the nominal to assure a stable 17-volt supply. A surplus filament transformer rated at 3 Amps should be adequate, but experimentation here by the builder is definitely encouraged.

The values of C1 and C2 are fairly arbitrary and can be changed by a factor of two with little performance change. If you buy these items, try to get all the capacitance in one unit to simplify construction.

Adjustments

R4 is the only adjustment in the supply. To adjust it, put an accurate (high-impedance-type) voltmeter from the base of Q2 to ground. Set the voltage for 14.0 volts so that the charger will shut down when the individual cell voltage in the TR-2200A battery pack is 1.40 volts (there are 10 batteries in the pack). According to the GE *Handbook*,[1] the cell voltage will increase above 1.40 volts at the beginning of an overcharge condition, and the 14.0-volt setting I have suggested above is based on this information. An alternate way to adjust R4 is to allow discharged batteries to charge for 16 hours and then to adjust R4 until the charge complete lamp just comes on. Some experimentation may be necessary to get the best voltage threshold for your rig.

A Low-Cost Alternative

If you are interested in building this dc supply/charger but do not want or cannot afford all of its features, a stripped-down version is easily derived from the complete unit. Just eliminate all components except those with an * on the parts list. This basic unit will still provide a dc supply and simultaneous charging, but does not incorporate any safety or convenience features.

Regardless of which version you decide to build, I am sure you will find this supply to be a valuable accessory to your TR-2200A. For those of you with other kinds of battery-operated rigs, I am sure they could be configured like the TR-2200A to make use of this circuit.

As far as I have been able to learn, a supply of this type is not now commercially available, and I would enjoy working with any enterprising group that would like to manufacture the unit. ■

Parts List

*T1	Filament transformer 12.6 V ac @ 3 Amps
*IC1	7812 fixed voltage regulator: 12 Volts
Q1, Q2	2N3904 NPN transistor
Q3	2N3906 PNP transistor
*D1, D2, D3, D4	Silicon diode 100 piv @1 Amp
*D5	1N914
D6	Zener diode 15-volt, 400 mW
D7	Zener diode 12-volt, 400 mW
D8	1N914
*C1, C2	8000 uF, 20 V
*C3, C4	1 uF tantalum 35 V
C5	16 uF, 20 V
R1	2.2k ¼ W 5%
*R2	82 ½ W 5%
R3	3.0k ¼ W 5%
R4	500-Ohm trimpot
R5	510 ¼ W 5%
R6	560 ¼ W 5%
R7	6.8k ¼ W 5%
R8	1.0k ¼ W 5%
K1	Relay, SPDT, dc coil 5- to 12-volt @ 5 mA
F1	Fuse 1 Amp delay type
F2	Fuse 1 Amp
*SW1	SPST toggle switch
SW2	SPST toggle switch
*SW3	DPST toggle switch
L1, L2, L3	LED lamps, choose your own colors

Reference

1. Joseph Grant, editor, *Nickel-Cadmium Battery Applications Engineering Handbook*, General Electric Co., 1975, page 4-38.

Build a Wide-Range Rf Resistance Bridge

—with a multitude of uses

Putting theory into practice.

William Vissers K4KI
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Excellent articles on rf resistance bridges have appeared in various publications, particularly one by Jerry Sevick in the Nov., 1975, issue of *QST*. However, my own analysis showed that a wide-range bridge would have many applications rather than the few for a bridge designed to measure a small range of resistance for a specific purpose.

The bridge I designed is simple, and easy to build, use, and calibrate. Its direct reading feature eliminates the need for an auxiliary chart or graph that can easily get lost or damaged. The versatility of the bridge makes it a worthwhile addition to any amateur station. The basic theory presented will outline how wide range is easily obtained, and the detailed description of its different uses will prove its value.

The Basic Bridge

Fig. 1 shows the wide-range bridge principle explained by a simple numerical example. The two legs of the bridge, R_A and R_B, are made up of a single variable 100-Ohm two-Watt linear potentiometer. R_C is a half-Watt 50-Ohm carbon resistance. R_X symbolizes the unknown resistance we wish to measure. E is a voltage source, and I is the meter I will measure our null with when the bridge is in balance.

Without going into a lot of bridge theory and proofs that can be found in any textbook, all we need to know is the basic bridge equation for a balanced condition, which is: $R_X/R_B = 50/R_A$. Solving for R_X, we find that $R_X = (R_B)(50)/R_A$. Now, as I've already said that R_A and R_B are nothing more than a 100-Ohm potentiometer, let us set the potentiometer near one end of its travel so that R_A is equal to ten Ohms. Then R_B will be equal to 100 − 10, or 90 Ohms.

Now, if we set the potentiometer near the end of its travel so that R_A is equal to 90 Ohms, we find that R_B will be equal to 10 Ohms. And, solving for R_X, we now find that $R_X = (50)(10)/90 = 5.56$ Ohms. These calculations show that a wide-range bridge design can be achieved quite easily.

I know that already some of you will be saying, "Why don't you run the potentiometer to zero for both calculations just shown and come up with a bridge with a range of from zero to infinity?" That is a very good thought, but we do run into some practical limitations. We would find that our bridge sensitivity would have dropped to zero, for one thing. And secondly, as there is no such thing as zero resistance when the potentiometer is at the end of its travel, our actual bridge range is somewhat less than zero to infinity. But with a small transistor amplifier we can easily increase the basic bridge sensitivity. And this increased sensitivity also allows our exciting voltage to be anything from an ordinary rf signal generator, to a grid-dip meter, to a simple low-powered variable-frequency oscillator. If a grid-dip meter is used, a single turn coupling coil attached to the bridge input jack will provide plenty of excitation voltage. In my own case, I use a Heathkit® Model LG-1 signal generator with a maximum output

of a tenth of a volt. This is adequate for proper operation of the bridge. So, if care is taken in our calibration, we can come up with a wide-range bridge sufficiently accurate for all amateur usage.

The Actual Bridge Circuit

The basic bridge circuit just described is used in the final circuit of Fig. 2. As in all rf circuitry, every effort should be made to keep the internal bridge leads as short as possible to avoid excessive lead inductance and capacity to ground. The input and output coax jacks are about an inch and a half apart on the chassis. This allowed very short leads to be used.

A pair of binding posts, A and B, are in parallel with the output jack J2 so that calibration resistors and wire-connected leads can be easily connected without having to use clip leads or other methods of connection. The 1N34 diode detector rectifies the nulling voltage and feeds it to the transistor amplifier through a 4.7k resistor, along with a couple of .01-uF bypass condensers. The transistor amplifier circuit was about the simplest one I know; it is a standard differential amplifier.

The transistors used were a couple of surplus PNP 2N396As donated by my buddy K4YS. Any standard general-purpose transistor will work as well, although it may be necessary to use another value of resistance for R4 of Fig. 2. In my own case, I temporarily used a variable 25k resistor for R4 and adjusted its value until the amplifier gave the gain and stability I desired. Then the variable resistance was measured with an ohmmeter, and a fixed value used in its place in the circuit. It's a quick and easy way to optimize a circuit. The variable 10k potentiometer R2 used for balancing the meter current to zero during the initial null was an available 2-Watt potentiometer, although a small trimpot can be used if desired. R3 is a 2-Watt potentiometer-type variable resistance used as a sensitivity control that limits the current through the 50-uA microammeter when setting for initial null. Switch S1 turns the transistor amplifier "on" or "off". Switch S2 allows the transistor amplifier to be used for other purposes, as will be described later on. The entire bridge is self-contained in a 7" x 5" x 2" chassis. A coat of gray enamel paint gives it a professional look. I have found that painting the chassis before final assembly and baking it in the kitchen oven for about fifteen minutes at 250 degrees Farenheit produces a hard, smooth finish.

Calibration

The simplest way to make the bridge direct-reading, which avoids the use of separate calibration curves, is to paste a piece of white cardboard directly on the chassis under the 100-Ohm potentiometer knob. This allows actual values to be inked in when the calibration is made. Fig. 3 is a theoretical calibration sheet illustrating the method just described. Theoretical values were shown, as every individual calibration will vary somewhat depending upon the linearity of the 100-Ohm potentiometer and the actual values of the resistance of the potentiometer at the ends of its travel.

I had mentioned earlier that this resistance will not be zero, and its actual value does affect the calibration points obtained. However, I did find that in my case there was close agreement between theoretical and actual values within the range of 10 to 400 Ohms. In any event, the actual values obtained during calibration will allow you to read well beyond the values just mentioned. Naturally, reproducible accuracy will not be as great at the extreme ends as at the middle of the resistance range. As in all instruments, the calibration is only as good as the standards used.

The calibration standards used were ordinary 5% tolerance small fixed carbon resistors. The calibration technique is very simple. Connect the calibration resistance selected across binding posts A and B. Set the balance control to about the midway position, and

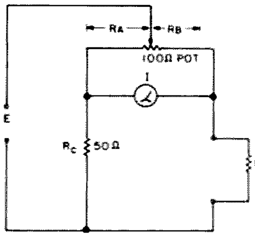

Fig. 1. Basic wide-range bridge.

set the sensitivity control to minimum sensitivity (maximum resistance). Turn the power switch to the "on" position. Now adjust the balance control until the meter reads zero. Apply an rf voltage from the signal generator to J1, the input jack. The signal generator frequency I used was 3.75 MHz, although the frequency is not important since the basic bridge is not frequency-sensitive. The meter will read some current. Adjust the 100-Ohm bridge potentiometer until a null is obtained. Now the sensitivity control can be increased to maximum sensitivity, and the output of the signal generator can be increased as desired. The bridge potentiometer is now rotated until the best null is obtained. The dial scale can now be marked for the calibration resistance value. As many calibration points as desired can be obtained in this way. The zero resistance point can be obtained by shorting the bind-

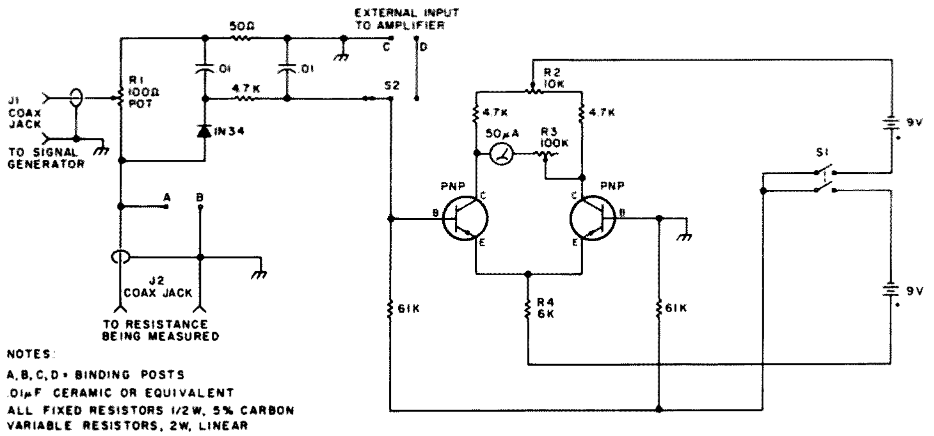

Fig. 2. Wide-range rf bridge.

ing posts and observing the null. The infinite resistance calibration point is found in the same manner except that the binding posts are left open. In both of these instances, the null will be poorer than those obtained at other points on the scale.

Actual Uses of the Bridge

Although the bridge is normally used to measure rf resistance, its wide range allows it to establish other measurements where the actual resistance values are of secondary importance. Therefore, I am going to include those items which make the bridge so useful under these circumstances. These secondary uses are of great value, not only for obtaining specific data, but also in tying many theoretical concepts we read about to simple observations that we are now equipped to make. In almost all rf measurements, the circuit being checked is frequency-sensitive so that at resonance the circuit becomes a pure resistance. Knowledge of the resonant frequency is read from the signal generator. The resistance value read from the bridge will provide sufficient information for almost any problem that the amateur may want to solve.

Antenna resistance at resonance:

Connect your antenna coax line to J2 and apply rf voltage from the signal generator. Establish a first approximate null by rotating the 100-Ohm potentiometer knob on the bridge. Then vary the frequency of the signal generator until the null is more pronounced. The final nulling consists of adjusting both the frequency of the signal generator and the variable control on the bridge. This is necessary to obtain the best null. At the lowest null obtained, the resistance will be the antenna system resistance, and the frequency will be its resonant frequency. I was careful to say antenna system, as this is defined as your antenna with the normal coax feedline attached. If for some reason you want to know the actual antenna resistance, then your feedline will have to be an electrical half wavelength long. The reasons for this are covered more fully in transmission line theory, and are considered a bit too much for the scope of this article. But, as we shall see shortly, our bridge will easily measure an electrical half or quarter wavelength of coax line if this information is needed.

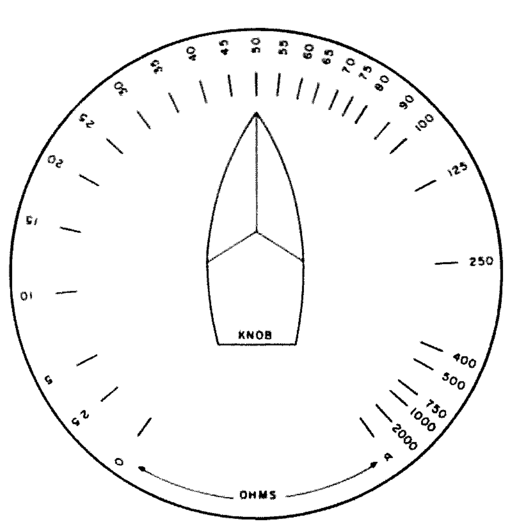

Fig. 3. Direct-reading bridge scale.

Tuning your matching unit:

This bridge is a wonderful device to allow you to load your transmitter to exactly 50 Ohms without even putting a test signal on the air. You no longer have the worry of inadvertently loading up into a high swr condition and possibly damaging your final. At the same time, you can't create any unnecessary QRM on our already crowded bands. And once you've done this for any frequencies, just note the dial settings of your transmitter and matching unit, and you can quickly put your transmitter on and be assured that you will be perfectly matched. First off, load up your transmitter at the desired frequency into a dummy load. (Normally, this is 50 Ohms.) Then connect J2 to the input of your matching unit, and connect the output of your matching unit to your antenna system. Select the frequency you just tuned up your transmitter to on your signal generator. Then set the variable 100-Ohm potentiometer on your bridge to 50 Ohms on the calibrated scale. Turn up your bridge, and adjust your matching unit until the best null is obtained. Presto! You are now completely tuned up. You don't have to touch your transmitter tuning or loading at all. Just reconnect your transmitter to your matching unit input and you are finished. Actually, I can do the above more quickly than I've written about it. And in addition, when you are done, you can't even see your swr meter or reflected power meter wiggle when you put your transmitter on the air. It's really fun to amaze your friends by obtaining such a perfect match, quickly and scientifically, and without any QRM on the air. It's tuning up your station in a really engineering fashion.

How good is your matching unit?

From the preceding step it is easy to go a bit further and establish the resistive matching limits of your tuning unit. It's a quick method of comparing one kind of a unit against another. I'm sure we all agree that to define the limits of a matching unit as "being able to load into a random wire" is not a very exact technical description. This is particularly true since random could mean anything from a couple of feet to a couple of wavelengths. I've found in my own case that my bridge has allowed me to design a wide-range matching unit, and quickly establish which variables are important to obtain the wide range I desired for my specific antenna needs.

All you do is see what the resistance limits are that your matching will load into and still retain 50 Ohms at the input jack. The technique is very easy. You can use your 5% calibrating resistors for this purpose. Just connect a resistance to your matching unit output and jack J2 of the bridge to the matching unit input. Set the bridge resistance knob to read 50 Ohms on the scale. Now adjust your matching unit until you can achieve a bridge null at the frequency of operation you have selected on the signal generator. In this way you can quickly determine the upper and lower resistance loading limits of your matching unit. If the resistances you select are too high or too low, you will not be able to obtain a satisfactory null on the bridge. My home-built matching unit matches from about 10 to 200 Ohms without any difficulty. Generally speaking, the wider the resistance range, the wider the range of the matching unit for varying impedances. And you'll be

surprised to find the different ranges obtained by different kinds of matching units. It's an education in itself.

Resonant frequency of tuned circuits:

The ease with which the bridge can determine the resonant frequency of a totally enclosed tuned circuit is quite amazing. And it will even tell you whether or not it is a series-tuned circuit or a parallel-tuned circuit. All you need is two leads from the circuit being tested. Connect the leads to output binding posts A and B. We know that if a circuit is a series one, its electrical resistance will be low. So, just to obtain the best null, vary the signal generator frequency and the 100-Ohm control at the low resistance end of the scale. At the best null obtained, the signal generator frequency will be the resonant frequency of the tuned circuit. The resistance reading will be its equivalent series resistance.

The parallel circuit is measured in the same way, except that the bridge potentiometer is at the high end of the scale. The resistance value measured will be the equivalent parallel resistance of the tuned circuit. And, as before, the signal generator will indicate the resonant frequency of the tuned circuit. I mentioned that the tuned circuit could be completely enclosed. This bridge can measure resonant frequencies where it would be impossible to inductively couple in a grid-dip meter to make a similar measurement.

Measurement of velocity factor of coax cable:

The technique of measuring the velocity factor of coaxial cable is simple when it is realized that an electrical quarter wavelength of line (or odd numbered multiples thereof) open at the far end acts like a series-tuned circuit at the near, or measured, end. Just connect your piece of coax cable to J2 and null the bridge at the low resistance end of the scale, at the same time varying the signal generator frequency for the lowest frequency for the best null obtainable. The equation for velocity factor in this case is: Velocity factor = (length in feet)(F_{MHz})/246 for a quarter-wave section of line. And now, as an experiment, if you triple your signal frequency, your line will again null the bridge. It is now acting as a three-quarter-wavelength line. In this way, it is very easy to demonstrate basic transmission line theory.

The same principle is used in determining the electrical half of a line open at the far end. This condition is equivalent to a parallel-tuned circuit. Just adjust your bridge null at the high resistance end of its scale, and at the same time adjust your signal generator for the lowest frequency that will give you the best null. The velocity factor can be checked and the formula will be velocity factor = (length in feet)(F_{MHz})/492 for a half-wave section of line. You can also use this method for setting up for a half-wave section of line if desired.

Characteristic impedance of coax cable:

The characteristic impedance of a coax cable can easily be determined with the rf bridge. All you do is connect one end of the cable to J2 and connect a selected resistor across the other end of the cable. The selection of this resistance is such that when the signal generator frequency is varied there is no change in the bridge reading. At that point, the resistance selected is equal to the characteristic impedance of the coaxial cable. It is an easy matter to try several different values of resistance to terminate the cable, so that a variation of signal generator frequency will show no change in the meter reading. The null can now be obtained, and the resistance reading will be the characteristic impedance of the cable. The value read will be equal to the terminating resistance at the end of the line. This illustrates the basic principle that a properly terminated line presents a constant pure resistance to a varying input frequency.

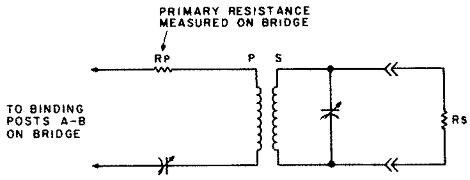

Fig. 4. The effect of secondary resistance being reflected in primary circuit.

Reflected resistance of tuned coupled circuits:

Although it is possible to wade through a great deal of circuit theory to prove that resistance can be reflected from one circuit to another, this easily performed experiment will show it in a manner in which, if once performed, it will never be forgotten. An actual experiment is such a wonderful way of firming up any theoretical proof in anyone's mind. The principle of reflected resistance can be demonstrated as shown in Fig. 4, where a parallel-tuned circuit is inductively coupled to a series circuit. Loading down the secondary with a resistance generates a reflected resistance in the primary whose value can be determined by measuring the change of resistance with the bridge. Close-coupling effects can also be demonstrated by observing the re-tuning necessary to reestablish resonance when the secondary is coupled into the primary. This item described is an easy way to demonstrate rather complex principles, particularly when teaching basics to students studying for an amateur license.

The transistor amplifier:

In addition to the many uses just described, I found that the addition of an SPDT switch, S2, and a couple of binding posts, C and D, would allow me to use the transistor amplifier for other duties in my amateur station. One valuable use is as a field-strength-meter amplifier. My regular simple field-strength meter diode circuit is now far more sensitive, which allows me to make my field-strength measurements further away from the antenna and avoid close-field effects. This makes my field-strength measurements more accurate and meaningful. A second use is as a small experimental capacity bridge, which I built using the same principles as the bridge previously described.

Conclusion

The development of this bridge and an investigation into its many uses has been one of the most interesting projects I've done since becoming an amateur more than fifty years ago. Undoubtedly, many more uses will be found for it, which will further enhance its value in your station. And if you are like me, you'll find that actually building something and using it is a wonderful way to impress theory on your mind. There is no better way of learning than by actually doing. ■

73 Magazine *Staff*

Try the Potted J

—a 2m antenna impervious to the elements

Structural integrity and simple construction.

Some antenna is better than no antenna at all. In many circumstances where adverse weather conditions are encountered, a primary consideration should be to have an antenna that will function dependably even though it might not provide the last dB of gain. This article describes such an antenna designed primarily for 2 meter repeater usage. The antenna has only a modest amount of gain over a simple ground-plane antenna. But, it has far better structural integrity. The materials used to construct the antenna might vary a bit depending on what is available locally, but the design permits construction by anyone using only simple hand tools.

The antenna form is a commonly used variation of the old-fashioned J antenna shown in Fig. 1(a). The variation, as shown in Fig. 1(b), simply uses a closed metal cylinder for the lower ¼λ section instead of the open-style construction of the original J antenna. This type of construction has a number of advantages, such as easy mounting on any type of mast, relatively inconspicuous appearance, and an all-metal, dc grounded structure. Since the antenna's central element and the metal cylinder are electrically shorted at the base of the antenna, that point will be a low impedance point. At the other end of the ¼λ cylinder, there will be a high impedance point. The latter is the only point where consideration has to be given to proper insulation between the metal elements of the antenna.

The mechanical dimensions of the antenna are given in Fig. 2(a). Depending on the materials available locally, the *diameters* of the cylinder and the radiating element can vary a bit from those shown. But, the *lengths* should be closely maintained and dimensioned using the formulas shown in Fig. 1(a) for the particular segment of the 2 meter band of interest. The mechanical construction can vary a bit from that shown as long as the dimensions are maintained, the central element is securely grounded to the bottom of the ¼λ cylinder, and the coaxial feedline is connected properly.

In the method of construction shown, the end of the central element is flattened out at the bottom and bent and bolted to the bottom side of the ¼λ cylinder. Additionally, a small piece of the same material as the central element is flattened out and used as a brace to the other bottom side of the cylinder. The coaxial cable shield is connected via a ground lug to the inside of the cylinder and the inner conductor is either soldered or connected to the central element

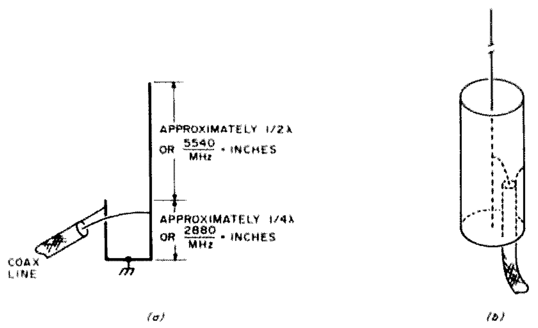

Fig. 1. Basic J antenna (a) and variation where lower ¼λ section is in the form of a cylinder (b).

at the point indicated via a ground lug. The connection to the central element can be made before that element is inserted in the cylinder. The connection of the cable shield must be made after insertion. This requires a bit of dexterity working in the narrow cylinder, but with good lighting and patience it can be done. One handy way to help things along is to temporarily glue the nut for the bolt holding the ground lug on a thin piece of wood. Once the nut is started on the bolt, the wood piece can be broken away.

Before the final assembly step, check the electrical performance of the antenna for swr. It should check out with a very low swr if proper dimensions have been maintained. If one wants to optimize the swr, the feedpoint on the central element can be varied slightly up or down. Usually this can be done without having to change the connection point for the ground shield of the coaxial feedline. This does mean going through the procedure of having to take out and reinsert the central element, but it is not at all that tedious after one does it once or twice. During this test, the central element can be held centered in the upper end of the cylinder by a PVC reducer fitting as shown in Fig. 2(b). These reducer fittings can be found wherever PVC piping fittings are available and one can be found which will fit exactly over a pipe having a 1¼" outside diameter.

The final and most important step in assembly is to fill the cylinder in completely with an insulating compound. This will give the antenna its final mechanical rigidity and, more importantly, completely exclude moisture leakage or condensation in the cylinder. Many potting or sealing compounds can be used as long as they contain no form of metal filler. The plastic resin body fillers sold in automotive stores, with or without fiberglass reinforcement, are readily available. However, to make the filler flow readily in the cylinder, the filler should be heated so that it is fairly liquid. Don't use an open flame to make the filler liquid, but rather insert the container (a tin can will do) containing the filler into a bath of very hot water. Temporarily plug the top end of the PVC fitting where the central element protrudes and, with the cylinder initially held at an angle, pour in the filler from the coaxial cable end.

The use of a coaxial connector on the antenna was deliberately avoided. Simple coaxial connectors, when used in a harsh outdoor environment, will almost always eventually become the source of a problem. This is the same reason why screw-in elements, etc., are avoided. Of course, this all means that the antenna becomes a throw-away unit in case something should really damage it. But, the cost of materials involved to build another antenna is relatively low. As long as it does last, one can use the antenna with the confidence that none of the electrical or mechanical connections inside the antenna are likely to become corroded.

The ¼ λ cylinder need not be insulated from a metal mast as long as it is fastened to the mast at the *bottom* of the cylinder with the usual metal U-type mast clamps.

One can add parasitic or phased elements around the basic antenna if it is desired to obtain some directivity. Parasitic elements, of course, require no cable connection to the main element, but then one has to go through a careful process of seeing that the feedpoint of the main element is altered to compensate for the presence of the parasitic element. In spite of the increased cable cost, etc., if one really wants to keep the weather-ruggedness for a directive antenna installation paramount, it would be better to have two spaced antennas of the type described with separate feedlines. Then, the necessary phasing, matching, and switching can be done from the protected environment inside the shack. ■

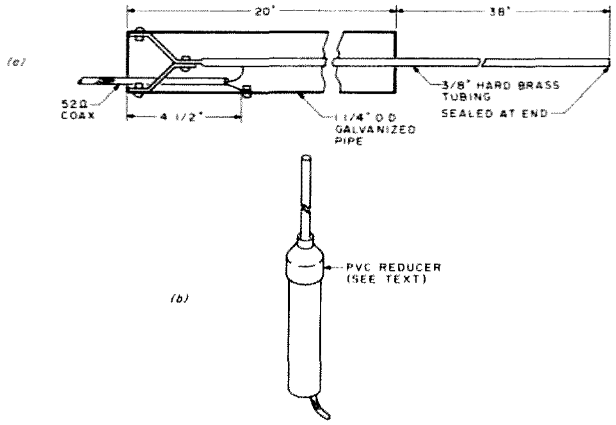

Fig. 2. (a) A cross-sectional view of the antenna giving dimensions centered in the 2 meter band. (b) A PVC pipe reducer used to insulate and center the vertical radiator at the top of the ¼ λ cylinder.

Testing the DSI 3600A Frequency Counter

—as much accuracy as you'll ever need

Score another one for DSI!

Bill Pasternak WA6ITF
Associate Editor

"Measures frequencies to 600 MHz; includes oven-compensated crystal timebase; includes built-in 600 MHz prescaler . . . not an ad-on; resolution to 1 Hz direct and 10 Hz prescaled; sensitivity 10 mV rms @ 146 and 220 MHz to 50 mV rms @ 450 MHz; accuracy .5 PPM over temperature; automatic decimal point placement; 8 large bright .5-inch digits and more!" . . . Yes, these are nice claims for any piece of equipment, and, when you realize that this counter costs only $199.95, it all seems even sweeter. Ah, but there is always a "but." In this case, the "but" was, "but will it work the way DSI claims under actual amateur shack conditions?" The answer is a large-sized "yes," so, if you are interested in a frequency counter of your very own, read on.

When DSI says that the counter comes complete and ready to operate, they are not fooling. Packed along with the 3600A, in the neat little white shipping carton, one will find a 110-V ac to 12-V dc power converter, a telescoping whip antenna, and one of the finest instruction manuals I have seen in a long time. The book not only contains the "how to's" of using the 3600A, but also has detailed schematics that take up two full pages and are very easy to read. Should you find it necessary to perform service on this instrument, such schematics are a true asset.

The basic counter is housed in a scratch-resistant, highly durable black plastic case. Plastic, you say . . . why plastic? Light weight and portability are but two of the reasons and I'll bet there are many others. The fact is that the 3600A is so light in weight that it feels like you are carrying a portable transistor radio without the batteries. DSI claims that there are virtually no spurious emissions from the case, and I corroborated that using my old standby Millen gdo as an absorption wavemeter. Nothing could be detected on the Millen from the BC band through the highest frequency of the gdo. Score one for DSI.

The front of the counter is a transparent dark red panel which has high light transfer properties, and about the only place you may have problems reading the .5"-LEDs is in direct bright sunlight. Along with the 8-digit display for frequency readout there are two other LEDs. One indicates gating time, while the other monitors the cycling of the crystal oven. The base frequency oscillator is temperature-compensated using the time-proven crystal oven technique, and I suspect that it's this oven that accounts for the remarkable long-term stability of the unit. Score another one for DSI.

There is but one control on the counter, and that is its "gating switch," which selects one of two timebases in either the direct or prescaled ranges. The rear of the unit has three connectors. A mini phone jack serves as power input, and two SO-239 UHF connectors are used for both rf inputs. To use the counters, one need only plug the power converter into the unit, connect either an input probe or the telescoping antenna, set range/gating, and read frequency.

DSI includes a warning in their manual that reads in bold black letters, "Warning—do not transmit directly into counter." Actually, the counter seems so sensitive that, in most cases, the whip sup-

plied by DSI is more than sufficient.

To check a frequency counter, one needs a source of signals to read, as well as something to compare against. Well, what can the "average" amateur use as a standard of comparison? In my case, I happened to have tweaked my Clegg FM-76 220 MHz radio earlier in the week on a multi-kilobuck counting device. Since it had only been a few days, I figured that it was close enough for "amateur work." The 3600A showed that the FM-76 was within 50 to 100 Hz on each of its 11 crystalled-up transmit positions. In my book, that was enough proof of the accuracy claim—far more than is necessary for most amateur applications. "Real nice," I thought to myself.

Over the next week, I tried the counter under a number of different conditions. In each case, I was all but amazed by the extreme sensitivity of the unit. One experiment I tried was placing the 3600A atop the Sylvania color TV set in the living room and keying my FMH in the den some sixteen feet away. The display lit up to read 146.52053. Not bad for a 1.5-Watt handheld and a rubber duck to a counter with a whip as an input probe. This "sensitivity feature" was real handy when I decided to reset the transmitter in my trunk-mount Motorola. I simply made up a cable with a mini phone plug on one end and a cigar lighter plug on the other, shoved the 3600A on the rear deck of the Torino to shield it from direct sunlight and tweaked the T-power with ease. No extension cords were needed. The car powered both the radio and the counter.

DSI claims a 600-MHz top end for the 3600A. I can't tell you about that, but it does work to specs in the 440-MHz range as checked using a Motorola HT-220 belonging to a good friend who owns one of those "secret" California remotes. Again, the test was from the den to the living room, whip to whip. I also checked the lower limits of the 3600A by using an Audiovox CB radio and my Globe Scout/Hallicrafters HA-5 combo. I'll tell you one thing—that HA-5 is one stable vfo, even when multiplied to six and 10 meters. I always suspected this to be the case, but having a counter really proved this once and for all. Again, these were the same kind of tests you might use a counter for.

In all, I tried the counter from the 80 meter amateur band up to 450 MHz which were the limits of the test rf available to me. In each case, the 3600A lived up to the claims made for it by DSI in their advertisements. What more is there? If something proves to be as it's claimed, it's very nice to be able to recommend it to others. The DSI 3600A counter is such an instrument.

More information on the complete line of DSI instruments can be had by writing DSI, 7914 Ronson Road #G, San Diego CA 92111. Or, if, after reading this, you are in a hurry to order one, you can call DSI at (800)-854-2049. In California, call (714)-565-8402 collect. Oh yes, lest we forget, DSI gives a warranty of one full year on parts and labor. DSI also pays the return postage. This guarantee is personally backed by DSI's marketing vice president Dennis Romack WA6OYI. I know Dennis and he is the one guy who means every word he says. ■

The Tri-Polarized VHC Antenna

—should be a killer for VHF

Vertical, horizontal, circular.

D. Mitchell K8UR
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Milan MI 48160

This article is about an easy way to achieve the various modes of polarization from a single antenna system, the VHC antenna. VHC—V for vertical, H for horizontal, and C for circular.

The attempts of antennas in amateur use to achieve the different modes were either expensive (multiple arrays and multiple dollars) or exclusive to a particular mode. This ultimately resulted in the purchase of many identical antennas to hang off the tower for vertical, horizontal, or a combination of the two to achieve circular polarization.

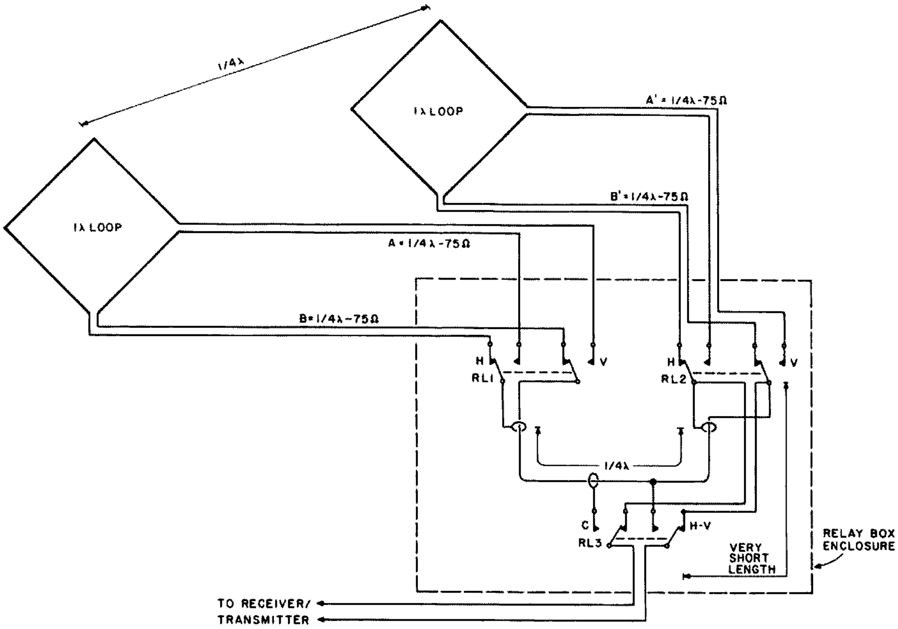


Fig. 1. VHC antenna.

The antenna I am about to describe is a single antenna to be used for all modes of polarization—vertical, horizontal, and circular. All of these polarizations are becoming more common due to the amateurs' diverse interests: VHF-FM, SSB, and OSCAR. Why use one array for FM, another for SSB, and another yet for OSCAR when on the VHF bands?

The VHC antenna idea came to mind while I was operating on 80 meters, actually. I often found it advisable to use a particular mode of polarization for DX work there which was dependent upon conditions on a particular night or even the particular part of the opening. Vertical

polarization proved superior on some occasions, while horizontal polarization would prove better on others.

While the problems encountered on 80 meters may not be thought of in the same light for the VHF frequencies, it is still useful insight, as the VHC antenna did first come from thinking of 80 meter antennas.

The difference between the 80 meter and VHF philosophy is that, on 80, it is not the actual polarization that is important, but the angle of transmitted or received radiation. It is often found that a low angle of radiation on 80 makes for a good DX antenna, but there are times when a horizontal antenna outperforms the low-angle vertical antennas that are often used. The many variations in antenna height and radiation angles of antennas, mixed with the ionosphere height, distance to the DX station, and his antenna system, are too complex for the human mind, and I will not attempt to share my ignorance of the matter with you. But I will tell you of an antenna to try.

The 80 meter version of the VHC antenna appears in Fig. 1. The basic premise is that by feeding the loop antenna at the bottom or top, horizontal polarization results. By feeding the loop at either side, vertical polarization results. And, as stated earlier, I feel it is not the polarization that counts here, but rather the lower angle of radiation achieved by the vertical polarization.

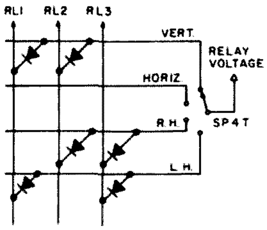
The orientation of the full-wave loop can be either square or diamond or circular. The version that is in use at K8UR is of the diamond variety so that only one support is required.

The idea of the 1/4-wave sections marked A and B is as follows. When feeding A, B (being an open-ended ¼ wavelength) appears shorted at the antenna connection and does not come into play. When feeding B, the ¼ wavelength of A does not come into play. Both elements are identical and the only thing that must be emphasized is that when either A or B length is left unconnected directly to the feedline, neither side of the coax center conductor or shield should be attached to the switchbox in any way. DPDT relays are highly recommended so that the builder does not have problems with the end of the ¼-wave sections of A and B not appearing as a short at the antenna end.

The switchbox containing the DPDT relays should have the SO-239s insulated from the container and tower, if mounted on one. Regular 4-lead rotor cable is used at K8UR to supply the switching voltages to the relays.

A logical way to switch the correct combination of antenna elements into play is shown in Fig. 2. The switching matrix uses diodes large enough for the relays chosen. The diodes can be mounted on the back of the relay voltage select switch that most likely will be in the power supply for the relays, convenient to the operating position.

All lengths of coax used are ¼-wavelength, with the exception being the length between RL1 and RL2, where it is actually two 1/8-wave pieces intersecting at RL3 and connected to RL3. When installing the loops, care must be taken to keep the center conductors of A and A′ going to the same side of their loops, respectively. The same is true for B and B′. If you follow Fig. 1 carefully, you should come out OK. The length of coax from



	RL1	RL2	RL3
Vertical polarization	On	On	Off
Horizontal polarization	Off	Off	Off
Right-hand circular	Off	On	On
Left-hand circular	On	Off	On

Fig. 2. Relays.

the antenna relay box to the transmitter is of any length.

The ability to switch instantly from vertical to horizontal or circular has taken the guesswork out of which antenna or polarization is best at any particular moment. The antenna used on 80 meters does not include the circular feature, but it is worth the effort with vertical and horizontal modes alone.

Two meters should be the ideal frequency for the VHC antenna, with SSB using horizontal, FM using vertical, and OSCAR using circular. The addition of parasitic directors and reflectors also has possibilities for the VHC. For the 80 meter band, where two elements alone are already large, it can be easily made to reverse directions by feeding RL1 first instead of RL2, as shown in Fig. 1.■

Glenn Jacobs WB7CMZ
Rathole 857
Poverty Flat
Eagar AZ 85925

The One-Note Pipe Organ

—CW never sounded sweeter

The latest from Rathole 857.

It is springtime. Today is the sixth of May, 1978. It is snowing outside and it is Saturday. So, why am I pushing typewriter keys instead of pushing a straight key down and pulling it back up? Because the spring winds blew all day yesterday, and besides wrecking the chicken house and blowing down branches and trees, it also blew down my entire antenna farm and broke up all the wooden slabs and scraps that held all those wires up in the air.

Mr. Hawkins runs a sawmill just a couple of miles down the road and he lets me have all the slabs and scraps I want. I have burned many tons of them in my heater, besides building the woodshed, the chicken house, and the antenna supports. But, it's snowing, and I don't really want to go scrounge slabs in a snowstorm. So, that's why I'm writing about radio instead of doing radio.

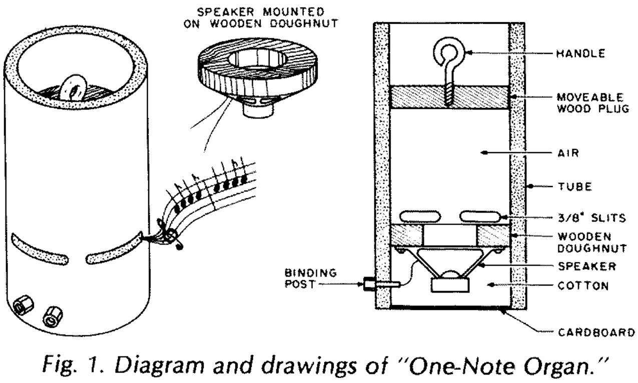


Fig. 1. Diagram and drawings of "One-Note Organ."

A few days ago, I noticed an ad for a special speaker for CW. It shapes the tones or muffles the off frequencies or something like that—there is even a graph full of decibels to show what it does. Aha! A really new idea. There *is* "something new under the sun."[1] Nobody ever thought of this before. Maybe I'll buy one of these instead of an active audio filter.

Browsing in my pile of old radio magazines . . . (Don't get the idea I got all these magazines by subscription. I just recently got my ticket and more recently began to subscribe to *73*. I got most of them at hamfests and from the Lockheed Radio Club for 20¢ apiece.[2])

Well, well. Lookie here! Here's something along the same line, and twenty-six years earlier! (*QST*, Sept., '52, p. 66.) The half page of text gives two versions of a sort of one-note pipe organ, attributed to the R.S.G.B.[3]

I have a Tech ticket (WB7CMZ) but my house is behind a hill and under the power lines, so I cannot key up the "local" repeater (fifty miles away). All I really have is a sort of five-year Novice license. (These days, I could've gotten that[4] anyway, without losing a day's wages and traveling five hundred miles to get it, but that was the best I could do this past winter.) "See Double You" is all I get to do. My antique Hallicrafters SX-28 is not really selective enough to suit me. The device interested me, so I built my own version of it. Here's how (dimensions are not critical, and there are probably 347 different ways to build this gadget successfully):

First, cut two round plugs of wood a little bigger than the inside of the mailing tube. Trim them with a very sharp knife or a rasp until they just fit inside the tube, but won't move without being pushed.

Mount the eyebolt or other handle in the center of one plug, so you can slide it in and out of the tube. You may tune the "organ" by changing the length of the resonant column of air.

Make a two-inch hole in the middle of the other plug and mount the speaker on it. Now is a good time to solder the wires onto your speaker. It will be very inconvenient later. This is the voice of experience. Glue this assembly three inches into one end of the tube. See Fig. 1. Mount the binding posts in the tube wall and solder the wires in place. Fill up the space behind the speaker with the cotton. Don't stuff it in so tight that the speaker cone cannot vibrate. Glue the cardboard circle into the end of the tube so the cotton stays in.

Cut three or four slits 3/8" wide around most of the circumference of the tube just ahead of the speaker plug, so the sound can come out.

Slather plenty of glue on all the cut edges of the cardboard to reinforce it.

Push the movable plug into the open end of the tube. Hook the binding posts up to your receiver speaker terminals with flexible wire. Adjust the movable plug to resonate the speaker to the CW note you like best, or to the note your receiver produces loudest, and enjoy a purer cleaner note, with less buzz, hum, pop, grind, and QRM. And you did it almost for free, in one evening.[5] ■

Parts List

Wooden fruit-lug end (or equivalent)
4"-diameter cardboard mailing tube (or equivalent)
3" speaker (or equivalent)—one that will fit inside the mailing tube
Handful of cotton (or equivalent)
4" circle of corrugated cardboard (or equivalent)
2 binding posts—optional
Hookup wire
Eye-bolt, screw-eye, or other finger handle

References

1. Ecclesiastes 1:9 and 10.
2. 2814 Empire Avenue, Burbank CA 91514.
3. Radio Society of Great Britain.
4. Recent FCC change makes Novice license renewable.
5. Unless you used epoxy glue. It hardens overnight.

Other Notes

1. If you don't happen to have a mailing tube, I suppose you could use plastic or metal pipe, tin cans, or a square wooden tube.

2. If you don't have a speaker that fits inside your tube, put the speaker in a separate box 3/8" away from the tube. If you're a sharp tinkerer, you can think of a way to make do with what you have.

3. If you don't like the looks of it when you get finished, it will work just as well painted, wallpapered, or with a lampshade.

4. I took a picture of this thing, but it just looks like two feet of mailing tube with slits and binding posts. (You can cut it shorter if you don't like low notes.)

5. If you pull out the plug entirely, the whole thing turns back into just a funny-looking speaker for listening to SSB or AM.

6. If you don't have binding posts, send me a quarter and an SASE to Glenn's Trading Post, Rathole 857, Poverty Flat, Eagar AZ 85925. I'll send you a pair you'll like.

✓ Reader Service—see page 179

H.C. Sherrod W5ZG
4715 Crockett Blvd.
Galveston TX 77550

A Better Heathkit "Cantenna"

—improved metering circuit for an old standby

Update your dummy load.

The Heathkit® "Cantenna" dummy load, Model HN-31, consists of a fifty-Ohm dummy load resistor, R1, immersed in oil, and an indicating circuit consisting of resistors R2 and R3, capacitor C1, and diode D1. Fig. 1 shows the schematic diagram.

The indicating circuit provides for connection of a direct current meter to the jack marked DC OUT. This arrangement provides a means of indicating relative power.

With the circuit shown in Fig. 1, an amount of power at 3.5 MHz applied to the dummy load will produce a certain meter deflection. If the same amount of power is applied to the dummy load at 29.7 MHz, the meter deflection will be considerably greater.

By modifying the indicator circuit to that shown in Fig. 2, the indicating meter can be made to read the same value for a given amount of power whether it be at 3.5 MHz, 29.7 MHz, or at any frequency between these values.

When this has been accomplished, the indicating meter may be calibrated in Watts and will provide satisfactory indication of transmitter output power at any frequency between 3.5 MHz and 29.7 MHz.

The basic difference between the indicator circuits shown in Fig. 1 and Fig. 2 is that the circuit shown in Fig. 2 incorporates a frequency-compensating network.

In my case, an indicating meter that would read 200 Watts full scale was desired.

The first operation was to modify the circuit shown in Fig. 1 to that shown in Fig. 2. Note that in Fig. 2 the value of resistor R3 has been changed from 1000 Ohms to 2500 Ohms. It will be noted that Fig. 2 includes the additional components noted in Table 1.

All of these additional components are installed within the small metal box which is attached to the pail lid of the Heathkit® "Cantenna."

The indicating meter employed had a 200-microampere full-scale movement with an internal resistance of twelve hundred Ohms. This meter was di-

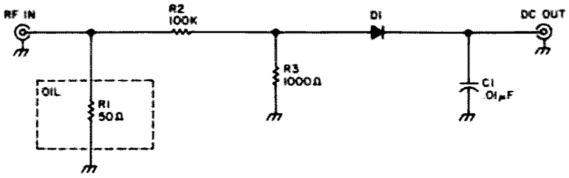


Fig. 1. Schematic of the Heathkit® "Cantenna."

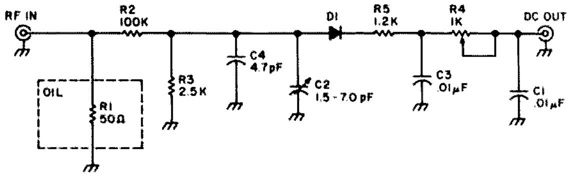


Fig. 2. Modified schematic of the Heathkit® "Cantenna."

C2	1.5-7.0-pF glass, piston-type variable capacitor
C3	.01-uF disk ceramic capacitor
R4	1000-Ohm miniature micro-potentiometer, Bourns trimpot 120-14-E1000
R5	1200-Ohm, ¼-Watt resistor, 10% tolerance
C4	4.7-pF disk ceramic capacitor

Table 1. The additional components included in Fig. 2.

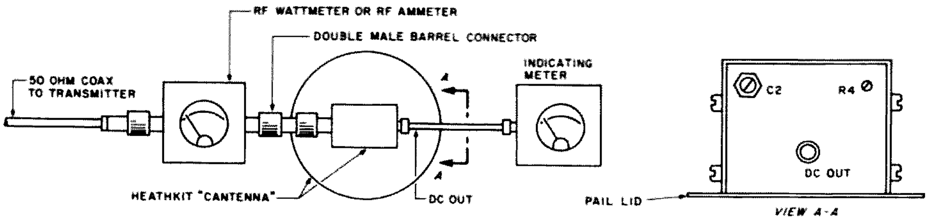


Fig. 3. Setup for frequency-compensation adjustment.

rectly connected to the DC OUT jack of the Heathkit® dummy load.

An indicator that will show the amount of power applied to the dummy load is necessary for proper adjustment of the frequency-compensating network. Either an ammeter or a wattmeter of known accuracy may be employed. The setup for frequency adjustment for proper compensation is shown in Fig. 3.

The adjustment procedure is as follows:

1. Set C2 at minimum capacity and set R4 at maximum resistance.

2. Set the transmitter on 3.5 MHz. Gradually increase the power level until the ammeter reads two Amperes or the wattmeter reads 200 Watts. Decrease the resistance of R4 until the indicating meter reads full scale.

3. Set the transmitter on 29.7 MHz. Gradually increase the power level until the ammeter reads two Amperes or the wattmeter reads 200 Watts. Note that the indicating meter will read full scale before the ammeter reads two Amperes or the wattmeter reads 200 Watts. Reduce the reading of the indicating meter by increasing the capacity of C2 until the indicating meter reads full scale when either the ammeter reads two Amperes or the wattmeter reads 200 Watts.

4. Repeat steps 2 and 3 in sequence until the indicating meter reads full scale when the ammeter reads two Amperes or the wattmeter reads 200 Watts, whether the applied frequency is 3.5 MHz or 29.7 MHz.

If a wattmeter was employed in the adjustment setup, the indicating meter may be directly calibrated from the wattmeter readings.

If an ammeter was employed in the adjustment setup, the Watts corresponding to the ammeter reading are shown in Table 2, and the indicating meter may be calibrated from this data.■

Ammeter Reading, Amperes	Indicating Meter, Watts
.4472	10
.6325	20
.7746	30
.8944	40
1.0000	50
1.0955	60
1.1832	70
1.2649	80
1.3416	90
1.4142	100
1.4832	110
1.5492	120
1.6125	130
1.6733	140
1.7320	150
1.7889	160
1.8439	170
1.8974	180
1.9494	190
2.0000	200

Table 2.

Harry W. Pardue AA4AG/DA1KV
PSC Box 1674
APO NY 09123

The 80 Meter Coax L

—compact design really works

There have been many articles written about do-it-yourself antennas for just about every purpose imaginable—multi-band, longwires, verticals, big ones, small ones, and on and on, but all of these antenna articles have this in common: You must have certain hardware items available and some electronics expertise to put them together. The antenna I am about to describe to you is simple, small (for cramped spaces), and very efficient. The best part about this antenna is the fact that all you need to build it is some solder, a soldering iron, #14 copper wire, some common hand tools, and a roll of coaxial cable.

I am not an electronics engineer by any stretch of the imagination and I don't fully understand how this antenna works, but I can honestly say that it does work and works very well. I am presently in West Germany with the US Air Force, and I have worked stations all along the east coast and in central USA, and, of course, all around Europe. I received consistent 5/6 and 5/7 reports from all contacts.

Construction and initial testing were conducted while I was stationed in Oklahoma, knowing that when I arrived in Germany, with its narrow, crowded streets and houses touching each other, I would not be able to put up a full-sized 80 meter dipole. This antenna is basically a quarter-wave shorted stub of RG-58 (or other common coax) fed out of phase against earth ground with the outer braid of the coax acting as the radiating portion of the antenna. Better results can be obtained by using a counterpoise or a radial system consisting of one or more radials laid along the ground. If a matchbox is available, this antenna, as described, will work well on 80 and 40 meters without pruning the antenna. It also can be used on other bands by making the length of the coax ¼ wavelength for the band desired. If no matchbox is available, quite a bit of cut-and-try work is required. However, when you reach optimum resonance using this method, the antenna will show an swr of about 1:1 across the entire 80 meter band from 3500 to 4000 kHz.

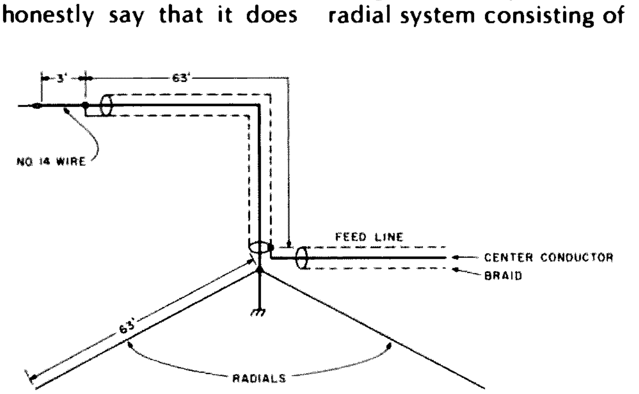


Fig. 1. The 80 meter coax inverted L.

Well, so much for the background history and specifications, and on to the construction and ways to get it in the air.

Construction is started by simply cutting a quarter wavelength of coax (approximately 63 feet) and stripping one end back one inch. Short the braid and center conductor together, attach a three-foot piece of copper wire (#14) to the braid and center conductor connection, and solder. The #14 wire will be used to tune the antenna. Strip the other end of the coax back one inch also and maintain the separation between the braid and center conductor.

When you reach this point, it is time to prepare the feedline. The length of the feedline is not critical and can be made to meet individual requirements. Strip the feedline (opposite the transmitter connector) back one inch and maintain the separation between the center conductor and braid.

Now it's time to connect the feedline to the antenna. This is achieved by connecting the braid of the feedline to the center conductor of the antenna and the center conductor of the feedline to the braid of the antenna. Next, drive a ground rod into good old Mother Earth and attach 1 or 2 radials (¼ wavelength of #14 copper wire each) to the ground rod, leaving the remaining portion of each radial stretched out across the ground. Now, connect the feedline braid and antenna center conductor to the grounding system and solder and tape all connections. The antenna itself can be erected in many ways, depending on available space, as depicted in the illustrations. Select the method that best suits your individual requirements and erect the antenna. It should be noted that the vertical and horizontal distances are not critical, but the connection between the feedline and antenna always should be kept at ground level. After

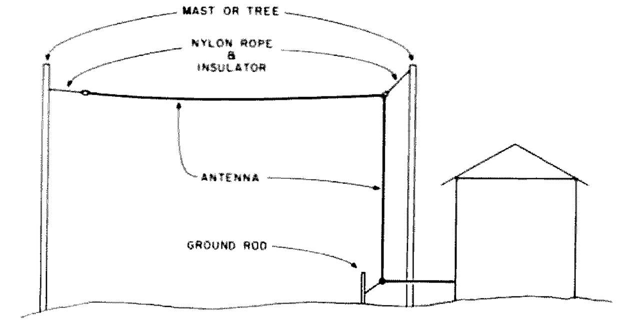


Fig. 2. Hanging method A—inverted L. This method requires only 33′ of yard space. The antenna is raised to a vertical height of 30′, using a tree or mast to secure the antenna to, and then out horizontally a distance of 33′. This method also provides vertical and horizontal polarization.

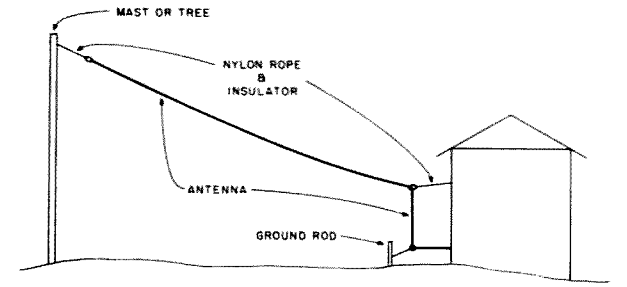


Fig. 3. Hanging method B—sloper. This method requires about 60′ of yard space, but can be used if a tree or mast near the house cannot be utilized.

the antenna has been erected, connect the feedline to the transmitter through the swr bridge.

Start out testing the antenna with low power and remain on low power throughout the testing and tuning stage. You may start with an swr as high as 2.5:1, but don't despair. This is when the tuning starts. Tuning is accomplished by trimming the #14 wire at the end of the antenna. Cut a 6-inch piece of the #14 wire from the end of the antenna and then check the swr again. If the swr has dropped, but not enough, cut off another 6-inch piece of wire, check the swr again, and repeat this process until the swr is satisfactory. If you continue to trim the #14 wire to a point where there is no more wire to trim and the swr is still too high, you must start cutting off 6-inch pieces of the antenna itself. Be sure that the braid and center conductor of the antenna are reconnected each time this is done, before the swr check is made. If, on the other hand, the swr went up after the first piece of wire was cut off, you must add #14 wire to the end of the antenna in 6-inch pieces until the swr is satisfactory. A lot of time could be saved in this process if a friend could cut and prune the antenna while you remain in the shack to conduct the swr checks, shouting instructions to him.

As I said before, this antenna is very simple, small, and efficient, and an excellent one especially for the Novice because of the low cost and ease of construction. ■

OSCAR Orbits

Courtesy of AMSAT

The listed data tells you the time and place that OSCAR 7 and OSCAR 8 cross the equator in an ascending orbit for the first time each day. To calculate successive OSCAR 7 orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the day's first ascending (northbound) equatorial crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world from you, it will descend over you. To find the equatorial descending longitude, subtract 166° from the ascending longitude. To find the time OSCAR 7 passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR 7 when it is within 45 degrees of you. The easiest way to determine if OSCAR is above the horizon (and thus within range) at your location is to take a globe and draw a circle with a radius of 2450 miles (4000 kilometers) from your QTH. If OSCAR passes above that circle, you should be able to hear it. If it passes right overhead, you should hear it for about 24 minutes total. OSCAR 7 will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15° east or west of you, add another minute; at 30°, three minutes; at 45°, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

OSCAR 8 calculations are similar to those for OSCAR 7, with some important exceptions. Instead of making 13 orbits each day, OSCAR 8 makes 14 orbits during each 24-hour period. The orbital period of OSCAR 8 is therefore somewhat shorter: 103 minutes.

To calculate successive OSCAR 8 orbits, make a list of the first orbit number (from the OSCAR 8 chart) and the next thirteen orbits for that day. List the time of the first orbit. Each successive orbit is then 103 minutes later. The chart gives the longitude of the day's first ascending equatorial crossing. Add 26° for each succeeding orbit. To find the time OSCAR 8 passes the North Pole, add 26 minutes to the time it crosses the equator. OSCAR 8 will cross the imaginary San Francisco-to-Norfolk line about 11 minutes after crossing the equator. Mode A: 145.85-.95 MHz uplink, 29.4-29.50 MHz downlink, beacon at 29.40 MHz. Mode J: 145.90-146.00 MHz uplink, 435.20-435.10 MHz downlink, beacon on 435.090 MHz.

OSCAR 7 Orbital Information				OSCAR 8 Orbital Information			
Orbit	Data (Aug)	Time (GMT)	Longitude of Eq. Crossing °W	Orbit	Date (Aug)	Time (GMT)	Longitude of Eq. Crossing °W
21540X	1	0135:11	88.3	7161X	1	0142:37	71.1
21552	2	0034:31	73.1	7174Abn	2	0004:33	46.6
21565	3	0128:48	86.7	7188Abn	3	0009:43	47.9
21577	4	0028:08	71.6	7202Jbn	4	0014:53	49.2
21590	5	0122:25	85.2	7216Jbn	5	0020:03	50.5
21602qrp	6	0021:46	70.0	7230Abn	6	0025:13	51.8
21615	7	0116:03	83.6	7244Abn	7	0030:23	53.1
21627X	8	0015:23	68.4	7258X	8	0035:32	54.4
21640	9	0109:40	82.0	7272Abn	9	0040:42	55.7
21652	10	0009:00	66.9	7286Abn	10	0045:52	57.0
21665	11	0103:17	80.5	7300Jbn	11	0051:02	58.3
21677	12	0002:37	65.3	7314Jbn	12	0056:12	59.6
21690qrp	13	0056:54	78.9	7328Abn	13	0101:22	61.0
21703	14	0151:11	92.5	7342Abn	14	0106:31	62.3
21715X	15	0050:31	77.4	7356X	15	0111:41	63.6
21728	16	0144:48	91.0	7370Abn	16	0116:51	64.9
21740	17	0044:09	75.8	7384Abn	17	0122:01	66.2
21753	18	0138:26	89.4	7398Jbn	18	0127:11	67.5
21765	19	0037:46	74.2	7412Jbn	19	0132:20	68.8
21778qrp	20	0132:03	87.8	7426Abn	20	0137:30	70.1
21790	21	0031:23	72.7	7440Abn	21	0142:40	71.4
21803X	22	0125:40	86.3	7453X	22	0004:36	46.9
21815	23	0025:00	71.1	7467Abn	23	0009:45	48.2
21828	24	0119:17	84.7	7481Abn	24	0014:55	49.5
21840	25	0018:37	69.6	7495Jbn	25	0020:05	50.8
21853	26	0112:54	83.2	7509Jbn	26	0025:14	52.1
21865qrp	27	0012:15	68.0	7523Abn	27	0030:24	53.4
21878	28	0106:32	81.6	7537Abn	28	0035:34	54.8
21890X	29	0005:52	66.5	7551X	29	0040:43	56.1
21903	30	0100:09	80.0	7565Abn	30	0045:53	57.4
21916	31	0154:26	93.6	7579Abn	31	0051:02	58.7

New Products

from page 24

order: (1) With too-high selectivity set in, the filter may "ring," so go easy and only use the degree of selectivity you need. Also, remember that it's hard to tune your receiver with 40-Hz bandwidth set in! (2) The auxiliary filter is wired in series with the main filter, so you have to remember to set it at minimum settings when it's not in use. (3) The filter can't completely overcome poor receiver i-f selectivity or overloading on strong signals. You may be able to minimize overload problems by turning off the agc and riding the rf gain control on your set.

All things considered, the filter is undoubtedly a good buy and has a number of very convenient features built in; I enjoyed reviewing and using it. Nevertheless, a few minor improvements could be made: (1) The power adapter furnished with my unit didn't enable the filter to develop quite enough audio. The instructions say that a full 18 volts at 300 mA is required for full two-Watt audio output. A huskier adapter would be useful. (2) The headphone jack could be transferred to the front panel, and a multiple-position speaker/phones selector switch added. (3) An "on-off" LED panel indicator would be a nice feature, as it's easy to forget to turn the filter off when not in use. (4) A schematic diagram, along with alignment instructions, should be provided for the day when maintenance may be required. (5) There is an audible click heard in the speaker whenever the unit is switched on and off. It's not loud enough to be objectionable, however.

At about $80 at this writing, the MFJ-752 filter packs in a lot of features at a modest price; for $20 less, the Model 751 is available (similar to the 752 but without the auxiliary filter, highpass function, bypass feature, and connections for a second receiver). I found the Signal Enhancer II to be a very competitive, seven-IC design that should be a handy accessory and worthwhile investment for the old-timer and beginner alike. For further information, contact *MFJ Enterprises, Inc., PO Box 494, Mississippi State MS 39762; (800)-647-1800.* Reader Service number M52.

Karl T. Thurber, Jr. W8FX/4
Ft. Walton Beach FL

AVANTI'S NEW MOBILE ANTENNA

Avanti Research and Development, Inc., has come up with a new concept in VHF mobile antennas, an antenna that mounts on glass in minutes without tools. No ground plane is required, and there are no holes to drill.

A low-profile, one-inch stainless steel mount holds the whip to the window by a new aerospace adhesive discovery that is 50 inch pounds stronger than a 1/4" × 20 metal bolt. It can be easily removed, though, according to instructions, and is guaranteed by Avanti to hold securely under even abnormal weather conditions and excessive vehicular vibrations.

There are no external electrical connections to corrode, as the coax cable and capacitor box are mounted inside the vehicle. The new AH 151.36 antenna has tested 1 dB stronger than conventional 5/8-wave trunk-mount antennas, according to the manufacturer. It is also claimed to have a more uniform omni pattern than "ground"-plane-type antennas.

Because this unique 1/2-wave design is mounted higher than a trunk-mounted 5/8-wave antenna, it offers a higher effective radiation point well above the roof of the vehicle for maximum performance in all applications. The capacitive coupler forms a highly tuned circuit between the antenna and the radio to assure maximum performance throughout the 2 meter band.

Its full half-wave design is said to provide a radiation pattern that is not directionally influenced by mounting location as are conventional 1/4-wave and 5/8-wave mobile antennas. Typical mounting of 1/4-wave and 5/8-wave ground-plane mobile antennas frequently blocks radiation patterns.

The stainless steel whip and hardware connect to a chrome-plated casting. The tough ABS capacitive coupling box houses a fine-tuning coil connected to the radio by a preassembled coaxial cable assembly. For further information, contact *Avanti Research and Development, Inc., 340 Stewart Avenue, Addison IL 60101; (312)-628-9350.* Reader Service number A93.

Ham Help

I have a Motorola UHF rig, model U44BBT-1000A which I plan to convert to 440 FM. I would like help in obtaining all schematics and information possible on the radio and its conversion. I also need wiring diagrams or schematics for the control head, which is missing.

Bob Lombardi WB4EHS
22246 SW 64 Way
Boca Raton FL 33433

LETTERS

from page 14

I recorded, on a standard tape cassette, much of their operation. I even caught one net when they switched to high-speed CW. The cassette, along with a detailed log, was sent to the ARRL "Intruder Watch." After a couple of months, with no reply, I sent a letter directly to Dick Baldwin asking if they had received the cassette. Again, no reply. Finally, after a few more months, I asked Harry Dannals to check on this. His verbal report was that they had received it, but apparently lost track of the cassette—they didn't know where it was! So much for "Intruder Watch."

Yes, 40 meters disturbs me, too, like 160 meters disturbs me. Yes, I know, the ARRL is the only "game in town." With all the money they have (our money), why can't they represent us *properly* in Washington and in Geneva? It is no wonder that not all hams are members of the ARRL.

An interesting sidelight: Many Long Island (this is Dannals country) hams, staunch defenders of the ARRL and loud detractors of Wayne Green, do not subscribe to *73* and don't read his editorials elsewhere! Guess who tells the radio clubs in the Hudson Division that Wayne is "lying"?

Thanks again for telling it like it is.

Byron H. Kretzman W2JTP
Huntington NY

DOUBLING

In the midst of the confusion generated here in JA/KA land by the FCC's new "system" of assigning amateur callsigns, a dim ray of hope came to me the other day. I'd like your opinion and the opinions of your readers on this.

What about doubling the number in the present KA callsigns in Japan? Instead of KA2RF, why not KA22RF? Instead of KA6OJ, why not KA66OJ? I'm not sure if the authorities here would go along with the idea, but it seems worth a try to me.

As I understand the system here, the FCC doesn't have to agree with such a change. They *don't* make our present callsign assignments.

Would such a change only cause more confusion? Would it make the KAs in Japan a unique, recognizable group again? Has anybody got a better idea? Let's hear from some of the former KAs who have operated from Japan. Let's hear from some of the new KAs in the States!

Ralph H. Fellows II
KA2RF/WB5FTV
Box 2785
APO San Francisco CA 96328

GFI'S

I enjoyed your June, 1979, issue of *73 Magazine*. Your article on page 138, "Protect Yourself with a GFI," is very true and something all of us should be aware of. I notice, however, that the price schedule on page 140 for the components and what it would take to build this apparatus does conflict quite a bit with available ready-made kits. For example, Hubbell Electric Company has a portable model GRP-115 available which has been on the market for some time. This unit sells complete for $53.60. Likewise, Slater Electric Company has a ground-fault interrupter ($30.60) with the entire component layout built into a receptacle which can be placed in a normal-sized 18-cubic-inch box. The two devices I am mentioning have a reset and test button already built into the receptacle, and, of course, do not need a 6 x 9 box with handles to enclose same.

Such devices have been required in any new construction since January 1, 1975. In other words, thousands and thousands have been produced and installed with very few problems. This could very well be the basis for a future article for your magazine.

Carroll T. Overton, Jr. WD4FZG
Goldsboro NC

CODE FOREVER

I have listened to your voice so much on the *73* Novice code study tape that I feel like I know you. I hope to finish up the Novice test next week and take the General in the next 30 days or so. Please let me thank you for the outstanding study material.

The letter from Jack McCord KA4EXD published in the May, 1979, issue of *73* was most interesting—made me stop and think a little. Here I am at age 42 working on a Novice ham license, looking forward to all of the possible new contacts and friends out there, and wondering why someone of Mr. McCord's radio experience and background would even think thoughts like that, much less write them!

I have sat by the radio for many years just listening, and now I sincerely have to search my soul to try and find just why I never realized what a truly wonderful hobby media amateur radio is. I could kick myself for never taking the trouble to sit down and learn the code that bonds all radio amateurs into a group that is like no other. I hope the code requirement is there always.

During the past few weeks, my understanding of the radio service, the amateur who does the talking or communicating, and the fraternity that this relationship and association really is has been increased with each dah and dit that has entered *my* mind. And believe me, it hasn't been easy. That has probably made it even more worthwhile!

Certainly ham radio has the rag chewers, the QSL collectors, the weather askers, and the guys who do all of the other things that Mr. McCord wrote about. It is a hobby, not a profession, and it is to be enjoyed. With all of the many hams out there, somewhere there is a person who enjoys the same thing you do. This is the reward of ham radio—trying to find this person—and making many, many contacts and friends along the way. I am really looking forward to it! I am just sorry I waited so long to get started.

Since Mr. McCord is a locomotive engineer, maybe his feelings have something to do with going down the same old tracks, in the same old trains, pulling the same old cars, never looking at the different people he is passing on his ride through life. The day will come when he will realize that he is wrong, and if not, I feel sorry for him

Again, thanks very much for your excellent publication and study materials. Although I purchased the ARRL package, too, I found your material and tapes much more valuable with regard to the tests. I am planning to press on for the General, Advanced, and Extra as my knowledge and understanding increase. I will be using your materials to get me there.

I am a Captain with National Airlines, flying the Boeing 727 on routes all over the country. Should you ever fly National, please check "up front" to see if I am there. I would enjoy talking with you.

William D. Mauldin
Boca Raton FL

THE WOODPECKER

I wanted to write you about the letter in May's *73 Magazine* concerning the Russian "woodpecker." I tried the recommended procedure from the shack at the store, and it worked. It may have been coincidence, but soon after I began to send dits in time with the clicks, the interference stopped. Even if it was coincidence (both times), it made me feel better! I hope it is really working, for that damn noise has helped me lose more DX than just about anything. The gentlemen from the West Coast DX Association are to be applauded. Now the Russians are probably hot on UFO chasing, with the recent glitches in their little radar. Brilliant!

One other thing, Wayne. Don't be too hard on those people who are loyal fans of yours. I understand your position on wanting people to agree with you with their brains and not their guts, but you are a public figure—in the public eye. To many, you are bigger than life whether you like it or not. Their gut reactions begin in their brains, for their brains filter your words down to the level of emotion. This is basic human nature, and this is an emotional subject, unfortunately. I think you'd be surprised at how many friends you have that never speak up for themselves; they like to hear you speak for them. I think they would come through in a pinch, however, and their group should be cultivated. You have the rare talent of being controversial combined with the ability to make friends. Well, I don't want to get too far into this, for I don't want you to think I'm a sentimental clod. Just know that you have friends who are behind you.

Steve Baumrucker WD4MKQ
Chapel Hill NC

Thanks for the most kind letter. If you get any more data on the woodpecker, please pass it along!—Wayne.

VLF

I have just had the pleasure of reading Mr. Ralph W. Burhans' article on VLF reception, and would like to inform readers that they can obtain more information from the manual *Naval Shore Electronics Criteria, VLF, LF, and MF Communications Systems*, Navelex No. 0101,113 (Federal Stock No. 008-059-

00015-2, $3.50), available from the Superintendent of Documents, US Government Printing Office, Washington DC 20402.

Harry A. Weber
Chicago IL

IARL

Please count me in as a charter member of the new International Amateur Radio Lobby. I'll join as soon as you call for members! Whatever happens during WARC '79, we all need to be more prepared the next time around. The organization you outlined in the April, 1979, issue of *73* looks as close to ideal as possible. I hope you can get it all together by the end of the year.

In answer to your questions, ten dollars a year is more than fair. With the ARRL asking eighteen dollars a year, you could probably justify twelve to fifteen dollars a year.

Contests have a definite place in amateur radio—how about the special mode contests, i.e., computer CW, RTTY, SSTV, satellite, etc.? Your mentioned contest ideas are very good.

The "IARL" should be separate from *73 Magazine*. I say that because I hate to be forced into anything—the choice should be left to the individual. A package price for the two would be welcomed, I'm sure.

The officers of the organization should be elected by the rank and file members and they should hold a two-year term.

In summary, I think we need a strong lobby voice in Washington, and I have full faith that you can get the job done. Go to it!

Randall L. Rife KA4BAX
Clearwater FL

CANAM COUNCIL

The Canam (Canadian, American) Repeater Council was formed in 1973 on the initiative of the Brandon Amateur Radio Club.

The Council is made up of representatives from amateur radio clubs from Manitoba and North Dakota. It usually gets together twice a year and meets on the air in between. It was our opinion that some group should be formed to suggest frequencies for the use of repeaters on both sides of the border so they would not interfere with each other.

It was hoped that groups planning repeaters would contact the Council before they picked their frequencies to see that it was not likely to interfere with some other group.

We would like to see every club in Manitoba and North Dakota have a representative on the Council.

For further information, please contact: Bill Graham VE4QG, 16 Frontenac Crescent, Shilo, Manitoba, Canada R0K 2A0, or Ken Larsen K0PVG, R.R. #1, Devils Lake ND 58301.

Dave Snydal VE4XN
Secretary-Treasurer
Brandon Amateur Radio Club
Brandon, Manitoba

NO MORE NET

The Novice 15m WAS Net has been discontinued and a 40m version started. Check-in on 7.135 at 0800 UTC on Saturdays. KA8AKL is net control.

Rick Todd KA8AKL
Newbury OH

WARMED OVER?

The April issue of *73* contains comments by Wayne regarding the $100,000 fiasco by the ARRL last year. This is old, old news.

The fiasco was disclosed at the Pacific Division Convention at Reno last August as explanation for the large number of *Handbooks* donated for use as door prizes. I was the recipient of one.

I know Wayne laughs all the way to the bank with his ARRL "disclosures." We look to him to amuse us with new stories, not those that are warmed over.

Vince Salemme
Livermore CA

W2NSD/1
NEVER SAY DIE
editorial by Wayne Green

from page 7

During the much-too-brief planning sessions for the linear amplifier testimony, I tried hard to convince the ham manufacturers and Bob Booth to think along these lines, but there was no way to convince them. They knew that the Commission was dead wrong and they were determined to tell them that. The Commissioners did not want to hear this news, so it went in one ear and out the other.

If we want a Communicator Class license, we can have it. First, we have to find out what the problems are which are holding it up with the Commission . . . and there is no difficulty in getting this information. Next, we have to come up with some good solutions to these problems . . . solutions which will make it beneficial for the FCC to do what we want. If we provide enough benefits to the FCC and don't give them additional problems, we'll get everything we want. It's as simple as that. This is the way I organized the hearing in 1973—and it worked perfectly. It can work again.

BENEFITS

The key to any sales pitch, whether it be for subscriptions to a magazine, to advertisers, to sell a product, or to convince the FCC to act the way we want, lies in the simple concept of emphasizing the benefits and having a ready and simple answer to any objections. For instance, when our ad department talks with advertisers, we point out that our readers are spending an average of $500 each per year on ham gear according to our latest poll. If you work that out, it comes to roughly $3.75 million per month . . . and that comes to about $37.50 in return for every dollar spent in the magazine for advertising. That's one hell of an ad return, and it perhaps explains why *73* has more ads than any other ham magazine. Most advertisers are primarily interested in the bottom line . . . not in a bunch of talk about circulation (which can include thousands of libraries . . . which don't buy products).

With the drop in newcomers to amateur radio, it might be prudent for both the industry and the clubs to think seriously in terms of getting some action on a Communicator Class license . . . there are certainly a bunch of advantages for hams. We've seen what the sparse use of 220 MHz has done to us . . . first with CB trying to poach it and then with the maritime interests sneaking around in back of us and grabbing it via the WARC route. We desperately need new hams, and I think we've seen that the traditional way of getting them has not been working.

WARC

There has been nothing much new on the WARC front . . . still no reason for optimism. But once that is past . . . if we are reasonably intact . . . we will have to get started on a program of growth and modernization. I've written before on our need for a three-pronged approach to the situation . . . with a lobby in Washington to work on getting the rules we need through the FCC expeditiously . . . a national lobby to get news of amateur radio into the media and encourage the growth of the hobby . . . and an international lobby to get amateur radio into every one of the emerging nations and make them supportive of amateur radio at future international conferences.

Let me say this clearly: If the ARRL doesn't shape up and accept the responsibilities outlined above . . . I will do it. I prefer to do more fun things and develop computer software sales . . . perhaps DXpedition a bit, etc. From here on it is up to you . . . either you get the League to stop wasting your money or else I'll get something going to do the job they should be doing. Note that, ARRL directors.

If I do get something working along this line, it is going to cost a lot more than $18 per year and you are going to enthusiastically support it. But then, I will get the job done and not come up with an emerdement of obfuscation about why nothing happened.

APRIL WINNER

Philip S. Rand W1DBM ran away with April's $100 bonus check for his article "An 8-Element, Ail-Driven Vertical Beam." Remember, you can vote for your favorite article by using your Reader Service card ballot at the back of the magazine.

BRITISH HAMFEST

The RSGB was kind enough to arrange their yearly hamfest during my short visit to England in May, bless their hearts. My main purpose for the trip was to set up distribution of Instant Software in the UK and other European countries, but you can be sure that I didn't miss visiting the yearly hamfest.

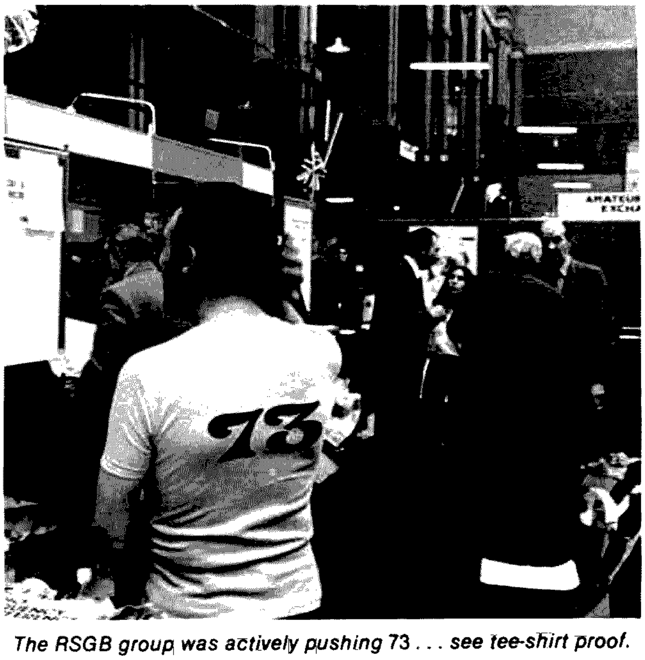
It was quite a way from the center of town. Sherry and I found it at the end of an Underground line . . . plus a bus trip . . . at the Alexandra Palace . . . a large building. My ego got a boost right away when I was recognized by some local *73* readers. That's fun.

I snapped a few pictures so

you could get an idea of the size of the hamfest. It was mostly involved with the selling of equipment and parts. They had dozens of booths selling zillions of radio parts.

This is a wide-angle view showing the center part of the exhibits floor. There is an antenna booth at the lower right and an enormous pile of used test equipment (much of it laboratory) in the center.

On each side of the main hall was a smaller section, again filled with booths selling used equipment and parts. It was perhaps 70% giant flea market in US terms.

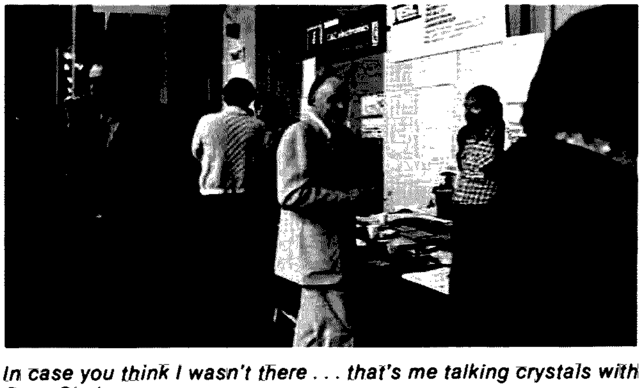


The RSGB group was actively pushing 73 . . . see tee-shirt proof.

This is the front of the palace. The exhibits hall ran the entire length of the building! You had to go way around to the side of the building to get in.

Most of the ham gear was pretty much what we have. It comes from Japan, just like ours.

This view may help give you an idea of the size of the place. This shows just the exhibits in the left-hand side of the main hall.



In case you think I wasn't there . . . that's me talking crystals with QuartSLab.

Microcomputer Interfacing

from page 26

wanted noise generated by the switching transients.

Analog switches may be used in almost any circuit that requires a voltage switch. Typical applications for analog switches include their use in D/A converters, programmable gain amplifiers, filters, and integrators. Our main interest in these switching devices centers around their use in analog multiplexers used to switch multiple signal inputs to a common point for amplification and digitization. The two types of switching devices that we shall consider are those without decoders and those with decoders.

Some analog switches, such as the Texas Instruments TL182C and the Analog Devices 7510, 7511, and 7512 devices, have control inputs for each individual switch. Pin configurations for these chips are shown in Fig. 2. This type of analog switch requires a separate logic signal to actuate each switch. These switches find use in applications where more than one switch is to be actuated at one time, or where individual switch control is needed.

Switches employed for analog signal multiplexing are generally more useful when they are equipped with built-in, or on-chip, decoder circuits. Such decoder circuits typically accept parallel binary TTL input and then actuate the correct switch that corresponds to the binary code applied. The binary code can only represent a single binary value at one time, so only one switch at a time is actuated. Block diagrams and truth tables for the Analog Devices 7506 and 7507 analog multiplexers are shown in Fig. 3.

When using analog multiplexers with on-chip decoders, it is still the user's responsibility to provide the correct code of the channel required. Many decoder chips also contain an enable input that permits multiplexer schemes to be expanded to include a larger number of selectable channels.

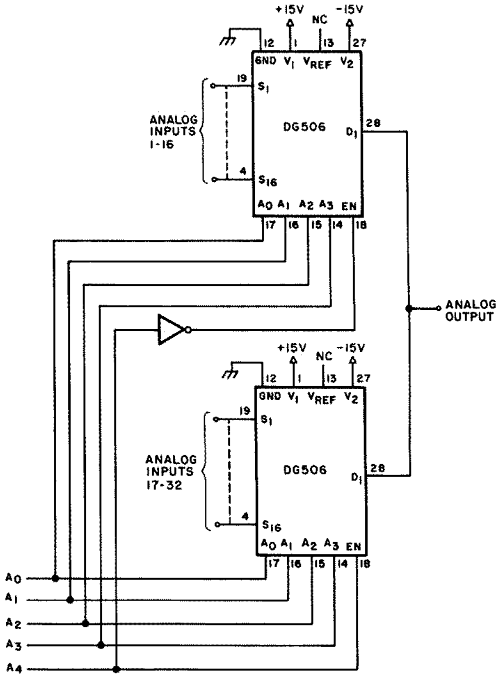


Fig. 4. Block diagram of a 32-channel analog multiplexer using 16-channel multiplexer chips.

A typical example is the 32-channel multiplexer circuit shown in Fig. 4. In this example, a Siliconix DG506 multiplexer is used. Note the use of the enable input at pin 18. This input allows us to switch between the two multiplexers by enabling one while disabling the other. With the aid of such an enable input and additional decoder circuits, such a multiplexer scheme can be expanded almost indefinitely.

Looking West

from page 12

the area. Paul said that with higher antennas, their distress beacon would have been more likely to be heard and rescue could have begun more quickly. It was very effective, since it emphasized in a direct way the sometimes life or death situations which occur and the value of our activities in dealing with them.

The Planning Commission voted to recommend to the Board an amendment excepting amateur antennas up to 100 feet in height from the minor use permit requirement. This was encouraging, but not entirely satisfactory. The Commission reasoned that a 100-foot threshold would exempt nearly all installations.

I did not mention the petitions to the Planning Commission. The Planning Commission is composed of citizens appointed by the Board of Supervisors. Petitions, it seemed to me, are most impressive to elected officials who run for office and who can be expected to be more sensitive to public opinion.

We were encouraged by the Planning Commission action. After all, for our purposes, 100 feet is more than twice as good as 50 feet. Since the Planning Commission action was unanimous and also supported, if somewhat belatedly, by the LUER staff, I was confident that the Board would approve at least 100 feet.

The Board of Supervisors hearing was set for April 29. An intensive effort was made to get a large turnout, since we felt that our turnout of a dozen or so at the Planning Commission hearing was definitely a helpful factor In obtaining the 100-foot recommendation.

About 30 hams appeared at the Board hearing on April 29. We found ourselves near the end of a long agenda. Arrangements had been made, as we had done at the Planning Commission hearing, to announce on the Otay repeater what time we would be heard so that all of us would be spared the ordeal of sitting there all day waiting. As it turned out, we sat there until after 4 pm when the Board realized that they would not get to us. The hearing was continued to May 16, with a promise that we would be heard early on.

We had decided, on the theory that there's no harm in asking, to take the approach that, while we definitely favored an amendment, we would be most in favor of a total exemption, being limited only by FCC rules which allow up to 200 feet in most areas.

We redoubled our efforts to obtain a large turnout, with hams even taking a day off from work to attend. Paul WA6GDC, a most talented artist, had come up with the great idea of inviting local hams to the "county's largest antenna-raising party, at their (Board of Supervisors) place." Paul drew this up and got it circulated and published in several newsletters and posted in all the local ham equipment outlets. This was another terrific example of the extraordinary creativity and willingness to work that many hams displayed.

Our efforts were rewarded by the appearance of about 60 hams at the hearing on May 16. This accounted for about 90% of the total attendance at the hearing, at which several other items were to be considered besides ours.

I had arranged for Bob WA6QQQ, who is a radio engineer and consultant to the broadcast and TV industry with top-notch credentials, to give a short technical presentation. He worked up a number of good points, but the Board indicated they didn't really want to hear the technical side of it. I thought this was a real shame, since he had done a lot of work preparing. His input was very valuable in helping me prepare my remarks, and so his effort was by no means lost, even though he didn't give his presentation.

Don WB6DPO, President of the El Cajon Amateur Radio Club, gave a brief but effective statement on behalf of that club's membership. The club's newsletter editor, Charlie WD6GVR, brought out, in a very impressive way, by asking a question, that the cost of a minor use permit was at least \$450—with no refund if denied. Jim Smith W6VCE gave a short talk emphasizing the value of our emergency services to the Weather Bureau, among others. His remarks drew brief applause.

Supervisor Lucille Moore's late husband was a ham, and she had a very good idea of what we were talking about. Supervisor Roger Hedgecock

surprised many of us by indicating that he felt local government would do well to avoid regulating amateur radio in a manner inconsistent with FCC rules, which, he said, "cover every detail."

Mrs. Moore initially moved acceptance of 100 feet. The vote was a 2 to 2 tie. After further discussion among the Board and several questions about FCC rules to the staff and to me, Mrs. Moore moved acceptance of an exemption of 200 feet. This time the vote was unanimously in favor. Sustained applause and cheering greeted the vote. We had won!

How had it happened? Primarily, I think, we learned that if we "circle the wagons" and all pull together, and if we prepare ourselves to sell our program in a positive, reasonable manner, our chances of success are considerably improved. Ham radio has an excellent record in most places and can be sold. By the way, it seems to me extremely important to preserve and guard this excellent record from being sullied by unfortunate and imprudent conduct.

In our case, three factors seem to account for the success of this effort. First, we had a fairly large turnout at the hearing. We would have been more secure had we had a large turnout at each hearing, but not everyone can arrange his affairs to attend. Hams have to work, travel, etc., just like anyone else. But it was definitely important that the Supervisors could look out into the audience and see that, if nothing else, their action was going to be witnessed by a roomful of voters who were concerned enough to come out and participate, who would probably remember this come the next election, and who were probably interested enough to tell their buddies how they were treated.

Second, the petition had a very important positive effect on the Supervisors. We didn't tell them how many signatures were gathered. I gave the petition to the Clerk of the Board without fanfare at the first hearing, which was continued. The Supervisors had the exact number of signatures at the time of the final hearing. *They* had had a count made by their staff, and when I mentioned the petition, they indicated that they had definitely reacted to it.

Third, we tried to present our arguments in a positive, rational way. This was in contrast to a group which appeared on another matter prior to ours. The thrust of their argument was negative. They eventually berated the Supervisors for passing such "stupid laws and for being such stupid jerks" who couldn't see the justice of the change the group sought. Needless to say, this was very poorly received. They went home empty-handed.

We tried to structure our presentation to emphasize the public interest, balancing the competing diverse interests in aesthetics versus the importance of reliable public service communications. The function of the Board, and any deliberative law-making body, is to balance these competing values, and this seemed to strike a responsive chord.

Special credit for this affair goes to SANDARC delegates and officers, SCM, W6INI, W6GIC, W6SLF, N6LY, W6QR, K6NA, W6US, K6KOI, WA6GDC, W6PDA, WB6DPO, WD6GVR, W6VCE, WA6QQQ, WA6HJJ, the officers of the several radio clubs in the county, and countless hams who pitched in and helped in many ways.

Who says you can't win at City Hall? We did!

•••••

There you have the story from someone who was a part of it. Looking West wishes to add its congratulations for the fine teamwork shown by the San Diego amateur community in stopping this ordinance from becoming a disaster for the Amateur Radio Service. Special thanks to Sybil Albright W6GIC for sending along Jim Allen's fine story.

TWO METERS AND THE GREAT BALLOON RACE

About ten years ago, the famed Fifth Dimension vocal group had a million-plus-selling record titled "Up, Up, and Away!" It was a dream song; it told of sailing freely through the air, free of the earthly bonds that shackle mankind to his oh-so-hum-drum existence. It was a song that any dreamer could relate to. It has stayed with me ever since . . .

There are balloons of one's dreams and then there are the real kind, the ones filled with helium or just hot air (no pun intended) that do indeed lift man from his earthly bonds. The fact is that ballooning is a very big hobby with many today and interest in it grows with each passing year. It was because of this interest that, in the year 1906, an expatriate US publisher named James Gordon Bennett lent his name in sponsorship to what came to be known as the Gordon Bennett International Cup Race. With the exception of the World War I years, the race continued uninterrupted until 1938. Poland won that one. However, then World War II intervened and a cloud of silence fell upon the event from 1939 to 1979.

Things might have stayed this way if not for the intervention of Dr. Tom Heinsheimer. Dr. Heinsheimer is not a ham; he is an aerospace scientist with a sincere love of ballooning, according to Nate Brightman K6OSC, who supplied much of the input for this story. It was because of the unyielding devotion of Dr. Heinsheimer that the year 1979 saw the revival of this event. Herein lies an amateur radio story to capture the imagination of any ham.

The "New Gordon Bennett Race" took a path from Long Beach, California, eastward to the "Duke City" of Albuquerque, New Mexico. It was expected that any balloon completing the race would be airborne for a minimum of 72 to 96 hours. Nobody could really be sure, since gas-filled balloons do not perform in the exact same manner as do other aircraft. You really can't steer a balloon. You can make it go up, you can make it come down, and that's about it. Once airborne, you are strictly at the mercy of Mother Nature herself. You go where the prevailing winds take you and the final outcome is anyone's guess. On the weekend of May 27th, some 18 gas-filled balloons took to the "wild blue yonder," scattered hither and yon as the winds carried them, in hopes of being the first to set down in the "Duke City."

Organizing a race such as this really presents quite a logistics problem, as you can well imagine. How do you keep track of eighteen free-flying balloons that might go anyplace? Enter amateur radio and an organization known as the Associated Radio Amateurs of Long Beach. Since the race was to begin in the parking lot for the *Queen Mary*, now permanently docked in Long Beach, California, harbor, using the newly-restored "wireless room" aboard the *Queen Mary* as a control point seemed to be the logical first step. The FAA must have thought this was a good idea since they declared the "wireless room" a temporary control tower for the duration of the race. The balloons

Thirty-five members of the Associated Radio Amateurs of Long Beach took part in communications handling for the Gordon Bennett International Balloon Race. The ARALB boasts a membership of 225. Photos by Nate Brightman K6OSC.

Ron Boan AK6Y, member of the ARALB, who set up the net with Arizona and New Mexico hams, is shown acting as net control. A minimum of 32 hams maintained a vigil on the net until released by Ron. Nate Brightman K6OSC, Projects Chairman for the ARALB, was Director of Communications for the balloon race.

After nightfall, Howard Brightman K6OSD followed his field operation with a night of monitoring phone calls from the balloon chase crews and the news media. Logging the most number of continuous hours, he slept with the phones and totaled 81 hours of operation. Behind Howard, a member of a chase crew club records reported balloon position. All field HT operators wore green ribbons on their right shoulders for easy identification.

As balloonist Ernest Iseln HB9BJ (one of two hams racing) looks up at his balloon, Howard Brightman K6OSD uses an HT to report progress to the command center in the Queen Mary *wireless room. The other ham racing, pilot of the Japanese balloon, was Saburo Ichiyoshi JR1IHI.*

were ordered to carry portable battery-powered VHF aircraft transceivers; however, there was no way to recharge batteries should they fail. Another sure-fire method to keep track of the balloonists was needed.

Since each balloon would have a chase car following it, it was decided that each car would be supplied with an amateur transceiver and a licensed amateur to operate it. To ensure ongoing communications, a two-meter interlink stretching from Los Angeles to Albuquerque by way of Kingman, Arizona, was established so that those serving as communicators would never be out of contact with the command center aboard the *Queen Mary.* Operators with hand-helds were also solicited and dispersed as lookouts from some of our "natural towers" that abound in the southwest. Under the guidance of the Associated Amateurs of Long Beach, a complete communications network was set up and checked out prior to the race. During the event, it performed flawlessly.

As the balloons took to the air, things reached a fever pitch on 146.52 and remained that way for close to three days. Even though .52 is a heavily used simplex channel around Los Angeles, virtually the entire amateur community stayed clear of the channel for the duration of the event, thus permitting an uninterrupted flow of information among those amateurs involved in the tracking operation. As an added measure of protection, a group known as the "Happy Flyers" was on standby alert should their services be needed. Operating under the direction of Squadron 5 Commander Lee Osborne WA6FSP, the Happy Flyers, who are a group of amateur radio operator pilots who normally involve themselves in search and rescue missions of downed aircraft, would take to the air to locate any balloon that might be lost from ground-level visual contact. Being amateurs themselves, the Happy Flyers could converse directly with both the command center and the ground units, thus eliminating the need for crossband relays. Luckily, nothing in the way of a true emergency occurred; however, for the first few hours of the race, an aircraft piloted by Commander Osborne was in the air to oversee things.

None of the balloons reached Albuquerque. One well-known balloon, the *Double Eagle II*, reached Las Vegas and under the rules was declared the winner. Others did not even get that far. Another US entry named the *Rosie O'Grady* touched down a few short hours later in the parking lot of the Jet Propulsion Laboratory in Pasadena, California, thus taking about five hours to make the trip from Long Beach that can be driven in 40 minutes. However, to balloonists, time has no relevance whatsoever; it's the freedom that counts. "To dance across a silver sky . . . to fly . . . free as a bird." To follow a dream—that's the real meaning. A US entry won this year's Gordon Bennett Race and next year the US will again host the event. Already the Associated Amateurs of Long Beach are planning for it. They did an excellent job this year and they intend to make next year even better.

220: THE WAR TO SAVE IT CONTINUES

The May 25th edition of *HR Report* contained a front-page statement that has angered many Southern California amateurs. It is *HR Report*'s claim that the "Fight to Save 220" campaign initiated by the 220-SMA of Southern California and taken up nationally by other groups is actually hurting the growth of 220. The story states that the current campaign is making people adopt a wait-and-see attitude and that this has stifled growth of the spectrum.

Rationale for this closing statement comes from *HR*'s belief that surface facts concerning the future of this spectrum point to the US position as being one of "bargaining" with 220 as nothing but another pawn in an overall chess game, that in the end, 220 will be safe and therefore this campaign is really not necessary. If only we could be sure that such was the case. However, the bureaucracy has sold amateur radio down the tubes so many times that in this case amateurs are totally convinced that their only defense is a strong offense, that once and for all it is time to put a stop to the "woodpecker effect" that has over the years eroded our spectrum. Every 220 operator I talk with, and that is a goodly number each week, is convinced that this is a fight to the death, that this is the one singular battle that will determine the destiny of all amateur spectrum. If inroads of any type are permitted to take place on 220, then no band is safe. Will 450 be next? Two meters or 20 meters perhaps? Regardless of what *HR Report*, the ARRL, or anyone else says, the battle will continue until such time as one side or the other has fallen. The objective is to once and for all make it clear that amateurs will not permit even the slightest bit of spectrum theft and will not tolerate further threats to 220 or any spectrum now assigned to the amateur service from any quarter.

220 operators from all over the nation have jumped onto the "Save 220" bandwagon, but, as of yet, only one magazine. Neither *QST* nor the ARRL proper has been heard from and everyone else seems to be waiting in the wings for something to happen. The 220 people I have spoken with have made it clear that with or without the blessing of the Newington hierarchy, they will continue. They never expected any real ARRL support from the outset and could care less if it does come. Even ARMA, which has a vested financial interest in this spectrum, has yet to come forth and say yea or nay. In the end, this has become a fight of the "people" against the "establishment," and the only support they have asked has been from one another. By far, the people of 220 are far more "together" than any other group I have ever had the opportunity to witness. Other amateur special interest groups can really take a lesson in strategy planning from them. They have, in effect, placed everything on the line in fighting to protect their spectrum and no veiled promises or threats will dissuade them. They could care less what the establishment thinks. They're out for only one goal—to win!

Along these lines, it was recognized that one of the most important aspects of any campaign is the ability to readily communicate. However, channelized relay operation does not readily lend itself to this without complex intertie systems. In seeking an alternative to this, 220-SMA Advisor Ray Von Neumann K6PUW and Henry Lachmiller WB6JLG hit upon a simple solution. Just as UHF remote bases have established 146.46 MHz as the National Remote Base Intertie Channel, why not have a similar gather-

ing spot for 220-MHz systems? Consultation between the 220-SMA and TASMA led to the establishment of 145.56 MHz as the "Regional 220 Intertie Channel" with recommendations from both groups that it be adopted nationally and be included in the overall national 2-meter bandplan. The concept here is to keep the people of 220 MHz in contact with one another without the need of synthesized radios or special equipment. Rather, each system provides a downlink to the common meeting ground of 145.56 MHz and conversation is automatic. In the few short weeks since the channel was announced, a goodly number of systems have initiated such operation and each week finds new ones. Ray has reported that Arizona may soon initiate a similar operation on 145.56 and hopes that it will eventually become a national 220-MHz intertie whereby information can be sent all over the place by relay from district to district. The ability to continually communicate is very important, more so now than ever before. VHF propagation tends to limit our communication ability. The 220 downlink concept is a step toward remedying this.

"AND THEN THERE IS 14.285 MHZ" DEPARTMENT

Another frequency to keep your ears on is 14.285 MHz on 20 meters. It seems to have become a very popular lowband intertie channel for VHF and UHF remote downlink HF operation and LW is getting quite a few reports of such operations. Actually there is no particular reason that 14.285 was chosen by the remote people. The story is simply that the first remote to install a 20-meter downlink radio just set it there and everyone else seems to have taken the same route. There is no way to know how many remotes downlink to 14.285; however, the number is growing rapidly. While it's doubtful that many systems will go to the trouble of installing a 20-meter SSB radio and antenna at their site, the fact is that a number have and users report it to be one heck of a way to operate HF while eating dinner at the local diner or driving home on a crowded freeway. A number of remotes are reported to have all-band/all-mode HF capability which includes remotely tunable receivers and remotely rotatable beam antennas. Squelch tales and "PL" on 20 meters? What next!?

Awards

from page 28

band, mode, or time restrictions. General certification rules apply.

ZONE 3 AWARD

This award is offered in four (4) levels of operating achievement:

1. Basic Zone 3 Award. This award is issued to those stations submitting written evidence of having worked an amateur in each state and Canadian province in Zone 3. These geographical limits would include Arizona, Oregon, California, Nevada, Utah, Washington, and the province of British Columbia. Contacts may be made in any amateur band and mode and must have been made on or after January 1, 1946.

2. Master Zone 3 Award. Applicant must follow the same rules as stated for the Basic Award with the exception that all contacts must be made with a station located in the capital city of each state and province in Zone 3.

3. Special Zone 3 Award. This special award recognition requires the applicant to work five (5) Zone 3 stations whose last call letters spell the word BEARS. All other rules for the Basic Zone 3 Award apply.

4. Extra Zone 3 Award. This award combines the difficulty of both the Master and Special Award and undoubtedly becomes the most sought-after in the Zone 3 program. To qualify, contacts must be made with stations located in capital cities of Zone 3 states and provinces. In addition, the last letters of their calls must spell the word BEARS.

All awards offered by the BEARS are available free of charge. Applicants must make a self-prepared list of required contacts, including the city and state of each amateur contact claimed, the date of each QSO, the band, and the mode. This list must be verified by at least two (2) amateurs, Technicians or above, an officer of an active radio club, or a notary public. In each case, the applicant must have written confirmations on hand for each contact claimed. Submit your award application to: The Boeing Employees' Amateur Radio Society, Willis Propst K7RS, 18415 38th Avenue, South Seattle WA 98188.

Representing the Finnish Amateur Radio League, Inc., our good friend Mervi Huotari, award manager for SRAL, writes to inform us about the beautiful OH series of awards being offered by this dedicated organization in northern Europe.

Mervi indicates that all applications must be forwarded to the attention of the SRAL Award Manager, PO Box 306, Helsinki 10, Finland, and suggests that QSL cards not be sent. Instead, Mervi states that all claimed contacts should be verified locally by two licensed amateurs, a club official, or a notary public.

To be valid, all contacts qualifying for the OH-series awards must have been made since June 10, 1947. The OH awards consist of the following:

OHA

1. Applicants in Denmark, Norway, and Sweden need contact with at least 50 different OH stations, including 8 OH call areas on one band, plus 8 different OH call areas together on other band(s).

2. Other European applicants need contact with at least 20 different OH stations, including at least 7 OH call areas. The maximum number of contacts per band is 15, so at least two different bands must be used.

3. Non-European applicants need contact with 15 different OH stations, including at least 5 OH call areas on any band or combination of bands. Contacts made on 3.5 MHz will count for two contact points each.

4. CW, phone, or mixed mode contacts count. The minimum acceptable reports are 338 RS(T). Contacts with Finnish maritime mobile stations do not count.

5. The award fee is 5 IRCs, to be sent with each application.

6. The OH8 stations with suffixes ND, NJ, NS, NV, NX, OA, OB, OC, OG, OI, ON, OP, OQ, OR, OU, OX, OZ, PA, PB, PD, PF, PL, PM, and PQ are counted as OH9 stations if contacted before June 1, 1954.

OHA-100

The applicant must have worked at least 100 different OH stations, including all 10 call areas on one band plus (again) all 10 OH call areas on another (one) band. The 100 stations must all be different, but in order to meet the call area requirement, the same station may be worked on different bands; in this case, the total number of contacts will be over 100. All authorized bands may be used, as well as CW, phone, or both.

The application list must be in district and alphabetical order (only callsigns and dates), giving separate declaration of the required 2 x 10 call areas/bands.

See also paragraphs 4, 5, and 6 of OHA rules above.

OHA-300

The applicant must have worked and confirmed at least 300 different OH stations, including all 10 OH call areas separately on each of three bands, i.e., 3 x 10 OH districts. The 300 OH stations must be all different, but in order to meet the call-area/band requirement, the same OH station may be worked on different bands. In this case, the number of QSOs will exceed 300. All bands, CW, and/or phone may be used.

The application list must be in district and alphabetical order (only callsigns and dates), giving separate declaration of the required 3 x 10 districts/bands.

See also paragraphs 4, 5, and 6 of the OHA rules.

OHA-500

This award will be available to any foreign applicant for confirmed contact with 500 different OH stations, regardless of time, mode, or band used. For OH applicants, only contacts made since February 1, 1967, will count.

A list of the 500 OH QSL cards on hand must be submitted to the awards manager. As with all OH-series awards,

this list must be verified by at least two amateurs, a club official, or a notary public. The award manager reserves the right to call for any QSL to be submitted in support of any claim. This list must be written in alphabetical order by callsign, and no other details are necessary.

The OHA-500 is given to qualified applicants free of charge, compliments of SRAL.

From down under, the boys at the Wireless Institute of Australia were kind enough to forward the March, 1979, issue of their publication, *Amateur Radio Journal*. In that edition, WIA columnists presented the entire portfolio of WIA-sponsored achievement awards. We will review the well-known Worked All VK Call Areas Award (WAVKCA):

WAVKCA

Objects:

1. This award is offered by the WIA as tangible evidence of the proficiency of overseas amateurs in making contacts with the various call areas of the Commonwealth of Australia.

2. The award may be claimed by any amateur in the world who is a member of an affiliated society of the IARU, but no Australian amateur will be eligible.

Requirements:

1. A handsome certificate will be awarded to any applicant who makes contacts with Australian amateur stations in the areas shown in Table 1. A total of 22 contacts must be made.

Operation:

1. Contacts between overseas stations and Australian stations must have been made on or after January 1, 1946.

2. Contacts may be made using any authorized frequency band or type of emission permitted to Australian amateurs, but crossband contacts will not be allowed.

3. No contacts made with ship or aircraft stations in Australian territories will be eligible, but land-mobile or portable stations may be contacted provided the location at the time of contact is shown on the confirmation.

Verifications:

1. The applicant must submit proof in the form of QSL cards or another form of written evidence confirming two-way contacts have been made. Such verification must show the date and time of contact, call of the station worked, type of emission and frequency used, signal reports, and location (portable or land-mobile stations only) of the stations contacted.

2. If the applicant is a member of a society which has a reciprocal agreement with WIA to verify claimed contacts for its members, submit your QSLs to that society, being sure to enclose sufficient postage fees for their safe return.

Application:

1. Applicants should submit their certified list of contacts and/or list of contacts with QSL cards to the Federal Awards Manager, WIA, Postbox 150, Toorak, Victoria 3142, Australia. There is no fee for the award—it's compliments of WIA!

Join me next month as we span the globe in search of operating incentives such as those which appeared this issue. Should you learn of any operating awards in the meantime, why not share them with our many readers throughout the world? I'd be pleased to hear from those who read this column and would appreciate your comments both pro and con, any suggestions you might have, and most certainly any award input you might care to submit.

Territory	Call Area	QSLs required
Australian Antarctica Heard Island Macquarie Island	VKØ	1
Australian Capital Territory	VK1	1
Lord Howe Island State of New South Wales	VK2	3
State of Victoria	VK3	3
State of Queensland Thursday Island Willis Island	VK4	3
State of South Australia	VK5	3
State of Western Australia	VK6	3
Flinders Island King Island State of Tasmania	VK7	3
Northern Territory	VK8	1
Admiralty Islands Bougainville Island Christmas Island Cocos Islands Nauru New Guinea New Ireland Norfolk Island Papua Territory	VK9	1

Table 1. In areas above where more than one confirmation is required, contacts may be made with any or all of the territories grouped together. VK9: Where a territory is no longer under Australian jurisdiction, contacts up to the date of independence will be accepted.

Review

AMATEUR TELEVISION IN A NUTSHELL

Sooner or later every ham gets the urge to try something new and different. For some this means a better rig. The more adventuresome types may want to try a new mode. Fastscan television is one such opportunity. Activity starts at 432 MHz and is even found in the microwave bands. Until recently, there has been no universally good source of information for the beginner. This void is partially filled by the book, *Amateur Television in a Nutshell: Everything you need to know to build or operate your own ham TV station.*

The book was first published in early 1978 by Henry Ruh WB9WWM, the publisher of *A-5 Magazine*. Despite its 8½" x 11" cover size, there are only 60 pages of text, making it truly a "nutshell" of information; price is $5.00. The contents include a short theory section followed by chapters on receiver, transmitter, and antenna construction projects. A listing of ATV operators, several charts, and a few pages of advertisements comprise the rest of the book.

Since the world of video is new to most prospective ATVers, the author gives a rather detailed explanation of the TV signal and describes how a camera works. Once the basics are mastered, it is time to think about gear. Ruh lists specific recommendations about the individual units an ATV station will need. The prices are sure to have changed, but the model and manufacturer information is likely to be useful for a few more years.

Although the easiest way to get involved in ATV is by purchasing ready-made equipment, many hams find that the long-term attraction of fastscan operation is home-brewing. The projects discussed in the book are lifted from the pages of *A-5 Magazine*. They are written in a cookbook fashion with little attention given to the mysteries of UHF construction. Despite the frequent occurrence of pictorial aids, a number of the photographs and diagrams are of questionable value because of blurry or crude reproduction.

Prospective ATVers are likely to ask, "What can I do with my station once it is built?" *Amateur Television in a Nutshell* lacks any good answer. For amateurs new to UHF and video, the best source of information and help is probably an experienced ham, preferably living nearby. *Amateur Television in a Nutshell* is not a replacement for practical knowledge, nor is it likely to be a timeless reference of the subject. If you have a genuine interest in the subject but don't know how to get started, do yourself a favor and buy a copy of *Amateur Television in a Nutshell.*

Tim Daniel N8RK
c/o 73 Magazine

Ham Help

I have a Hallicrafters receiver, model S-40A, and I need alignment instructions and identification of the trimmer capacitors. I also have an Elmac Model A54H portable transmitter for which I need instructions for aligning the vfo and identification of the trimmer capacitors. I will be glad to pay a reasonable charge for copies and postage.

Benford Rhodes W4RKW
126 Elizabeth St.
Jacksonville NC 28540

I am doing experimental work in radio spectrum efficiency. I am in urgent need of a spectrum analyzer, which I cannot afford. I need an inexpensive method to adapt a B&K 10-MHz, dual-beam, triggered-sweep oscilloscope for my needs. I am especially interested in the region of 100 kHz ± 5 kHz.

Roy Hickman, Sr.
PO Box 572
Wauchula FL 33873

I need a schematic and/or manual for a Viking 122 vfo. I will pay for photocopying and shipping.

John Pape KA2FJA
72 Stelfox St.
Demarest NJ 07627

Contests

from page 18

formation plus 2 IRCs or one dollar. DX stations will qualify by working XJ3TBC on 2 different bands. Each day an appropriate prize will be given to the lucky Canadian or US amateur working XJ3TBC closest to a preselected time. Amateurs visiting the station are invited to and will receive a commemorative memento of their participation.

SARTG WORLDWIDE RTTY CONTEST
Contest Periods:
0000 to 0800 GMT
Saturday, August 18
1600 to 2400 GMT
Saturday, August 18
0800 to 1600 GMT
Sunday, August 19

The contest is sponsored by the Scandinavian Amateur Radio Teletype Group. Use all bands 80 through 10 meters on RTTY only. Operating classes include single-op, multi-operator/single-transmitter, and SWLs. The same station may be worked once on each band for QSO and multiplier credits. Only two-way RTTY QSOs will count.

EXCHANGE:

RST and QSO number.

POINTS:

QSO with your own country is 5 points, with other country in the same continent is 10 points, with other continent is 15 points. In USA, Canada, and Australia, each call area will be considered as a separate country. Use the DXCC list and each district in the three countries listed above for multipliers. Note: A contact with a station which would count as a multiplier must be found in at least 5 logs, or contest logs from the multiplier station must be received in order to be valid. Final score is the sum of QSO points times the sum of multipliers. SWLs use the same rules for

Continued on page 172

Results

1979 US SSTV CONTEST RESULTS

Once again, the annual SSTV Contest was a joyous success and all contestants reported having the times of their lives during this informal event. As you will recall, this US-sponsored SSTV contest is held during the second full weekend of each March.

The overall 1979 SSTV Contest winner was Roland Soucie N6WQ of Costa Mesa, California. As you can see in the contest tally, Roland's victory was practically a landslide—and he followed the correct (shorter contest times) rules which were published in 73 *Magazine*. Roland also took the awards for most countries worked and the most continents worked. Since John WB9OGS and Roland N6WQ tied for most states/provinces, both SSTVers will receive awards for their accomplishments.

Brooks W1JKF and Dave K4TWJ wish to thank everyone who participated in the SSTV Contest for making this event a tremendous success. We tried to expand this year's contest into a jointly-sponsored event which was announced in all the amateur magazines. Unfortunately, CQ published incorrect contest times while QST mentioned the contest somewhere in the back of an issue, under QCWA happenings or the like. I never found that announcement!

On-the-air contest monitoring which Brooks and I did indicated an extremely congenial spirit of competition and courtesy among all SSTVers. Many operators would actually wait in turn for QSOs to avoid possibly QRMing others.

Several SSTVers have recommended changes for next year's contest. These recommendations were acquired during the contest, via the Saturday SSTV Net, and via mail. The prime consideration involved making this contest an international affair. Before this plan can be adopted as a unanimous effort, we need opinions (and assistance!) from all SSTVers. If the contest is to be truly international, then prime time should also be available to our friends around the world. What operating schedules would you deem necessary? How should an awards and publicity program be implemented? Please contact W1JKF and K4TWJ with your opinion . . . soon! The Saturday SSTV Net is usually this activity's planning table. See you then?

Dave Ingram K4TWJ
Brooks Kendall W1JKF

	Total Credit	QSOs	States Provinces	Countries	Continents	Name
N6WQ	231	123	33	10	5	Roland
WB9OGS	159	86	33	5	3	John
WA3APB	159	69	25	9	4	Bill
WBØRYP	150	74	27	6	3	Carl
AF9K	146	75	26	6	3	Mel
W1WS	132	60	22	7	3	Connie
WD4DCW	129	54	19	2	1	Stan
W3CJI	129	52	22	8	3	Brownie
W2GND	121	51	25	6	3	Harry
W6WDL	111	74	27	5	1	Bob
W9ET	108	45	18	6	3	Jerry
K4FJK	101	52	24	3	2	Jerry
WB9UTM	100	48	27	4	1	Bob
K8EMI	96	36	20	5	3	Ed
XE1HT	76	32	14	3	3	Juanita
WAØLLQ	74	31	23	3	1	Jay
PA9DXY	66	20	11	4	3	Kees
K9TW	51	22	14	2	1	Tom
SWL				RYT	Netherlands	J.A. Vande

1979 SSTV CONTEST COMMENTS

"The SSTVers are a great bunch of hams who should be commended for their sportsmanship and courtesy during the contest."—K4FJK.

"Rig acted up once, but I gave it the old gravity test from 3 inches off the table and it straightened right up."—WA9LLQ.

"Great contest, but it needs a magazine sponsor."—W2GND.

"And one that can get information right and illustrate an interest in SSTV, like *73* continuously does. Right, Wayne?"—K4TWJ.

"Although I couldn't stay in the whole time, it was loads of fun."—K8EMI.

"Great—can't wait until next time."—WB9RYP.

"In our Dutch magazine, *Electron*, contest rules were not clear."—PAØDXY.

"Disappointing was working 2 DX stations in the same country."

"Mixed emotions was working 2 mobile SSB contacts and sending them video before finding out they did not operate SSTV. My average was five contacts an hour."—AFØK.

Results

RESULTS OF THE SCANDINAVIAN AMATEUR RADIO TELEPRINTER GROUP (SARTG) 8TH WORLDWIDE RTTY CONTEST, 1978

WORLD TOP SCORES

Single-Operator Top Five
Class A

I3FUE	298,540
IT9ZWS	247,845
K3KD	241,825
F9XY	240,800
HB9AVK	233,225

Multi-Operator Top Five
Class B

I5MYL	244,925
DL8TS	183,150
LZ2KRR	182,250
I1COB	153,655
G3UUP	152,800

Shortwave Listeners
Class C

F. Rossi	218,550
OK1-11857	209,700
B. Niendorf	206,640
G8CDW	72,600
K. Wustner	70,265

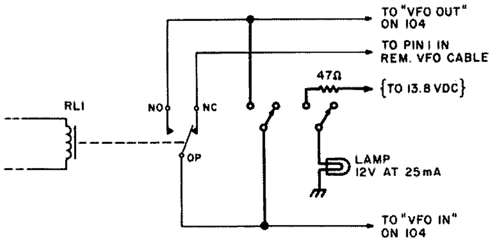
Corrections

After my article appeared in the April, 1979, issue of *73* ("The Heath/Kenwood Connection"), I found a small refinement which could be added to the project. Its total cost is small and it should take only a few minutes to install.

I realized that one could use some method of instantly bypassing the remote vfo aside from using the function switch on the remote vfo. For example, in case of some unexpected failure in which the remote vfo and its function switch are inoperative, it would be nice to immediately go to the rig's vfo. I have not had any such failure as yet, but anything can happen in electronics.

A side benefit was found when it was discovered that *both* vfos (internal and remote) could be used at the same time. This is very nice when one wants to find a clear spot to move to while still in contact. Also, one could monitor a sked or calling frequency while tuning around.

The only parts needed are a lamp, a resistor, and a switch. The lamp I used is a Radio Shack 12-volt/25-mA lamp with red lens and mounting clip. Since I felt it was a little too bright, I put a 47-Ohm, ¼-Watt resistor in series to prolong the bulb's life. (See Fig. 6.)



Revised Fig. 6, "The Heath/Kenwood Connection."

Why install a red lamp? It's okay to *listen* on two frequencies at the same time but not to *transmit* on two frequencies at the same time. In fact, I considered using a push-button switch which would then allow multi-frequency operation *only* whenever one makes the conscious effort of pressing the switch. I recommend giving serious thought to this alternative. If a toggle switch is installed, the bright red lamp may prevent giving an SSB CQ with the other vfo on the CW segment of the band!

The addition meant placing the interface box up front where it's more accessible and visible but I feel it's worth it.

Robert B. Lunsford, Jr. WB5QGI
Killeen TX

Social Events

Listings in this column are provided free of charge on a space-available basis. The following information should be included in every announcement: sponsor, event, date, time, place, city, state, admission charge (if any), features, talk-in frequencies, and the name of whom to contact for further information. Announcements must be received two months prior to the month in which the event takes place.

IRVING TX
AUG 3-5

Encounter '79, the Texas VHF-FM Society's 1979 Summer Convention, will be held August 3-5, 1979, at the Villa Inn, Irving, Texas. Activities include a transmitter hunt, flea market, FCC exams, manufacturers' exhibits, hospitality room, and several programs and forums. Talk-in on 146.52 and repeaters in the area. Registration at the door is $6.00. For further information, people may write to Encounter '79, PO Box 3608, Arlington TX 76010.

FLAGSTAFF AZ
AUG 3-5

The Amateur Radio Council of Arizona will hold its annual Ft. Tuthill Hamfest on August 3-5, 1979, at Flagstaff, Arizona. Prizes include TS-520 transceivers, a microwave oven, a Wilson Mark II HT, a Wilson System III triband antenna, and more. Featured will be a western barbecue, tech sessions, and exhibits. Camping facilities are also available. For further details or information, write Ft. Tuthill Hamfest, c/o 8520 E. Edwards Ave., Scottsdale AZ 85253.

LITTLE ROCK AR
AUG 4-5

The Central Arkansas Radio Emergency Net (CAREN) Amateur Radio Club will hold its second annual Ham-a-Rama on Saturday and Sunday, August 4-5, 1979, at the Arkansas State Fairgrounds, Little Rock, Arkansas. There will be two main prizes given, as well as door prizes. Featured will be forums, dealers' exhibits, a Saturday night party, and a large flea market. Talk-in on 146.34/.94. For details, send an SASE to Morris Middleton AD5M, 19 Elmherst Drive, Little Rock AR 72209.

JACKSONVILLE FL
AUG 4-5

The Jacksonville Hamfest Association is pleased to announce the 1979 Jacksonville Hamfest and ARRL North Florida Section Convention to be held on August 4-5, 1979, at the Jacksonville Beach Municipal Auditorium, Jacksonville, Florida. The location is just one block from the beach, where U.S. 90 meets the sea.

Advanced registrations are available at $3.00 per person from R. J. Cutting W2KGI/4, 303 10th St., Atlantic Beach, Florida 32233. Price at the door will be $3.50.

A large indoor swap area will be featured, with advance table reservations available for $5.00 per table per day from Robbie Roberts KH6FMD/W4, 10557 Atlantic Blvd., #31, Jacksonville, Florida 32211. Information on exhibitors' booths and space are available from the same address.

Other features and programs include statewide organization meetings on such topics as traffic nets and MARS, a microprocessor seminar, a solar power demonstration, a DX "pileup" contest, a hidden transmitter hunt, an OSCAR forum, ARRL forums, emergency preparedness programs, DX and contest presentations, antenna and technical seminars, and much more.

More general information may be obtained from JHA, 911 Rio St. Johns Dr., Jacksonville FL 32211.

LEVELLAND TX
AUG 5

The Hockley County Amateur Radio Club and the Northwest Texas Emergency Net will sponsor their 14th annual picnic and swapfest on Sunday, August 5, 1979, at the City Park, Levelland, Texas. A $2.00 registration is requested but not required. Registration begins at 8:00 am and lunch will begin at 12:30 pm with a bring-your-own-picnic-basket lunch. There will be swapping all day with tables provided. Talk-in on 146.28/.88.

GLENN MI
AUG 5

The Black River Amateur Radio Club will sponsor its 26th annual VHF Picnic and Swap 'n Shop on Sunday, August 5, 1979, at the Allegan County Park, Glenn, Michigan. Take Interstate 196 north of South Haven, Michigan, to the Glenn Exit. Door prizes will be awarded. Bring the family and a picnic basket (no lunch will be provided on the grounds) to enjoy the beach and playground. Talk-in on 147.90/.30 and 146.52. For information, contact Ed Alderman WB8BNN, RR#2, Box 98AA, Bangor MI 49013, or phone (616)-427-8830.

ANGOLA IN
AUG 5

The Steuben County Radio Amateurs will hold their annual F.M. Picnic and Hamfest on Sunday, August 5, 1979, at Crooked Lake, Angola, Indiana. There will be prizes, picnic-style barbecued chicken, inside tables for exhibitors and vendors, and overnight camping (fee charged by county park). Talk-in on 146.52 and 147.81/.21. Admission is $2.00.

SALEM OH
AUG 5

The second annual Salem Area Hamfest will be held on August 5, 1979, from 9:00 am to 3:00 pm at the Kent State Salem campus, Salem, Ohio. Tickets are $1.50 in advance and $2.00 at the door. Inside tables are $5.00 with space for your own table at $2.00. Flea market space is $1.00. There will be air-conditioning, a wheelchair ramp, free parking, refreshments, and prizes, consisting of an Atlas RX-110, TX-110, and a PS-110. Talk-in on 146.52. For details, write Harry Milhoan WA8FBS, 1128 West State, Salem OH 44460.

REND LAKE IL
AUG 5

The Shawnee Amateur Radio Association Hamfest will be held on August 5, 1979, at Rend Lake in southern Illinois. Complete camping and recreational facilities will be available, so plan to spend the weekend at the lake and attend the hamfest on Sunday. Family activities are planned. Hourly door prizes will be awarded. There will be no charge to vendors. For informa-

tion, contact WB9ELP or WB9SWG.

PITTSBURGH PA
AUG 5

The South Hills Brass Pounders and Modulators will hold its 42nd annual Pittsburgh Hamfest on August 5, 1979, from noon until dusk at the Allegheny County Community College south campus on Rte. 885, 2 miles south of the Allegheny County Airport and approximately 15 miles southeast of Pittsburgh, Pennsylvania. Advance registration is $1.50; $2.00 at the door. There will be a large indoor air-conditioned area for vendors and the flea market, and a large paved surface for the outdoor flea market. There will also be prizes and food. Talk-in on 146.13/.73 and .52/.52. For information and preregistration, write Bruce Banister, 5954 Leprechaun Dr., Bethel Park PA 15102.

MT SINAI LI NY
AUG 5

The Radio Central Amateur Radio Club will hold its "Ham-Central" on Sunday, August 5, 1979 (rain date is August 12, 1979), at the Mt. Sinai Elementary School, Rte. 25A, Mt. Sinai, Long Island, New York. Admission for sellers is $3.00 per tailgate space and $1.50 for buyers, with XYL and children under 12 free. Monies are to be used for Radio Central and the St. Charles Hospital Repeater. Doors will open at 7:00 am for sellers and 9:00 for others. They will close at 4:00 pm. Featured will be antenna advice with Art and Madeline Greenberg, a Novice table, great food, a CW contest, an ARRL table, a special event of a fly-in by the Suffolk County Police Dept. helicopter, and a Radio Central Club table. Talk-in on 146.52 WA2UEC and 144.71/145.31 K2VL. For information, call Joan Longtin at (516)-924-8438 or Robin Goodman at (516)-744-6260, or write Radio Central, "Ham-Central," PO Box 680, Miller Place NY 11764.

AMARILLO TX
AUG 10-12

The Panhandle Amateur Radio Club will hold its sixth annual Golden Spread Hamfest and Convention on Friday, Saturday, and Sunday, August 10-12, 1979, at The Inn of Amarillo, 601 Amarillo Blvd. West, Amarillo, Texas. The format consists of two full days of exhibits and trading, six technical sessions, programs for the ladies, valuable door prizes, Army and Navy MARS meetings, ARES meeting, an ARRL forum, and plenty of free parking. Displays may be set up any time after 1:00 pm on Friday, August 10th, at a fee of $20.00 per table. For information, write Hamfest, PO Box 10221, Amarillo TX 79106, or phone Jay Ledbetter WB5UBM at (806)-376-6042 (nights and weekends) or Chuck Passmore WB5BRC at (806)-372-1631.

MUNCIE IN
AUG 11

The Delaware Amateur Radio Association will hold its 2nd annual hamfest on Saturday, August 11, 1979, starting at 7:00 am, at Springwater Park, County Roads 300 E. and 100 N., Muncie, Indiana. Tickets are $1.50 in advance and $2.00 at the gate. Reserved table space is $1.00 per table with no extra charge for outside space. There will be hourly drawings from 9:00 am until 3:00 pm, with the grand prize of a Tempo SYNCOM S1 being drawn at 3:00 pm. Second prize will be a HAM III rotor. Talk-in on 146.25/.85 and 146.52/.52. For information or tickets, send money and an SASE to DARA, PO Box 3021, Muncie IN 47302.

WOODBRIDGE NJ
AUG 11

The DeVry Tech Amateur Radio Club will hold its third annual flea market on Saturday,

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Social Events

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August 11, 1979, in the rear parking lot at DeVry Technical Institute, 479 Green St., between Rte. 1 and Rte. 9, Woodbridge, New Jersey. Space is' $2.00, admission is free.

CHARLOTTE VT
AUG 11-12

The Burlington Amateur Radio Club will hold Its International Field Days on August 11-12, 1979, at the Old Lantern, Charlotte, Vermont. The outdoor flea market will be held on both Saturday and Sunday. Special features will include bingo and a model air show, plus many prizes. Camping will be available by reservation only; there will be no early birds. Admission is $3.00 both at the gate and in advance. For further information, write BARC, Box 312, Burlington VT 05402.

LEXINGTON KY
AUG 12

The Bluegrass Amateur Radio Club will host its annual ARRL Central Kentucky Bluegrass Hamfest on August 12, 1979, starting at 8:00 am at the Fasig-Tipton Sales Paddock, Newtown Pike, Lexington, Kentucky. Featured will be grand prizes, hourly door prizes, forums, indoor exhibits, distributors, and a paved outside flea market. Admission is $2.50 advance and $3.00 at the door, which includes parking. Food service will be available. Talk-in on 146.16/.76. For details, write Bluegrass Hamfest, Attn: Edward Bono WA4ONE, 2077 Dogwood Drive, Lexington KY 40504.

WILLOW SPRINGS IL
AUG 12

The Hamfesters Radio Club, Inc., will hold its 45th annual picnic and hamfest on Sunday, August 12, 1979, at Santa Fe Park, 91st and Wolf Rd., Willow Springs, Illinois, a suburb southwest of Chicago. This event will feature the famous swapper's row. Tickets are $2.00 at the gate or $1.50 in advance. For hamfest information and advance tickets, send check or money order (SASE appreciated) to Box 42792, Chicago IL 60642.

CEDARTOWN GA
AUG 12

The Cedar Valley Amateur Radio Club will hold its annual Cedar Valley Hamfest on August 12, 1979, from 8:00 am to 4:00 pm at the Polk County Fairgrounds, on US 278, two miles east of Cedartown, Georgia. There will be food, drinks, and prizes. Talk-in on 147.72/.12 (WR4AZU). For more information, please contact Jim T. Schliestett W4IMQ, Secretary, Cedar Valley ARC, PO Box 93, Cedartown GA 30125, or phone (404)-748-5968.

RIPLEY WV
AUG 12

A hamfest and flea market will be held on August 12, 1979, at Cedar Lakes Park, Ripley, West Virginia. Forums include Bob Halprin K1XA of the ARRL Communications Department. For advance flyer and general information, write Bob Morris WA8CTO, 628 Church Street South, Ripley WV 25271.

OKLAHOMA CITY OK
AUG 14-16

The "Private Satellite Seminar," sponsored by Bob Cooper, Jr., Editor-in-Chief of *CATJ Magazine* and host of the *Satellite Magazine* television program, will be held on August 14-16, 1979, at an educational institution in Oklahoma City, Oklahoma. Highlights will include a two-part seminar on the TD-2 conversion and a two-part seminar on the "Howard Terminal" (complete plans included in registration packet). Numerous manufacturers will be on hand to demonstrate their equipment and to investigate the "private TVRO market." Registration fee for the three-day event is $125. For full information, contact SPTS '79 at (405)-947-4717, or write SPTS '79, Suite 106, 4209 NW 23rd, Oklahoma City OK 73107.

OAKLAND NJ
AUG 18

The 550 Amateur Radio Club and Oakland Repeater, Inc., will hold its annual flea market on August 18, 1979, at the American Legion Hall, Oak Street, Oakland, New Jersey. Indoor tables are $5.00, and tailgating is $3.00. There is no admission fee for buyers. Refreshments will be available on the premises. Talk-in on 147.49/146.49 or 146.52. For information, call Bud Hauser WA2JUO at (201)-797-8471 or (201)-791-0589 for advance reservations and information.

TACOMA WA
AUG 18-19

The Radio Club of Tacoma (W7DK) will hold its annual Hamfair on Saturday and Sunday, August 18-19, 1979, starting at 9:00 am both days, at Camp Murray, about 10 miles south of Tacoma, Washington, on I-5. Featured will be prizes, seminars, contests, commercial exhibits, a food bar, a flea market, and a Saturday night banquet. Camping and trailer facilities will be available. Talk-in on .96/.36. For more information, contact Dave Ransier WB7SDB, 10315 63rd Ave. Ct. East, Puyallup WA 98371, or phone (206)-845-7800.

DECATUR AL
AUG 18-19

The North Alabama Ham Association will hold its annual hamfest on August 18-19, 1979, at the Calhoun Community College gym in Decatur, Alabama. Examinations will be administered by the FCC, door prizes will be given, and tickets may be purchased for other equipment drawings. Camping is available at nearby Point Mallard. Talk-in on 146.40/147.00, 146.34/.94, or .52/.52. For more information, write to the North Alabama Ham Association, Box 9, Decatur AL 35602.

PETOSKEY MI
AUG 18-19

The Straits Area Radio Club will hold its Swap 'n Shop and hamfest on August 18-19, 1979, at Petoskey Middle School, State and Howard Streets, across from the Catholic church and post office, Petoskey, Michigan. There will be a donation of $2.00 at the door. Table space is also $2.00. Refreshments will be available. There will be a swap and shop on Saturday from 9:00 am to 4:00 pm and on Sunday from 9:00 am to 12:00 pm. Prizes, a ladies' program, and seminars at 11:00 am and 2:00 pm on Saturday will be featured. A banquet at the Holiday Inn on Saturday at 7:00 pm will have Mellish Reef DXpeditioner Bob Walsh WA8MOA as guest speaker. Banquet tickets are $7.50 and are limited to 200, sold in advance only. For full information and lodging, send an SASE to Bill Moss WA8AXF, 715 Harvey Street, Petoskey MI 49770, or phone (616)-347-4734.

ABINGDON VA
AUG 18-19

The 3rd annual Bristol Hamfest will be held on Saturday, August 18, from 9:00 am to 5:00 pm, and on Sunday, August 19, 1979, from 9:00 am to 4:00 pm at the New Washington County Fairgrounds (behind the Rex shopping center), Rte. 11, Abingdon, Virginia. This will be an all-indoor event. Admission is $1.00 with an additional $2.00 for flea market space (bring your own tables). Additional prize tickets may also be purchased. Featured will be ladies' activities, children's games, and catered food. Prizes include a Ten-Tec Triton IV, with power supply, an electric toaster oven, and a Yaesu FT-202R hand-held, with accessories, plus various other smaller prizes. The main prize drawing will be held on Sunday afternoon at 3:00 pm. Talk-in on .01/.61 and .07/.67. For further information, please send an SASE to Lowry Rouse WD4ECF, 77 Bordwine Road, Bristol VA 24201, or phone (703)-669-3086.

MONTGOMERYVILLE PA
AUG 19

The Mid-Atlantic Amateur Radio Club will hold its annual J.B.M. Hamfest on August 19, 1979, from 9:00 am to 4:00 pm at the Budco 309 Twin Drive-In Theater at the end of 309 Expressway and Rt. 63, Montgomeryville, Pennsylvania. Doors will open at 8:00 am for setup. Admission is $2.50 with $1.00 additional for tailgating. Non-hams in the party are free. Food and beverage service will be available. Door prizes and a raffle for a major piece of equipment will enliven the festivities. Talk-in on 147.45, 146.52, and on the club repeater, WB3JOE, 147.66/.06. For further information, contact Gene Hoenig WB3FTJ, 717 Amherst Circle, Newtown Square PA 19073, or call (215)-221-3666 during business hours or (215)-353-3281 evenings or weekends.

WARREN OH
AUG 19

The Warren Amateur Radio Association, Inc., will hold its 22nd annual Warren Hamfest on Sunday, August 19, 1979, at the Kent State University Trumbull Campus, Warren, Ohio, located at the Intersection of Ohio Rte. 5 bypass and Ohio Rte. 45. Registration is $2.00 each, or 3 for $5.00, with children under 12 admitted free. There will be a giant flea market on the campus grounds, with the flea market opening at 6:00 am at $1.00 per space. Many dealer displays will be inside an air-conditioned building. Main prizes include a Ten-Tec 546, a Wilson System I, a Wilson Mark II, an Atlas transceiver, and many more. The main prize drawing will be at 4:00 pm. Winners need not be present. Mobile check-in on WR8ACX 146.97.

LAFAYETTE IN
AUG 19

The Tippecanoe Amateur Radio Association, Inc., will hold its Lafayette, Indiana, Hamfest on Sunday, August 19, 1979, at the Tippecanoe County 4-H Fairgrounds, on Indiana Highway #25, Lafayette, Indiana. Gates will open at 6:00 am. Advance tickets are available by

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Social Events

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mail at $2.00 per ticket. Send payment and an SASE by the 10th of August to Carl Vinyard KB9DV, 10012 SR 26 East, Lafayette IN 47905. Tickets are also available at the gate. Preregistration prize will be a Wilson Mark IV handie-talkie and charger; the grand prize is a Yaesu FT-227RA 2m mobile transceiver. Many other additional prizes will be awarded. There will be a flea market, forums, and refreshments available, plus camping on the grounds with limited hookups available Friday through Sunday nights only. A camping fee, in addition to a hamfest ticket, is required. Talk-in on 146.13/.73 and 146.52.

WRIGHTSTOWN NJ
AUG 19

The West Jersey Radio Amateurs, Inc., will hold its hamfest on August 19, 1979, from 10:00 am to 5:00 pm at McGuire Air Force Base, Wrightstown, New Jersey. Admission is $2.00 at the door and $1.50 in advance, with XYLs and children free. There will be an additional $2.00 admission for tailgate or table space (bring your own table). Featured will be refreshments, door prizes, and activities. Talk-in on 146.52 and 147.75/.15. Advance tickets may be purchased from club members or by sending an SASE to Sam Shontz WB2GEX, 107 Spruce Lane, Rte. 16, Mt. Holly NJ 08060. For information, call Larry Cohen WA2TRJ, at (609)-871-5852 or Mary Lou Shontz WB2QIU at (609)-267-3063.

BEAR DE
AUG 19

The fourth annual New Delmarva Hamfest will be held on Sunday, August 19, 1979, at Gloryland Park, Bear, Delaware. Donations will be $2.00 in advance, and $2.50 at the gate. Tables are available at $3.00 each. Tailgating will be $2.00 per space. There will be many prizes, and food and drinks will be available. Talk-in on .52/.52 and .13/.73. For tickets or information, send an SASE to Stephen Momot K3HBP, 14 Balsam Rd., Wilmington DE 19804. Make checks payable to Delmarva Hamfest, Inc.

HAMDEN CT
AUG 25

The WELI Amateur Radio Club will hold its 3rd annual flea market on August 25, 1979, at Radio Towers Park, Benham St., Hamden, Connecticut. Rain date will be September 1, 1979. Admission is $.50 with kids under 12 free. Dealer's fee is $5.00 at the gate and $4.00 for pre-registration. Food will be available. For information or pre-registration, write WELI Amateur Radio Club, PO Box 85, New Haven CT 06513.

MANSFIELD PA
AUG 25

The Tioga County Amateur Radio Club will hold its third annual hamfest on August 25, 1979, from 9:00 am to 5:00 pm at the Tioga County Fairgrounds, East of Mansfield, Pennsylvania, on Rte. 660, ½ mile off US Rte. 6. Admission is $1.00 per person, with children under 16 admitted free. Featured will be an open-air and under-cover flea market, dealers and traders, technical forums, ARRL news, FCC information, a slow scan demonstration by Fred WB2NAC, ladies' and harmonics' activities, a craft show, and RC models. There will be a raffle and door prize every hour. Bring your picnic lunch or visit the snack bar. Talk-in on 146.19/.79 WA3DPV/RPT, .52/.52, and CB channel 5. For information, contact Wells Farr WB3CUF, 101 Sherwood Street, Mansfield PA 16933, or Don Kimble AE3Z, Box 109, 210 Maple Street, Knoxville PA 16928.

ST. CHARLES IL
AUG 26

The Fox River Radio League will hold its hamfest on Sunday, August 26, 1979, at the Kane Co. Fairgrounds Exhibition Hall, St. Charles, Illinois. Tickets are $1.50 in advance and $2.00 at the gate. For information, contact Martin Schwamberger WB9TNQ, 1051 Northfield Drive, Aurora IL 60505.

LA PORTE IN
AUG 26

The annual La Porte County Hamfest will be held, rain or shine, on Sunday, August 26, 1979, at the County Fairgrounds, on Highway 2, west of La Porte, Indiana. There will be an outdoor paved flea market area and also plenty of indoor display spaces available at $1.00 each. There will be overnight trailer hookups for early birds. Advance tickets are $2.00 each. Send an SASE to PO Box 30, La Porte IN 46350.

WENTZVILLE MO
AUG 26

The St. Charles Amateur Radio Club, Inc., will hold Hamfest '79 on August 26, 1979, at the Wentzville Community Club, Wentzville, Missouri. Featured will be a flea market, a CW contest, free bingo, and many more activities for XYLs and harmonics. Admission is $1.00 per car. Talk-in on .34/.94 and .07/.67. For motel and camping information, prize lists, and dealer reservations, write SCARC, PO Box 1429, St. Charles MO 63301.

MARYSVILLE OH
AUG 26

The Union County Amateur Radio Club will hold its "Hamfest '79" (rain or shine) on Sunday, August 26, 1979, at the Union County Fairgrounds, Marysville, Ohio. Take Rte. 33 north from Columbus, exit at the second Marysville exit, and follow the signs to the Marysville Fairgrounds. Admission is $1.50 advance and $2.00 at the door. There will be food available on the grounds and free overnight camping on Saturday. There will also be a large flea market with no charge to the seller, only a gate pass will be needed. Inside tables will be available for dealers. Featured will be an ARRL forum, an AREC meeting, a MARS meeting, and more. Talk-in on 146.52 or 146.99/.39. For information or dealer space, write Chuck Simpson, 19726 Del Co. Line Rd., Marysville OH 43040, or phone (614)-666-2721.

WATERLOO IA
AUG 26

The Iowa 75-Meter Net Picnic will be held Sunday, August 26, 1979, at Hickory Hills Park, south of Waterloo, Iowa. The event will begin in the morning with a potluck meal at noon and a brief program in the afternoon with prizes, etc. For further information, write Lovelle J. Pedersen WB0JFF, 2327 W. Reinbeck, Hudson IA 50643.

Ham Help

I am blind and have been bedridden with spinal arthritis for nine years. All this time I have spent living in hospitals, from which I am writing to you now. I hope your readers can help me.

I would like some friends out there beyond my four walls to help me get a two-meter set, a handie-talkie, or perhaps a mobile, though I don't drive a car. I need some Morse code tapes, although I do know some characters already. I need to learn the radio theory on tape cassettes, also.

I became more interested in ham radio when I found myself in a county hospital and confined to bed without a phone in my room. On my Sony radio receiver, on 147 MHz, I accidentally picked up some hams, and I discovered that they were on repeaters and I could pick them up from fifty miles away in the San Fernando Valley. I heard other blind ham operators on the repeaters, also. And I wish I could talk to some of them. Some are very humorous and intelligent; others argue, but it's all interesting. I heard one or two young ladies, also. I know Phil, Scott "KMO," and Bob "HMC," but I can't talk to them. Darn it!

What is this synthesizer and simplex they talk about? I think it's pretty good for my indoor Sony radio to pick them up in this concrete and steel building, though I am six stories up in Torrance.

I need live visitors and those who will read for me since I am blind. My hospital desk phone is (213)-533-2783 (though I unhappily will go back to a nursing home). Please call and write me, hams, readers, and pen pals.

Dick Jastrow
Room 6, West Floor
Harbor General Hospital
1000 West Carson Street
Torrance CA 90509

First of all, I'd like to thank everyone who helped me out with information on the Knightkit R-100A receiver. I really appreciated it.

Next, I wonder if anyone could furnish me with a schematic for a Hallicrafters model CRX-102 VHF receiver. It's a transistorized receiver that covers 144 to 174 MHz. The chassis number is SN 1312449. Also, can anyone get me a schematic for an EICO 720 CW transmitter? Thanks.

John Vercellino WB9OVV
4636 Pershing
Downers Grove IL 60515

I would like to get in contact with a ham in the Santa Fe NM area, who could help me obtain my General ticket. I also am in desperate need of a manual, schematic, and alignment info for the following equipment: Hammarlund HQ-110 receiver, Motorola HT-220 hand-held transceiver, and a General Electric Royal Executive FM transceiver. Any help will be greatly appreciated. I will be more than happy to pay for copying costs and postage.

Mark A. Arnold
Rt. 1, Box 210X, Space 130
Santa Fe NM 87501

DX

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Watch 7007 and 21035 kHz from 2330Z.

6O1FG returned to Italy from Somalia on April 2 with far fewer contacts than were hoped for. The political situation is still not settled enough for good DXing. He would have liked to have spent more time operating, but conditions just were not favorable.

W2TDQ runs a twice weekly sked with SV9JI on Crete. Watch 14288 kHz on Tuesdays and Fridays from 2100Z.

JA7JT/JD1 left Ogasawara and set up shop on Marcus Island. He plans to stay through August when he will return to Ogasawara. QSL to JH7BRG.

N4WX kept the faith and finally came up with a ZD9BM QSL for a 1970 contact.

Jacky F6BBJ advises that he still has logs for his previous activity from St. Brandon VQ8CFB, Chagos VQ9SM, and Agalega 3B6CF, and can supply QSLs on request.

Before his untimely death last year, ZE7JX provided many stations with a new one on 160 meters. Steve Reichlyn AA4V has obtained those logs and QSL requests should be directed to Steve at Box 9096, Columbia SC 29290.

OZ8AE was active from Macquarie Island signing VK0JC just at the end of 1978. QSLs can be directed to OZ6MI but don't expect any return until OZ8AE makes it back to Denmark later this year.

In lieu of other routes, T2 stations can generally be QSLed via Weather Station, Funafuti, Tuvalu, Central Pacific.

For any of you adventuresome types looking around for somewhere new to vacation, W9KNI reports the following areas have been silent since at least January 1, 1975: BY, CE0X, VK0H, VU2L, XZ, YA, ZA, 3C0, 3X, and 7O. There have been rumors of 3X, YA, and 7O, but these have not been authenticated. Take your pick. Any one is guaranteed to draw a crowd.

P29JS checked into the possibility of obtaining Andaman operating permission while on a short trip to India. It seems licensing requirements have been relaxed somewhat, but he is still waiting for official word.

Ex-EP2VH, Vern Hardy, is back in Florida, but his logs covering two and a half years of activity in Iran, were confiscated. Vern is not sure if he will ever get them back.

The DXCC workload at the ARRL has increased tremendously with the large jump in the number of licensed amateurs in the last couple of years. The result will probably be, among other things, limiting submissions of new countries to only twice a year.

HC5EE passes along word that HC5RG was killed in a plane crash April 30th while searching for another downed aircraft.

CR9AJ is returning to Portugal where he will be signing CT1ADP. Torres has provided most of the CR9 activity the past couple of years and will be missed. His new address is PO Box 2676, Lisbon, 1100, Portugal.

S2BTF still shows regularly on the weekends on 14225 kHz after 1200Z.

Although the original intent was for DL8DC to handle the QSL chores for TY9ER, plans were changed and cards should be routed through W2TK. This decision was made so that some of the more obnoxious entries could be edited from the log. If your card came back marked "not in log," maybe a little self-examination of your DX operating habits is in order.

A51PN has been showing most Tuesday/Wednesday/Friday mornings after 1145Z on a 14265/14195 kHz split frequency operation. Listen on the long path and QSL direct.

KX6PP has been showing around 0830Z on 14252 kHz. QSL to 1406 34th Street West, Birmingham AL 35218, with the usual SASE.

ZD7HH needs Maine, Vermont, and Wyoming to complete his WAS. Look for him on 21291 kHz from 2100Z. QSL to W4FRU.

ZS2MI has been showing around 14240 most weekdays at 0630Z in a list-type operation. Look for WA2JUQ making the list. QSL to WA2IZN, 225 Route 17, Upper Saddle Brook NJ 07458.

Ex-EP2IA has returned to England where he now signs G3SXW. Roger has shipped his EP logs and a stack of blank cards to W4YE for processing. Any QSL requests should be directed there.

Someone at the FCC monitoring station in Anchorage apparently got hold of an outdated list of banned countries and issued pink slips to several rather startled DXers for contacts with HS stations in Thailand. The notices stated that contact with amateur stations in Thailand was forbidden and gave the offenders ten days to reply. A quick check with local FCC offices and the ARRL showed no change in HS status, much to the relief of the "guilty" parties. We wonder if the DXCC Desk would accept those pink slips in lieu of a QSL for HS credit.

Although the recent YV0AA activity should have slowed the Aves Island demand for awhile, it appears that there is a permanent population of scientific types on Aves and not one, but two, permanent amateur stations. It seems that YV5HAM and YV5HQE are both located on Aves Island and are used for handling traffic back to Venezuela. They do not sign with the standard YV0 prefix because they do not want to attract the unwanted attention of the DX types. If you habla espanol, you might listen for them daily below 14200 kHz.

With rumors abounding that a Swedish group had permission to operate in Albania, the sudden appearance of a station signing ZA5T and giving SM2DMU as his QSL manager, gave many the hope that finally here was a true-blue Tiranian. Unfortunately, it turned out to be Tirana Slim. Someday...

UK1PAA has been showing from Franz Joseph Land on a very limited operating schedule. The station is crystal-controlled on 14030 kHz and the time to listen is around 1400Z. Some reports also have him on fifteen meters around the same time on 21015. He seldom stays around for long, but he will apparently be there for some time.

Jacky F6BBJ, one of the operators on the Clipperton Island effort as well as several other expeditions, is planning a 3B6 St. Brandon operation in September. Jacky is a top operator and always manages to run up a large QSO total wherever he goes.

The KP4AM/D logs for the Desecheo operation arrived at the Northern California DX Foundation for QSL processing in late May. Although there were some 20,000 entries in the logs, all cards were in the mails before the end of June. If you haven't received yours as yet, it might be time to try again. The ARRL DXCC Desk announced they would begin accepting Desecheo QSLs September 1st... only for contacts made March 1, 1979, or later. That should clear up any questions concerning the earlier W0DX/D operation.

That TH8JM operation from the Central African Empire in May was apparently sans official permission, so there is some question concerning ARRL acceptance.

In response to our DX riddle in which three DXCC countries share the same prefix but are located within different continental boundaries, Charles Martin AB4I and John Reasoner WA4QMQ came up with VK0—Heard, VK0—Macquarie, and VK0—Australian Antarctic. Nice going, guys, but these are not the ones I had in mind. See what else you can come up with.

To improve our coverage of specific areas of DX interest, we are looking for a few reporters who would have time to send in a page or two each month covering happenings on their favorite band/mode of DXing. We need more information on OSCAR, SSTV, CW, Novice bands, 160 meters, VHF/UHF, channelized 10-meter AM, etc.

If you specialize in any of these areas and would like to have a monthly byline here in this column, write and let me know what your specialty is and we will try to assemble a top staff of super reporters.

That's all this month. Work a new one.

Thanks as always to the *West Coast DX Bulletin*, LIDXA *Bulletin*, and *Worldradio News*.

Contests

from page 141

scoring, but based on stations and messages copied.

ENTRIES:

Logs must be received by October 10 and must contain: band, date, time in GMT, callsign, exchanges, points, and multipliers. Use a separate sheet for each band and enclose a summary sheet showing the scoring, classification, callsign, name, and address, and in the case of multi-operator stations, the names and callsigns of all operators involved. Send logs to: SARTG, Contest & Award Manager, C. J. Jensen OZ2CJ, Meisnersgade 5, 8900 Randers, Denmark.

HELL DXPEDITION

W8TQE, the Adrian Amateur Radio Club, will give you a chance to work Hell, Michigan, between 1600 GMT August 25 and 1600 GMT August 26. The operating frequencies will be: CW—3710, 3565, 7110, 14065, 21110, 21065; SSB—3900, 7235, 14285, 21360, 28625. A colorful QSL certificate can be obtained by accompanying your QSL with a legal-size SASE and mailing it to: W8TQE, PO Box 111, Adrian MI 49221.

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7A	7	7	7	7	7A	14	14	14	14
ARGENTINA	21	14A	14	7A	7	7	14	21	21	21A	21A	21
AUSTRALIA	21A	14A	14	7B	7B	7	7	7	7	7	14	21
CANAL ZONE	21	14	14	7	7	7	14	14	14	21	21A	21A
ENGLAND	14	14	7	7	7	7A	14	14	21	21	14	14
HAWAII	21	14	14	7B	7	7	7	14B	14	14	21	21
INDIA	14	14	7B	7B	7B	7B	7A	14	14	14	14	14
JAPAN	14	14	14	7B	7B	7B	7B	7A	14B	14	14	14A
MEXICO	21	14	14	7	7	7	7	14	14	14	21	21
PHILIPPINES	14	14	14B	7B	7B	7B	7B	14B	14	14	14	14
PUERTO RICO	14	14	7	7	7	7	7A	14	14	14	14	14
SOUTH AFRICA	7B	7	7	7	7B	14	14	21	21A	21A	14	14
U. S. S. R.	7	7	7	7	7	7B	14	14	14	14A	14A	14
WEST COAST	21	14A	14	7	7	7	7	14	14	14	21	21

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7A	7	7	7	7	14	14	14	14
ARGENTINA	21	21	14	7A	7	7	14	14	21	21	21A	21A
AUSTRALIA	21A	21	14	14	7	7	7	7	7	7	14	21
CANAL ZONE	21A	21	14	7	7	7	7	14	14	21	21	21A
ENGLAND	14	7	7	7	7	7	14	14	14	14	21	14
HAWAII	21	21	14A	14	7	7	7	7	14	14	21	21
INDIA	14	14	14	7B	7B	7B	7B	7A	14	14	14	14
JAPAN	14A	14	14	7A	7B	7B	7B	7A	14B	14	14	14
MEXICO	14	14	7	7	7	7	7	7A	14	14	14	14
PHILIPPINES	14	14	14	14B	7B	7B	7B	14B	14	14	14	14
PUERTO RICO	21	14	7A	7	7	7	14	14	14	14	21	21
SOUTH AFRICA	7B	7	7	7	7B	7B	14	14	14	21	21	14
U. S. S. R.	7	7	7	7	7	7	7A	14	14	14	14A	14

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7A	7	7	7	7	14	14	14	14
ARGENTINA	21	21	14	14	7	7	7	14	21	21	21A	21A
AUSTRALIA	21A	21A	21A	14	14	14	7	7	7	7	14	21
CANAL ZONE	21A	21	14	7	7	7	7	14	14	21	21	21
ENGLAND	14	7	7	7	7	7	7	14	14	14	14A	14
HAWAII	21A	21A	21	14	14	7	7	7	14	14	21	21
INDIA	14	14	14	14	7B	7B	7B	7B	14	14	14	14
JAPAN	14A	14A	14	14	7	7	7	7	7A	14	14	14
MEXICO	14A	14	14	7	7	7	7	14	14	14	14A	21
PHILIPPINES	14A	14A	14	14	14	7B	7B	7	14	14	14	14
PUERTO RICO	21	14A	14	7	7	7	7	14	14	14A	21	21
SOUTH AFRICA	7B	7	7	7	7B	7B	7B	14	14	14	21	14
U. S. S. R.	7B	7	7	7	7	7	7B	14	14	14	14	14
EAST COAST	21	14A	14	7	7	7	7	14	14	14	21	21

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor
SF = Chance of solar flares

august

sun	mon	tue	wed	thu	fri	sat
			1 G	2 G	3 G	4 G
5 G	6 G	7 G	8 G	9 G	10 G	11 F
12 F	13 F/SF	14 F/SF	15 F/SF	16 F/SF	17 P/SF	18 P/SF
19 F	20 G	21 G	22 G	23 F	24 F/SF	25 F/SF
26 F	27 F	28 G	29 G	30 G	31 G	

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0 09

W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

10-GHZ RECORD EXTENDED

Not satisfied with holding the world's record for states worked on the amateur 10-GHz band (five), the record holders have been working to extend it to six ... perhaps seven. The sixth was worked, I'm glad to report.

It all started out last fall when Chuck Martin WA1KPS got interested in the Microwave Engineering Gunnplexers and got a pair of them perking. The first contact from New Hampshire to eastern Massachusetts was relatively easy. Oh, it took us about fifteen minutes to find each other while tuning one unit and sweeping the general direction of the hill a bit over 50 miles away. Eventually, we lucked onto both the right frequency and bearing and the contact was solid.

Later, Chuck made an expedition to a mountain in southern Maine, also well over 50 miles away. Again it took a lot of tuning and turning of the two transceivers before the contact was made. Both have to be on the right channel and pointed very close to the right direction. No dishes were involved at this time—just the Gunnplexers, with their little waveguide antennas.

Chuck then drove to Mt. Ascutney in Vermont, again over 50 miles from my mountain in southern New Hampshire, Pack Monadnock. It is no accident that I have a drive-up mountain within four miles of the *73* offices ... that's what attracted me to this area when I moved here, 17 years ago. I've been a VHF and UHF nut right from the earliest days of my hamming, starting out on 2½ meters, for those of you who remember that band. I ran a pair of 76s with their bases slotted for "efficiency" and was the terror of Troy (NY). That was before WWII ... forty years ago!

Next we needed to work New Hampshire, so Chuck drove to the top of Mt. Washington and we made it ... but that one was tough. We were both freezing in the cold winds, clouds were swirling around Washington, and the transceivers were not working well at all. In the light of later improvements, they had never been working more than marginally! But we did make it for an exchange of callsigns and signal reports ... whew! That was 106 miles, with faulty transceivers and no antennas to boost the signal.

It took two tries to get Rhode Island, and we had several frustrating failures with Connecticut. Just as Chuck had the transceivers working better and a two-foot dish ready to use, snow finally blanketed my mountain and that was that for the winter. When spring finally arrived, we tried to make it to Connecticut again, with Chuck even climbing trees to try and get the few extra feet of height needed. No go. Then we tried to make it through from the New York border ... again a failure. There was no strain when we tested the system out between the Pack and Mt. Greylock in western Massachusetts, but the path to New York was just not there.

Bigger problems call for sterner measures. The Pack is about 2,500 feet high and is usually excellent for VHF contests. It has the benefit of a toll road to the top ... the very top ... plus a fire lookout tower for a few added feet. About 12 miles away is Mt. Monadnock, a 3,500-foot lump whose top half is all rock. This mountain has a slight problem in that it is a 2½-mile hike to the top and the going is not easy. I'm almost 60 years old, my primary exercise is sitting at a typewriter all day, and I have no business climbing a 3,500-foot rock mountain. A few days of skiing during the winter helps a bit, but does in no way prepare one for hard mountain climbing.

Put into perspective, world records call for that extra effort, so I agreed to make the climb. That was not one of my better decisions. Chuck rounded up his team of Steve K1KEC and Eric WA1HON and headed for the best possible location in Connecticut ... near Somers. I rounded up our summer tech, Tim Daniel N8RK, and Sherry and we headed for Mt. Monadnock.

The first half was easy ... a dirt road. The second half was a pain. There was no scaling of rock faces—it was just a grueling climb up rocks for over a mile. It seemed to go on forever. We'd see what looked like the top just above us maybe 500 feet, but when we got there we would see another peak beyond that. Sherry, who is used to mountain climbing being like walking up Stone Mountain in Atlanta, said that this was between ten and a hundred times as difficult. Tim? At 17 years old, he went up like a mountain goat.

When I finally arrived, panting and a bit worse for wear at the top, I was greeted by a couple hams and a three-element six-meter beam! They'd packed 40 pounds apiece up there for some DXing on six meters, only to find a maximum of six contacts to be made. It was Sunday afternoon, with very little activity on six meters. There were a couple dozen hikers, all looking disgustingly fresh and rested.

Tim and I set up the 10-GHz rig and aimed it in the direction of Connecticut, coordinating the effort on 220-MHz simplex and, on occasion, on two-meter simplex. This was the easiest of them all ... contact was made almost immediately. Chuck's group was using a two-foot dish on top of a fire tower and we had the plain Gunnplexer, but mounted on a tripod this time for stability. The signal strength pin went right over full scale and then off scale! The voice was just like the other team was right with us. We did get some interference from the six-meter team breaking through on our

INFO.

Manuscripts

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link. RFI, even on top of Monadnock!

The climb down was not much easier than going up. It didn't take as much grunting and straining up through the rough places, but it took a lot of care and knee-shaking jumps to rocks. I was lame for several days afterward with knee-cap shock. The thought that Chuck and his group might want to do this all over again for another try for the New York-New Hampshire path went through my mind with each and every rock that I climbed down . . . all one damned mile and a quarter of them.

Fortunately, the day was reasonably cool . . . perhaps around 80° . . . and beautifully sunny. Visibility was only about 30 miles in the haze, but then it was a natural haze caused by the trees and not smog. There is never anything but clean air in New Hampshire.

The team down in Connecticut didn't have to cope with climbing a rock mountain, but they did have their problems. Being considerably south of us, they had much hotter weather and suffered greatly from sunstroke and heat prostration. Steve became completely prostrated in the back of their van when the time came to disassemble their setup and carry it down the tower. Oh, the agonies we have to go through to become world champeens.

BITING THE LIFERS

A recent letter from Chapman (ex-New England director) to ARRL life members on ARRL Foundation letterhead asked for donations to set up a $100,000 slush fund for HQ to spend at Geneva this year.

For some reason, nothing was mentioned of the $100,000 fund which has already been set up for just this type of use. I'm reminded of the League saving money for years to buy a new headquarters building . . . money taken from the members as dues . . . and then, when they finally had enough money, running a building fund and collecting the same money a second time. And to cap that, they sold their old building for almost the cost of the new building. That's mainly how they built up that $2 million-plus they have in securities and banks.

It seems to me that this begging for more money calls for some whistle-blowing. They seem to be trying to make up for the recent bad management of the League by asking for donations in the name of WARC.

The $100,000 is still carried on the balance sheet of the League in their latest annual report . . . it is for "the defense of amateur frequencies." That would seem to cover WARC like a glove. The fund was set up years ago and has been used for undisclosed purposes and then refunded by the League at the end of each year. It would seem that members of the League are entitled to a detailed accounting of the money spent from this fund down through the years. Any publicly held corporation would have to account to the shareholders for such a mysterious fund . . . particularly when there is a serious question about it being used for the personal benefit of League officials. IRS, please note.

I think I join many members in hoping that the League will be more prudent at Geneva this year. At the last WARC, they had a huge suite in one of the most expensive hotels in town and entertained lavishly. Throwing money around like that is the Ugly American way and we need friends, not resentful enemies.

To sum it up . . . the ARRL Foundation is in disgrace over the resignation of most of its directors . . . a fact which HQ has refused to discuss or even let members know about. They already have $100,000 in cash set aside for just such an event as WARC, so the begging for $100,000 more stinks. If you have money to pour down rat holes, I'm sure you can find better charities than this one.

ARRL PROBLEMS

I see that the ARRL's Central Division convention was a monumental flop . . . eight exhibitors and about 400 in attendance. The magic seems to have gone out of ARRL conventions, and the active hams are staying away in record numbers. Compare this to the Atlanta Hamfestival, where, in spite of the severe gasoline shortages, the attendance was only down a bit from last year and the exhibit hall was packed solid with exhibits and people. Compare it with the St. Louis hamfest, where a first-time show filled the exhibit hall and packed the hall with attendees.

What were the differences? One was a matter of promotion, where Atlanta and St. Louis got extensive promotion in both *73* and *MICROCOMPUTING* magazines . . . ads and editorial. Another difference was the speaker program, where one had no one of a controversial nature . . . not even of any significance . . . and the others had speakers who packed 'em in. I suspect that the day is past when you can pull in a good crowd at a hamfest just by listing it in *QST*.

OUTLAW RADIOS

A recent attempt to amend a New Jersey law which prohibits the use of radios in cars capable of receiving police channels so that it would exempt amateurs was vetoed by Governor Byrne. Someone should make it a point to acquaint the governor with the facts of radio life and the ridiculousness of the whole charade.

Maybe a few years ago something like this could be legislated, but with the modern scanners there is no way to keep anyone who wants to from receiving police channels. Like guns, the laws only have an effect on the honest person. Criminals carry guns and are quite capable of buying and using radios which will receive police channels . . . and how can a policeman know? With just about every other car sporting some sort of special antenna, a car can be set up for CB, for hamming, for any of a hundred special services . . . or to illegally receive police channels.

If the police are looking for just one more rap to lay on a criminal once he has been caught, the ramifications for hams and other honest users of radios are much too great a penalty to pay. Virtually every mobile ham rig for VHF is quite capable of being tuned to a police channel. The scanners, which are being sold by the tens of thousands, can get just about every police channel there is, high- or lowband . . . and they are 12-volt jobs, just fine for mobile use.

Will someone please bring Governor Byrne up out of the 1950s? And perhaps someone should alert the New Jersey legislature that making it illegal to have radios capable of receiving police channels in cars is not going to have any effect on criminals . . . it will only harass non-criminals.

SPREADING THE WORD

One of the jobs that I feel a national amateur radio organization should do is lobby for us on a national level. This means organizing campaigns which will get amateur radio favorably into the media . . . articles in national magazines . . . demonstrations which are covered by television . . . promotion of ham activities during emergencies, etc. In case there is any doubt, we are not getting such a service from *any* of our national amateur radio organizations.

Individual clubs, in a few instances, have been doing a fine job of getting publicity, but unless you are terribly isolated from the general public, you must be aware that most people have no idea of the difference between CB and ham radio. We do need PR and we need it badly

Continued on page 148

Looking West

Bill Pasternak WA6ITF
24854-C Newhall Ave.
Newhall CA 91321

The last time I went on a Field Day outing was in the early sixties. I was a member of an organization known as the Flatbush Radio Club of Brooklyn, New York, and we took to the hinterlands of New York City. The place was Prospect Park, which sits in the center of Brooklyn. OK... so it wasn't really the hinterlands. It was fun, but through the years the memories of that outing grew faint.

Since moving to California, the closest I have come to taking part in a Field Day outing was the time I went from club to club showing the PARC Field Day film, *Field Day 1972*. In the seven and one-half years I have been here, something has always come up to make me miss Field Day. One year I was out of town, another time I had to work... you know the story. Well, this year it all clicked. The San Fernando Valley Amateur Radio Club was holding its Field Day operation on a hill not twenty minutes from my house. I had film in my Polaroid in addition to 600 feet of Super 8 film. Most important, I had the time and the opportunity to attend. The lure was overwhelming...

If you have never experienced a real Field Day operation, you've missed something important. This is true gut-level amateur radio operation at its best. It's you the amateur versus the bands, the elements, and the odds. To me, the whole idea of Field Day is not whether I win or lose, but rather the camaraderie that is shown among amateurs during such an event. The San Fernando Valley Amateur Radio Club is an excellent example of such fellowship.

Let me tell you a bit about the SFVARC. It is a true amateur radio club with members whose interests go in many diverse directions. Unlike most clubs of this era, the SFVARC does not own or operate a repeater, nor does it ever plan to. In fact, a few years back I offered them such a device and it was rejected. It is not that SFVARC members don't like repeaters—far from it. Most of the members can be found operating the myriad of two-meter and 220-MHz systems that abound in this locality. However, to the SFVARC, a repeater is nothing but a way of extending the communications range; with over 300 operational 2-meter repeaters in southern California, there is no need for yet another. So, while most members do operate VHF or 2-meter FM, they do so using the existing relay facilities.

Rather than worry about running a repeater, the SFVARC looks in other directions. It does such things as provide communications for March of Dimes walk-a-thons and work with "Santa" at Christmas to help bring joy to children in hospitals. The best way to describe the SFVARC is to say that they epitomize the concept of an amateur radio club in the truest and broadest sense. Perhaps that is why Field Day with SFVARC was so much fun. There were about a dozen dedicated people from the club spending almost thirty-six hours on a remote California hilltop enjoying each other's company and their amateur radio hobby. They were fulfilling a dream that could only be fulfilled once a year. Being together enjoying the experience was the point of their hilltop excursion. I could only spend Sunday with them, but it was well worth it. My memories of the past were rekindled and somehow I felt more like a "real ham."

Ever wonder how a film is produced? Here's the secret... teamwork! (Photo by Bill Orenstein KH6IAF.)

A NEW MOVIE

Hollywood, which has brought you such epics as *The Poseidon Adventure, Two For the Seesaw, Charlie*, and other great moments in cinema, is now proud to announce another achievement. *The World of Amateur Radio* was produced by a man I consider to be a true cinema artist, Dave Bell W6AQ. I am writing this only an hour after leaving Dave's Hollywood studio. We just screened the first answer print of this new film and the consensus is that it is a superior work. With Dave Bell as the film's producer, the results were not surprising. In my opinion, he is a genius in his chosen profession. He knows his business, knows how to get a job done properly the first time out, and has the ability to lead others in the proper direction. Being able to work with someone like Dave has been a real honor and a truly rewarding experience.

The World of Amateur Radio is fast-paced, relevant, and covers most aspects of our amateur radio world. NBC-TV News correspondent Roy Neal K6DUE is the film's host and chief narrator. There are contributions from Senator Barry Goldwater K7UGA, Arthur Godfrey K4LIB, and Stu Gilliam WD6FBU, and special appearances by Dick Van Dyke and His Majesty King Hussein of Jordan JY1. The film was produced by Dave Bell Associates for the American Radio Relay League and it will soon be available from the ARRL. I am happy to say that this is one time when the League is truly serving the amateur community; it should be applauded for its fine work on our behalf. Through the cinematic expertise of Dave Bell, the ARRL is providing us with the type of visual vehicle we need in order to explain what amateur radio is all about. As this is written, the film print is en route to Geneva, Switzerland, to be presented to those who will be deciding our future—the delegates to the World Administrative Radio Conference.

The World of Amateur Radio is our world, and now, thanks to Dave Bell and the ARRL, we will be able to share it with virtually everyone. All who worked on the project sincerely hope that you will enjoy the film. I have one request: At present, only one print of the film exists, and that print is in Geneva. It will be a few weeks before distribution prints are available. Please do *not* contact Dave Bell Associates or the ARRL requesting the film. Instead, keep watching for ARRL official bulletins, *HR Report*, the Westlink Amateur Radio News, and this column. All these sources will let you know the moment the film is ready for release. While we wait, readers of this column may want to start recruiting non-amateur groups for introductory talks about amateur radio, using the film as the focal point of the meetings. While we amateurs will enjoy viewing it, it's far more important that the film be seen by the non-amateur general public. It is time for the rest of the world to discover us and our service capabilities. Therefore, it is extremely important that the film reach as wide an audience as possible. Public schools, public television, civic groups, and church groups can all be approached. This is where *you* come in. The film will do no good sitting on a shelf. To be effective, it must be seen. Any takers?

Continued on page 153

New OMNI/SERIES B Filters The Crowd

The new OMNI/SERIES B makes today's bands seem less crowded. By offering a new i-f selection that provides up to 16 poles of filtering for superior selectivity. And a new Notch Filter to remove QRM. No other amateur transceiver we know of out-performs it.

NEW I-F RESPONSE SELECTION. OMNI comes equipped with an excellent 8-pole 2.4 kHz crystal ladder i-f filter which is highly satisfactory in normal conditions. But when the going gets rough, the new OMNI/SERIES **B**, with optional filters installed, provides two additional special purpose i-f responses.

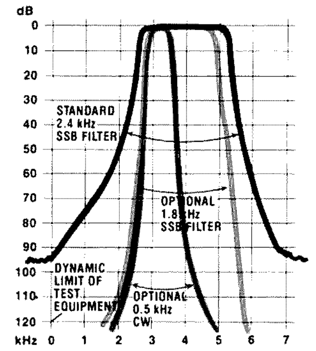
The 1.8 kHz crystal ladder filter transforms an unreadable SSB signal in heavy QRM into one that gets the message through. The 0.5 kHz 8-pole filter provides extremely steep and deep skirts to the CW passband window which effectively blocks out even the very strong adjacent signals.

Both of these filters can be front-panel switched in series with the standard filter to provide up to **16 poles** of filtering for near-ultimate selectivity. In addition, the standard CW active audio filters have three bandwidths (450, 300, and 150 Hz) to give even further attenuation to adjacent signals. In effect, OMNI/SERIES B has six selectivity curves—three for SSB and three for CW. That's true state-of-the-art selectivity.

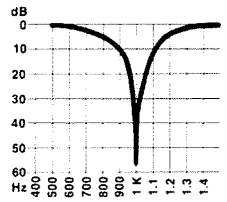
NEW NOTCH FILTER. A variable frequency notch filter in OMNI/SERIES B is placed inside the AGC loop to eliminate interfering carriers and CW signals without affecting received signals. Attenuation is more than 8 "S" units (over 50 db) for any frequency between 0.2 kHz and 3.5 kHz.

OMNI/SERIES B RETAINS ALL THE FEATURES THAT MADE IT FAMOUS.

All solid-state; 160-10 meters plus convertible 10 MHz and AUX band positions; **Broadband design** for band changing without tuneup, without danger;



OMNI/SERIES B I-F RESPONSES WITH STANDARD AND OPTIONAL FILTERS.



NOTCH FILTER PERFORMANCE ADJUSTED TO 1 kHz POINT.

TEN-TEC, INC.
SEVIERVILLE, TENNESSEE 37862
EXPORT: 5715 LINCOLN AVE., CHICAGO, ILL. 60646

Choice of readouts —OMNI-A for analog dial or OMNI-D for digital dial; **Built-in VOX and PTT** facilities; **Selectable Break-in,** instant or delayed receiver muting; **Dual-Range Receiver Offset Tuning,** ±5 kHz or ±0.5 kHz; **Wide Overload Capabilities,** dynamic range typically exceeds 90 dB and a PIN diode switched 18 dB attenuator is also included; **Phone Patch Interface Jacks; Adjustable ALC; Adjustable Sidetone; Exceptional Sensitivity; 200 Watts** input to final with full warranty on final transistors for first year, pro-rata for 5 years; **100% Duty Cycle** for RTTY, SSTV or sustained hard usage; **12 VDC Circuitry** for mobile use, external supplies for 117/220 VAC operation; **Front Panel Microphone and Key Jacks; Built-in 25 kHz Calibrator** in analog dial model; **Zero-Beat Switch; "S"/SWR Meter; Dual Speakers; Plug-In Circuit Boards; Functional Styling,** black textured vinyl over aluminum "clamshell" case, complementary nonreflective warm dark metal front panel; **Complete Shielding; Easier-to-use size:** 5¾"h x 14¼"w x 14"d; **Full Options:** Model 645 Keyer $85; Model 243 Remote VFO $139; Model 252MO matching **AC** power supply $139; Model 248 Noise Blanker $49; Model 217 500 Hz 8-pole Crystal Ladder **CW** Filter $55; Model 218 1.8 kHz 8-pole Crystal Ladder **SSB** Filter $55;

OMNI owners note: Your OMNI can be converted to a SERIES B model at the factory for just $50 (plus $5 for packing and shipping). The notch filter replaces your present squelch control and provision is made for the two additional optional filters; a partial panel with new nomenclature is provided. Contact us for details.

Model 545 Series B OMNI-A $949
Model 546 Series B OMNI-D $1119

Experience the uncrowded world of OMNI/SERIES B. See your TEN-TEC dealer or write for full details.

DX

Chuck Stuart N5KC
5115 Menefee Drive
Dallas TX 75227

ARRL INTRUDER WATCH

Our recent comments concerning the "woodpecker" and other unauthorized encroachments into the amateur bands seem to have unintentionally opened a Pandora's Box of complaints directed at the ARRL-sponsored "Intruder Watch" program. Now, before you groan and say, "Won't those guys at *73 Magazine* ever get tired of blasting the ARRL?", let me assure you that Dallas is a long way from Peterborough and that the editor of this column has been a League member for over twenty years and has no axe to grind with the ARRL. The purpose is to simply find out what is going on in the Intruder Watch program and to determine if it is doing the job it was created to do.

If you have had any recent experience with the Intruder Watch program, either good or bad, let us know. Since negative opinions are most often voiced, we are especially interested in receiving reports of positive results as a direct result of this program. To keep everything aboveboard, letters postmarked Newington or Peterborough will not count.

If you're wondering what all this has to do with DX, try working some on 40 meter SSB.

NOVICE CORNER

Now that you have switched to UTC time for logging DX contacts and making out QSLs (you have switched, haven't you?), it is important to remember to always advance the date at 2400 UTC. QSL managers report that the most common mistake made in filling out QSL cards is neglecting to advance the date at the proper time.

That same error can easily cause you to miss a sked of a DX net. Suppose you read in this column that a station you need has a schedule with his QSL manager at 0000Z on Fridays, but when you show up Friday at the scheduled time, no one is there. The reason no one is there is probably because you're 24 hours late. 0000Z Friday is exactly the same time as 2400Z Thursday. In Texas, for instance, 0000Z on Friday is 7 pm Thursday CDST. It's easy if you just remember that 2400Z is midnight and the date always advances at midnight.

HEARD ON THE BAND

Dave Schoen N2KK and Scotty Meadows K5CO are planning an extensive series of operations later this year in the Indian Ocean and African areas. The plan is to operate independently from some areas and then join forces for the important ones. Dave will leave the States in mid-November in time to set up in J28 Djibouti for the CQ WW CW Contest. From Djibouti he will head over to FR7 Reunion Island to begin a long series of Indian Ocean efforts. Initial plans call for stops at 3B8, 3B7, and 3B9. He is also looking at possible FH8, D68, FR7/G, and FR7/J operations, as well as some of the more rare East African countries. Dave is a professional photographer and his assignment will be to photograph the area for tourism promotion. Scotty, who has operated from TT8, 5A, 7P8, and 9H1, will join up with Dave after their plans have firmed up. Early hopes are for better than 100,000 QSOs total for the operation. We should have more news on this one next month along with the suggested QSL routes.

Reports continue to surface on some really big gun efforts later this fall aimed at one or more of the following areas: 7O1 Yemen, VS9K Kamaran, 8Z4 Neutral Zone, or SY1 Mt. Athos. Mt. Athos and the Neutral Zone seem to be the betting favorites.

KH6LW showed as expected from Kure Island with a good signal to stateside. QSL to Richard Senones KH6JEB, 95-161 Kauopae Place, Mililani Town, Hawaii 96789.

According to the McNish-Lincoln and Sargen predictions, the sunspot maximum will occur in November of this year hitting a smoothed high of 156. After that, a gradual decline will begin, bringing the June, 1980, figure down to around 145. There will be good times for the deserving DXer for several months yet.

A new country emerged from the Pacific Ocean on July 12th. The name is Kiribati and it was formed from, among others, the Gilbert Islands, the Line Islands, and the Phoenix Islands. Christmas Island, covering 124 square miles, is the largest island in the new country. The total land area of Kiribati is 264 square miles scattered across two million square miles of Pacific Ocean.

5N0DOG is Dave Guthrie, formerly K4QX/5N0. Dave's setup there in Nigeria includes a TS-820, an Alpha linear, and a TA-33 up 60'. He also has SSTV equipment and has promised unlimited activity. Dave has moved around quite a bit, having formerly signed HS1ADV, OX3BQ, KG1FR, KG6AOU, KL7ARL, TF2WBV, and KC6BO, to name a few. QSL to W4FRU, 4640 Ocean View Avenue, Virginia Beach VA 23455. SASE, of course.

Slim recently advised us of his *upcoming* itinerary. He will be signing RG8U from the Belden Congo (QSL to C0AX), and then is off to the Indian Ocean where he will be signing FR0ZE with C0LD handling the confirmations. I hope you will be able to add these new ones to your list.

The nonprofit Northern California DX Foundation elected new officers recently and the results were as follows: President—John Troster W6ISQ, VP—Bob Ferrero W6RJ, Secretary—Merle Parten K6DC, and Treasurer—Vince Chinn. Don Schliesser K6RV, who has headed the Foundation for several years, stepped down as President but will continue on the Board of Directors.

Lem Nash WA4YVG, who previously signed /VQ9 and VQ9IN, is now signing /KH2 and has settled in for an 18-month stint on Guam. Any of these calls can be QSLed via W4XQ, 102 Schoolfield Drive, Danville, Virginia 24541.

The following bit of editorial comment was recently making the rounds on twenty meters. You CW types will probably have to explain it to your SSB brothers. "DX lists, DX lists, DX lists, RAH. Three dits, four dits, two dits, DAH."

W1OUN was in India recently and visited the Bangalore Radio Club. He reports that hopes there still run high for some possible Laccadive action before the year is out.

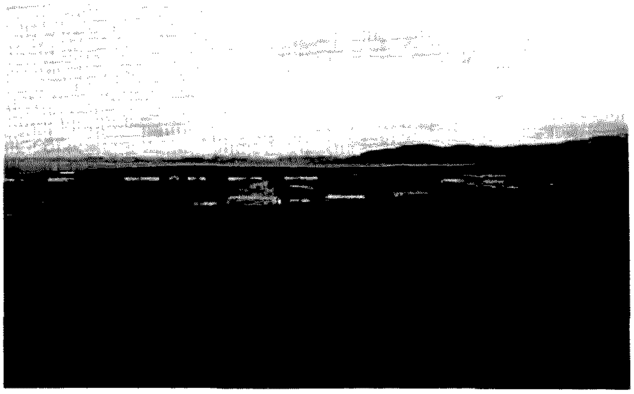
IG9BVS and IG9DMK were on Lampedus Island. QSL to I2BVS and I2DMK.

8J3ITU ran off some 20,000 contacts during ITU week. The QSLs are oversize and will be going out via the bureau. If you're in a hurry, you might try sending a large SASE to JH3DPB.

From time to time you will hear an overseas station complain that IRCs are not accepted in his country. Just because a post office clerk does not recognize an IRC, it does not mean they are invalid there. IRCs are legally good in all countries, with no exceptions. If you are having problems getting IRCs accepted, write to the local postal authorities. Do not take the word of a minor window

Continued on page 152

Kris FB8XV and his station on Kerguelen Island. Kris has handed out many new country contacts from this rare QTH.



Scenic view of lush Kerguelen Island. FB8XV says there is no lack of feminine companionship as there is a girl behind every tree.

LETTERS

INTERESTING METHODS

The article by Jerrold Swank W8HXR, "Compact Beams for 20 or 15," in the July, '79, issue provides some interesting methods of compacting HF beams.

Swank's method of feeding, however, may cause considerable exasperation to anyone who attempts to duplicate his results, or who picks up the tidbit about using a quarter wavelength of RG-59/U as a quarter-wave transformer providing a 2:1 step-up ratio and later attempts to apply the principle to a similar feed problem.

Swank states, "I used a quarter wavelength of RG-59/U as a matching section from the driven element to the RG-8/U coax lead-in. I guessed that the beam impedance would be about 20 Ohms, and this would raise it to 40 Ohms."

His first guess was probably close, but his guess about what the quarter-wave RG-59/U matching transformer would do missed by a country mile. The 20-Ohm feedpoint agrees closely with published data in several books by Orr and the *ARRL Antenna Book*, where driven element-to-director spacing approximates 0.11 wavelength spacing. Swank's 20-meter beam with an 8-ft. boom would provide this condition.

However, a quarter-wave matching transformer of RG-59/U (73 Ohms), will only provide a 2:1 step-up ratio where Z_S = 106.07 Ohms and Z_R = 53.035 Ohms. These conditions are not met, since he estimates Z_R to be 20 Ohms.

Given that his feedpoint resistance does, in fact, conform to textbook data, what his quarter-wave matching transformer of 73-Ohm coax will do is transform the 20-Ohm Z_R up to 266.45 Ohms, presenting then a 5.124:1 mismatch to the 52-Ohm RG-8/U feeder.

This can be proven mathematically by the standard quarter-wave transformer equations: $Z_S = Z_O^2/Z_R$ and $Z_O = \sqrt{Z_R Z_S}$, where Z_O = characteristic Z of line, Z_R = resistive termination, and Z_S = input Z of the line.

From the equations, we can also calculate the correct Z_O to provide the desired match between 20 Ohms (Z_R) and 52 Ohms (Z_S), the nominal Z of the RG-8/U feeder. For these impedances, the Z_O should be 32.2 Ohms, which is not a standard coaxial line. It can, however, be accomplished by using parallel quarter-wave sections of RG-59/U or RG-59B/U, connecting both braids and both center conductors in parallel. This will provide an equivalent line with Z_O of 36.5 Ohms (75 ÷ 2), a value close to the ideal. To calculate the mismatch into the RG-8/U using such a transformer, it is necessary to refer again to the equation: $Z_S = Z_O^2/Z_R$; Z_S = 66.6 Ohms.

Impedance mismatch between the RG-8/U (52 Ohms) and the quarter-wave transformer Z_S (66.6 Ohms), being a function of the ratio of these two values, then becomes 1.28:1, obviously a very acceptable value and a substantial improvement over the mismatched condition presented by Swank's quarter-wave of RG-59/U.

This then raises a question about how Swank obtained an swr measurement of 1.5:1 at the lowest point. This would make it appear as though the quarter-wave of RG-59/U was transforming a Z_R of 68.32 Ohms to a Z_S of 78 Ohms, since RG-8/U terminated in a 78-Ohm load would operate with the 1.5:1 swr he indicates. With a parasitic element spaced only 0.11 wavelength from the driven element, a feedpoint resistance of 68.32 Ohms would be much higher than normal, unless the elements were severely detuned. While this is possible, it is much more likely that his indicated 1.5:1 swr is simply incorrect. This can be verified by adding another length of RG-8/U between the feeder and swr bridge. The chances are that the swr will then change, indicating that neither the 1.5:1 value nor the second value obtained present a true picture of what the mismatch actually is.

My purpose in writing this is twofold—first to correct the error in the article, since Swank's assumptions about the quarter-wave transformer were totally incorrect and may lead someone astray, and second, to demonstrate that his original guess of a 20-Ohm feedpoint resistance may also have been in error.

Before applying any method of improving the impedance match, it would seem logical to actually measure the feedpoint resistance. Two of the regular advertisers in *73* offer economical equipment for this purpose: MFJ's MFJ-202 RF Noise Bridge and Palomar Engineers' RX Noise Bridge. Both will indicate feedpoint resistance in addition to the resonant frequency, eliminating the need to "guess" what these critical characteristics might be. To hang a matching system on an unknown feedpoint resistance is kind of like scooping a handful of pennies into a bag, then saying that by removing 20, only 52 will remain.

Robert G. Wheaton W5XW
San Antonio TX

The chances are that my feedline was not a real half-wave multiple. Anyway, the simplest solution would be to use a pair of 59/U coax cables in parallel, which would be 37.5 Ohms. The length required is only about 10' 10", and this would give a match of 1.4:1.

The alternative would be to use no matching section, which would give a match of 2.6:1, and, if necessary, trim the feedline for a match or use a small L network.

I wrote the article mainly to give hams ideas on how to make beams with the materials at hand. I apologize for the error.

Jerrold Swank W8HXR
Washington Court House OH

MINUTES

A little research of the Minutes of the ARRL Board meetings the past six years has turned up a few interesting facts and raised a few questions, all of which might be the subject of a future editorial: expense accounts of the Directors and the President of the ARRL.

Naturally, being in the Hudson Division, I took a look at the expense account of this Division Director. It looks like this:

	Authorized	Increase	Total Received
1979	$4,000.	$(note)	$4,000. + ?
1978	3,500.	300.01	3,800.01
1977	3,000.	204.30	3,204.30
1976	3,000.	none	3,000.00
1975	3,000.	36.23	3,036.23
1974	2,500.	none	2,500.00

Note: The increase in authorization to a Director comes at the Board meeting the following year.

Now, I work for the State of New York, traveling extensively throughout the state (not just the Hudson Division), with an occasional extra trip to Harrisburg PA or to Washington DC. My expenses include lodging, subsistence, plane fare, airport limos, taxis, and car rentals. My expenses for any year haven't come anywhere *near* the Hudson Division Director's expenses authorized for 1974, the minimum of those checked!

Another very interesting fact turns up when looking for the expense accounts authorized to the President. The 1979 Board (1st) meeting authorized Mr. Harry Dannals an amount not to exceed $10,000 "for 1979." Looking at the Minutes again, I can't find *any* authorization for Mr. Dannals for the years 1978 and 1977. (Isn't that strange?) He was authorized $7,500, "for 1976," though. Apparently nothing was authorized for 1975 and 1974. Question: If, indeed, as I suspect, the President *did* receive expense authorizations for the years 1978, 1977, 1975, and 1974, where were they hidden???

The above "gravy trains" are being financed by the membership through an increase in dues in 1977 to $12 a year, and again in 1979 to $18 a year. It is no wonder that they are finding it difficult to increase the membership in the ARRL at these rates.

A most significant item (Minute #74) in the Minutes of the January, 1979, Board meeting, makes me very suspicious of financial finagling in Newington. Mr. Holladay made this motion that the General Manager (Baldwin) be directed to publish the League's audited financial statements in *QST*. This motion was amended by Mr. Price (at whose instigation?) to have the editor of *QST* directed to remind members through "League Lines" of the availability upon request of the League's audited financial statements. The amended motion was adopted, over the opposition of Mr. Holladay.

It is no wonder, with all the "lulus" available, that the Directors and the President are not desirous of rocking the boat by asking for an investigation of blatant dictator management of the ARRL in Newington.

Byron H. Kretzman W2JTP
Huntington NY

SACRIFICE

With mixed feelings, I wish to inform you that, in a drive to cut down my subscription list to something commensurate with my time to read, I am renewing your magazine and sacrificing the comparably laudable *Scientific American* and *Mother Earth News*. Yours has more circuits.

I have successfully resisted becoming a ham for some 35 years, and now that I am partially deaf (the National Semiconductor LM389 makes a dandy hearing-aid amplifier chip, though), it's unlikely that I'll ever succumb. I'm a longtime

Continued on page 156

RTTY Loop

Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

Occasionally, a letter comes in which is so far afield from an idea I was trying to get across that I feel I must have made too many assumptions in the presentation. Such is the case this month.

Pete Buyaki K5GV is having trouble understanding my presentation of hexadecimal arithmetic. Pete writes, "[I] . . . hit a snag when I came to $5F, etc. This seems odd since these numbers are in the middle of the ASCII table, because it's in the middle of the alphabet table . . . Looking up in the ASCII tables:

	$	0100100	
	5	0110101	
	F	1000110	
	$	0100100	Subtracting this
	2	0110010	group from the
	0	0110000	group above
the difference		0000000	space ?
		0000011	ETX (end text)
		0110000	SYN (synchronous idle)

"I'm sorry, but I don't understand the relation as to how the Baudot will remain in the capital letter format when ASCII is putting out lowercase letters."

Okay, Pete, there are two items of note here. First off, the convention representing one eight-bit byte in hexadecimal is "dollar sign—left nybble—right nybble." In other words, 01001110 in binary corresponds to 4E in hexadecimal. So, when I say $4E, what I mean is 01001110. Now, in ASCII, that $4E corresponds to "N". Lowercase "n" is $6E, which is $20 more than $4E. That is, $4E + $20 = $6E. Another way to look at that is by converting the hexadecimal to decimal. $4E is 78 decimal, and $20 is 32. Thus, 78 + 32 = 110, and 110 decimal is $6E hexadecimal.

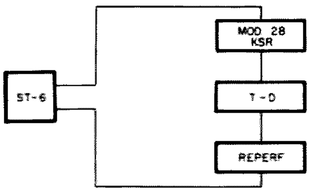


Fig. 2.

If everything is clear so far, I'll throw in one more loop. The ASCII we have been talking about is a seven-bit code, but the hexadecimal representation is eight bits. The most significant bit is frequently called the "parity bit," and we have assumed it is set to zero. Some references assume a parity bit of "1". In that case, add $80 (1000000 binary) to the ASCII values as represented. For example, carriage return becomes $8D rather than $0D, and that "N" becomes $CE rather than $4E.

One final note before I move on. I said that the dollar sign is used to preface hexadecimal numbers. You might wonder if other bases have similar labels. They do! Binary is denoted by a percent sign, and decimal either by no sign or an ampersand. Thus, %01011010 = $5A = &90.

Another item in the mailbag this month is from D. A. Scott W4AKQ in Cape Coral, Florida. Scotty is looking for information on "silent RTTY," that is, RTTY using video terminals or computers. Sorry to say, I know of no book devoted exclusively to the subject. More articles have been published here in *73* than just about anywhere on that topic, however, and Fig. 1 is a compilation of articles I have noted within the last several years. Little information on any of the commercial RTTY video terminals has been received by this column, despite promises and offers from several sources. I would encourage you to ask around your area and see what people are using. Be sure to write the manufacturers of any equipment you contemplate buying prior to investing in a unit, for information and literature. There apparently have been some problems with rf sensitivity and interfacing difficulties with some widely advertised equipment.

8080-based systems:
- "A Very Cheap I/O—The Model 15," *73*, May, 1976, p. 77.
- "Digital Group RTTY Micro," *73*, September, 1977, p. 98.
- "Baudot Interface Cookbook," *Kilobaud*, September, 1978, p. 66.

6800-based systems:
- "Baudot To ASCII," *73*, November, 1976, p. 172.
- RTTY Loop, *73*, June and July, 1978 (receiving).
- RTTY Loop, *73*, June and July, 1979 (transmitting).

6502-based systems:
- "RTTY With The KIM," *73*, September, 1977, p. 110.
- "Try Your KIM-1 On RTTY," *73* October, 1977, p. 88.
- "KIM-1 Can Do It," *73*, February, 1978, p. 68.
- "RTTY With The KIM," *73*, December, 1978, p. 170.
- "RTTY Transceive For The KIM-1," *73*, May, 1979, p. 78.

Other systems:
- "Build This Exciting New TVT," *73*, March, 1976, p. 76.
- "ASCII/Baudot With A PROM," *73*, June, 1976, p. 114.
- "A RTTY/Computer Display Unit," *73*, July, 1976, p. 118.
- "The XITEX Video Terminal," *73*, December, 1978, p. 132.

Fig. 1. Articles on silent RTTY.

Another note received in the mail is from Art Santella K1VKO in East Norwalk, Connecticut. Art is using a Model 28-KSR Teletype and has added outboard paper tape equipment to provide the features of the "ASR" set. What he wants to be able to do is punch a reply tape while receiving.

I presume that you have the common Model 14 tape equipment, Art, although this will apply to any standard equipment. The tape punch you have is called a "reperforator," because it punches off of an active TTY line. Data is fed into it via the standard 60 mA [R]TTY Loop (don't mind the plug!). From what you tell me, you are using a HAL ST-6 demodulator as both the source of data and the loop supply. I assume your station hookup is something like Fig. 2.

There are many ways of hooking equipment up together, switches, tie lines, and the like, but the way that many RTTY enthusiasts have come to love over the years is with a patch panel. Diagrammed in Fig. 3, this is a series of phone jacks which are connected in series, so that any equipment plugged into the strip is in series with anything else. Equipment may thus be switched from loop to loop with a minimum of effort. The key to the system is that the jacks are all shorted if nothing is plugged in. Thus one jack or all may be in the system at any time. Such a plug/jack system may be just what you need.

If you look into your Model 28, you should find a terminal strip, diagrammed in RTTY Loop, October, 1978, page 20, upon which are represented the leads for the keyboard. You should find a black and a brown wire on terminals seven and eight of TB-751. Bring these wires out to a plug and the terminal connections to a shorting jack. When you plug the keyboard leads into this jack, all will be as original. However, when you plug the keyboard into an auxiliary loop, which also supports the reperforator, you will be able to punch tape independent of the printer. Fig. 4 diagrams this system.

If you are going to do this, be sure that your keyboard contacts are clean and bypassed for rf. You normally do not receive while typing, and thus are unaware of the arcing that takes place on many keyboard contacts. If not conditioned, this arcing can generate severe hash in the received signal. A simple loop supply to use to run the auxiliary loop is shown in Fig. 5. Please don't forget that current-limiting resistor. Fried selector magnets do not smell very good.

That's about it for this month. With autumn approaching, conditions should be changing on many of the HF bands, and I hope to be on more and QSO many of you who have written.

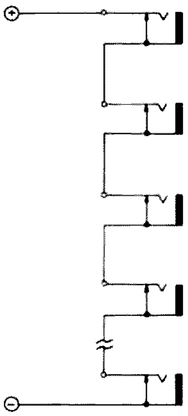


Fig. 3. Jack strip wiring.

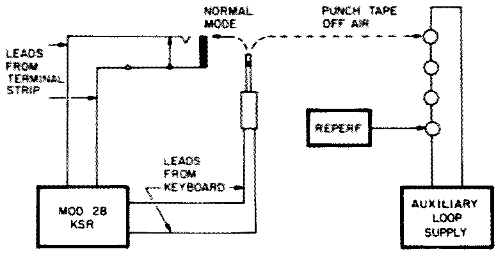


Fig. 4. Sample station wiring.

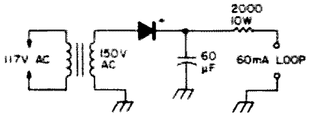


Fig. 5. Simple loop supply.

New Products

SON OF THE QF-1

The recently introduced Autek Research QF-1A active audio filter is a unique selectivity-enhancing accessory that should be of interest to many amateurs, not only because of its quality and features, but also because of its moderate price tag ($65 at this writing).

The QF-1A is the latest in a line of receiving filters that Autek has marketed since 1972. One could probably trace the lineage of the QF-1A and its competitors to the popular National Radio "Select-o-Ject" audio filter that was the apple of many a ham's eyes in the fifties. The current breed of solid-state filters offers a lot of improvements over the "S-o-J" and its vacuum tubes; the QF-1A, I found, has a number of special features that make it of great interest to CW and SSB operators alike.

Among these features are four filter modes of operation (peak, notch, lowpass, and highpass), continuously variable selectivity or bandwidth from "flat" down to 20 Hz, a main frequency adjustment that can be set anywhere from 250 to 2500 Hz in any of the four modes, and a *second* notch frequency adjustment control (added since the QF-1—more on this feature later). The filter is housed in a 6½" × 5" × 2½" gray-finish case and is designed to be plugged into the headphone or external speaker jack of the transceiver or receiver with which it is to be used. It contains a well-filtered 115-V ac power supply and a one-Watt audio power amplifier, so it does not require any additional connections to the rig for power or audio tap-in.

I have used the earlier QF-1 model filter for more than two years and have found it to be an essential station accessory—and, I might add, one which has required no maintenance at all. And, despite the reasonably sharp 600-Hz CW and 2400-Hz SSB i-f filters which my Tempo 2020 has built in as standard equipment, I have found that the QF-1 has made the transceiver's selectivity a great deal sharper. The continuously variable filter characteristics allow a much greater flexibility in combating QRM and in eliciting "armchair copy" in an extremely crowded band.

The original QF-1, written up in *QST* in March, 1977, is similar in design to the newer version but is simpler and has fewer front-panel controls. The QF-1 has selectivity and frequency controls, a three-position mode switch, a speaker/headphone jack, and an ac on/off switch. The QF-1A, apparently drawing on user suggestions and throwing in some "nice to have" features, has five switches and controls on the front panel: (1) an ac on/off switch, which automatically bypasses the filter when turned off; (2) a four-position mode switch; (3) a calibrated selectivity control; (4) a frequency control; and (5) an auxiliary notch frequency control. The headphone/speaker jack is now mounted on the rear panel.

After unpacking the QF-1A from its shipping carton and reading the instructions (which were carefully prepared and complete), I hooked the unit up to my 2020, replacing the faithful QF-1. I found that overall performance was similar, although audio quality was somewhat "cleaner." Like the QF-1, the filter allowed superior "single-signal" reception of very closely spaced CW stations. The filter also worked nicely on SSB, having a very definite impact on signal readability by reducing sideband chatter, static crashes, background noise, and receiver hiss. By using the adjustable notch feature, heterodynes (beats) could be reduced or eliminated on both CW or SSB with no trouble.

Autek's QF-1A.

So far, there was little difference between the units. I found, however, that the newer filter provided a few operating features not found in the QF-1. For example, the on/off switch now automatically bypasses the filter when it is turned off. When using the QF-1, you had to unplug the speaker or headphones and plug them back into the transceiver or receiver when you were not actually using the filter, a minor but not insignificant annoyance. The older model's controls were adjustable over a comparable frequency range, but they were not calibrated; the QF-1A's controls are calibrated at key points, a factor which is useful in resetting the filter to the "flat" position when casually tuning the band or in trying to remember "which way to go" with a control in a pileup. The controls also have a somewhat improved "feel" and bandspread. The auxiliary notch control even allows a second heterodyne to be nulled out should the occasion arise (it will!). It's also possible to use this auxiliary feature to combine operating modes so that you can simultaneously notch/peak, notch/lowpass, or notch/highpass to your heart's content; the instructions tell just how to set up the controls to perform all this "black magic."

The new filter, I found, really comes into its own in serious CW work under crowded contest weekend or DXpedition conditions where weak, in-the-grass signals can often be brought up to effective "599" levels even in the presence of close-by rock-crushing signals which would ordinarily obliterate them. The desired signal can be peaked with an effective bandwidth of as little as 20 Hz with minimal ringing (although such narrow bandwidths are not usually necessary and can be fatiguing to the operator). Using the notch mode, very pronounced rejection (up to 70 dB) can be attained with very little tinkering with the controls. I find that operating in the lowpass mode doesn't produce excessive "booming" and is perfectly adequate for casual CW work used in tandem with the Tempo's 600-Hz filter. When the QRM gets rough, I switch to the peak mode and use the selectivity and frequency controls to zero-in on the desired signal. It's interesting to note that even with the transceiver's sharp CW filter, it's possible to actually "tune through" the Tempo's 600-Hz bandwidth and bring up three or four *separate* CW signals to solid copy that were unreadable without the filter in the circuit.

My use of both filters has indicated that SSB reception is also normally best in the lowpass mode and allows one to easily cope with adjacent-signal splatter and QRM; I like to run with this mode engaged at all times, as it enhances overall audio quality. The auxiliary notch control is effective in nulling out heterodynes, and when the SSB sledding gets rough, all one has to do is to slightly "sharpen up" the selectivity by tweaking the selectivity and frequency controls.

While the QF-1A and other active audio filters work best with receivers and transmitters that have narrow, steep-skirted internal i-f filters, I have found that the filter also does a surprisingly good job on sets that have poor i-f selectivity characteristics. For example, I found that I could dramatically improve the *effective* selectivity of my Yaesu FRG-7 general coverage receiver. The FRG-7, as supplied from the factory, is much too broad for good SSB and CW work. It's mainly an AM-type SWL receiver, and a good one for that purpose. Its basic i-f selectivity is listed as ±3 kHz at 6 dB down, and a built-in *fixed* audio filter allows selection of either 3-kHz, 2500-Hz, or 1500-Hz bandwidths. When hooked into the QF-1A, I could tell little *practical* difference in overall CW and SSB selectivity characteristics between the FRG-7 and the Tempo 2020 with its excellent internal filters! CW signals which were completely unreadable on the barefoot FRG-7 were now a solid Q-5 copy with the filter switched in, and the improvement in SSB reception, though not quite as dramatic, was nevertheless impressive. Of interest to SWLs, I found that the filter also improved AM selectivity on both the shortwave and AM broadcast bands and allowed stations just a few kHz apart to be separated nicely with little cross-channel chatter. This ability would be of special help to the medium-wave DXer in trying to sort out split-channel AM broadcast stations (those operating between the standard 10 kHz U.S. channels), as well as foreign broadcast stations which are often but 3 or 4 kHz apart on the shortwave bands. (If you use the QF-1 with the FRG-7 or another receiver with a built-in fixed audio filter, run with the internal filter *out* for best results.)

Being an inquisitive sort, I tried out the new filter with some other equipment and was surprised by the results. For example, I used it quite effectively with a converted Johnson 4740 SSB transceiver on ten meters. When operated in the

lowpass mode, the filter did a great deal to reduce channel "bleedover" effects and crosstalk. Also, the notch feature was handy in suppressing annoying heterodynes from the many AM stations now on the band that use converted AM CB transceivers.

I also experimented with the filter on my KLM-2800. The 2700 is designed for two meter all-mode work, though the primary emphasis—as in most other "all-mode" transceivers—is on FM; it is somewhat lacking in good CW selectivity, and there are no provisions to add optional i-f filters to reduce bandwidth. Hooking up the QF-1A had much the same beneficial effect as it did when it was worked with the Tempo 2020—only more so. The filter added a great deal of selectivity to an otherwise broad set for serious CW work, and it made a difference on SSB as well. As expected, it didn't do much for FM reception.

The original QF-1 design was a good one. Most of the QF-1A's changes are convenience features and minor improvements, such as the addition of the automatic bypass, the auxiliary notch control, and the calibration marks on the selectivity/frequency controls. Also, the newer version's selectivity goes down to 20 Hz, as opposed to a "mere" 50 Hz on its predecessor. Both designs are thoroughly bypassed and filtered to prevent rectified rf from your transmitted signal from getting back into the audio circuitry and causing problems; I had no difficulty from rf feedback even when running a full kilowatt on 80 through 10 meters.

When working with very narrow selectivity, you may find it convenient to connect a Y-cord adapter in the output line and run an output to an oscilloscope or ham-type monitorscope (such as the Heath SB-610 or similar Yaesu and Kenwood versions) to visually help in determining exact audio peaking. Also, one feature that could have been added to the QF-1A but wasn't is a set of switches to allow its use with two audio sources (two receivers, or a transceiver and a receiver) and two outputs (a headphone and a speaker). As it stands now, the unit must be manually plugged in and out of the equipment with which it is to be used, and the speaker and headphones must be plugged and unplugged by hand.

Also, I have found it expedient to feed the filter's output to a small "wireless FM rebroadcaster" module (I use the Ramsey module @ $3) used in conjunction with a pair of cordless FM headphones. Doing so eliminates the need for clumsy headphone coiled cords and has the side benefit of allowing you to monitor the band anywhere in your home or yard by tuning in the rebroadcaster's signal on a nearby FM radio. You may not want to try this, but I mention it to point out the possibilities and advantages of hands-off, cord-free hamming.

Some suggestions I had for enhancing the versatility of the basic QF-1 were described in my May, 1978, *73 Magazine* article, "The Super Select-o-Ject." Many of the changes I made to the QF-1, such as the switching arrangement, can be adapted to the new filter.

One caution: The QF-1 and its successor tend to emphasize any residual ac hum present in the transceiver's or receiver's audio output. This is normally caused by insufficient ac filtering in the rig and not in the audio filter. I have found this condition to be noticeable mainly when operating in the lowpass mode and feeding low-impedance, hi-fi type headphones, which normally have a heavy bass response. This problem can be minimized by adding a 50-to-150-Ohm, ½-Watt resistor in series with the headphone lead to cut down the phones' sensitivity and low frequency response.

In my opinion, the QF-1A is a real jewel well worth the modest price tag. While I have not as yet made an in-shack comparison between the Autek filter and its competition, I can say that the quality of construction (steel case) and circuitry board is excellent and reflects care in design and manufacture. The QF-1A makes a modest receiver or transceiver "come alive" in the selectivity department and allows the average set—so often lacking in *real* CW performance—to become a winner. For further Information, contact *Autek Research, Box 5127, Sherman Oaks CA 91403.* Reader Service number A100.

Karl T. Thurber, Jr. W8FX/4
Ft. Walton Beach FL

Notes

1. There are a large number of audio communications filters on the market today. These include some highly competitive designs by MFJ, Waneco Radio, Dynamic Electronics, Datong, Kantronics, Electronic Research Corporation of Virginia, and others. These filters range in price from about $30 to $200 and more. If you are interested in building your own, a very good active filter design is shown by Donald Morar W3QVZ in the December, 1978, issue of *73*. His article, "Build the Flexi-Filter—A Very Active Device," is on page 222.

References

1. Product review, Autek Research QF-1 R-C Active Filter, *QST*, March, 1977, p. 44.
2. Thurber, Karl T., Jr. W8FX/4, "The Super Select-o-Ject," *73 Magazine*, May, 1978, p. 116.

Non-Linear System's MS-215 Miniscope.

MISSION IMPOSSIBLE? NOT WITH THE MS-215!

The manufacturer's service information reminded me of that TV series "Mission Impossible," and for that matter, what I had to do could very well have been a script for the show. It was nothing exciting—I just had to identify one bad chip on a circuit board containing 36 chips, located in a cabinet with an access door about 18 inches square. But, not to worry, according to the manufacturer—just get into the cabinet with a dual-trace 10-MHz scope, triggered, and look for the inputs and outputs on each chip. When you don't find both conditions, you've found the bad chip. I did omit one minor consideration—the board was a part of a computer-based central station monitor at our hospital, was hardwired in, and had to remain operational during the entire test procedure.

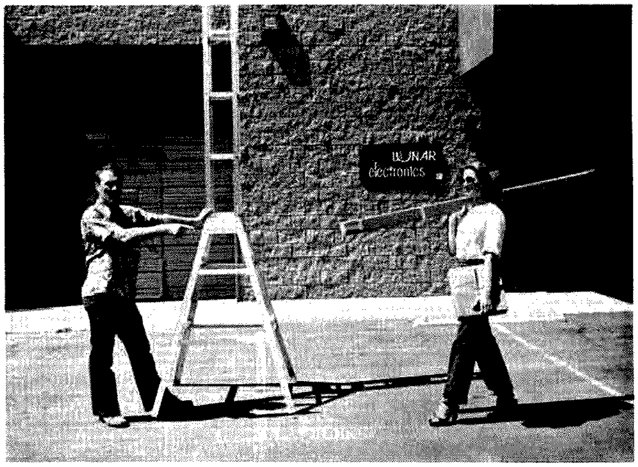
Not to be thwarted, I reached into my tool set and removed just what the "doctor" ordered, the Non-Linear System's MS-215 15-MHz dual-trace scope. Besides being self-contained and self-powered by nicads, the Miniscope measures a mere 2.9" x 6.4" x 8.0". Its vertical bandwidth extends from dc to 15 MHz, with ac, dc, or ground coupling switch-selectable. Deflection is 10 mV/div to 50 V/div in 12 calibrated ranges (with a stated accuracy of 3% of full scale with the vernier in the full clockwise position). The horizontal characteristics include: internal timebase or external horizontal switch-selectable mode with a timebase of 0.1 usec/div to 0.5 sec/div in 21 calibrated ranges. The maximum input voltage for both horizontal and vertical sections is 350 V dc and peak ac, providing that the dc component does not exceed 250 volts. A switch-selectable trigger permits + or −, with modes of internal, external, and line (line is non-functional when operating off the nicads). A trigger-level control permits continuous adjustment of the trigger point.

While all of these technical specifications will impress a number of you, why should you or any ham want a scope this tiny? The answer is quite simple: The MS-215 Miniscope can go to the work when the work can't go to the scope! Maybe that's an oversimplification of the issue, but how many times in the last six months have you wished that you could have a piece of test equipment which was scaled down in size to the IC circuitry being examined, be it a computer CPU or the innards of a synthesized 2-meter ham rig? Better yet, how many jobs could you have done with little or no sweat if you and your scope could have been right there—on the spot rather than tied to a large scope with equally large probes further hindered by an ac power cord.

I acquired an MS-215 because with it we could locate the defective chip and remove and replace it at a total cost of perhaps $2.00 in parts, while the new board would have cost somewhere in the area of $1200. Considering that the MS-215 sells for around $400 from a number of advertisers in *73*, purchasing it was a very wise move in terms of dollars and cents!

What can't you do with the MS-215? Well, to be honest, very little—unless you want to display a waveform to more than two close friends. We have literally used the scope for everything and anything you could imagine—from probing the interior works of a piece of hospital gear to troubleshooting the somewhat sickly departmental HT. In all cases, it performed as well as one of the larger and considerably higher-priced scopes in the department. Considering that the small package even included a calibrator which provides a square-wave signal of 1 volt peak-to-peak, and a graticule

Nye Viking's Model 250-0046-001 phone patch.



Lunar's LT-1 modular tower.

which (while small like the CRT) is easy to read—what more can you ask for in a package you can comfortably stuff into a coat pocket?

If you are interested in what you've read thus far and want more information about the MS-215 Miniscope, drop Mr. Allan Kay a line at *Non-Linear Systems, Inc., Dept. 73, Box N, Del Mar CA 92014.* Be sure to tell him that you read about their products in *73 Magazine*. Reader Service number N22.

Elliot S. Kanter W4PGI
Savannah GA

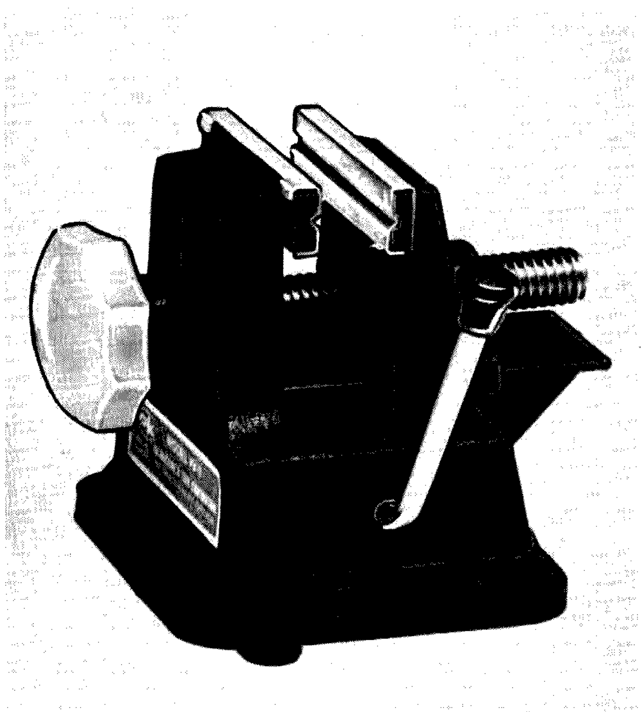
NYE VIKING RECEIVES FCC REGISTRATION FOR PHONE PATCH

Approval by the Federal Communications Commission for official registration under Part 68 of the FCC Regulations has been granted to the Wm. M. Nye Company, Bellevue WA. This allows the Nye Viking phone patch to be plugged directly into the telephone line without the need (or cost) of a telephone company-supplied coupling device. It should be noted that users must still notify the telephone company that they are connecting the phone patch to the telephone line, and must furnish the company the official registration number and the ringer equivalence number (which are printed on an attached label).

Telephone patches may not legally be connected to party lines or pay telephone lines. Users are cautioned that they must comply with all other requirements of the FCC pertaining to amateur radio communications.

The Nye Viking phone patch comes in two models: the 250-0046-001, without speaker, which provides connection to your own external speaker, and the 250-0046-003, with built-in loudspeaker, for use with most transceiver installations.

Nye Viking phone patches manufactured prior to official FCC approval and registration can be upgraded to approved status with the necessary changes, which include a 7-foot cord and a plug to connect into the telephone company line socket. Units returned for modification should be carefully packed and contain the sender's name and address. For further information, contact the *Wm. M. Nye Company, Inc., 1614 130th Ave. NE, Bellevue WA 98005.* Reader Service number N4.



OK Machine and Tool's new VV-1 vise.

LIGHT-DUTY VISE

The new Model VV-1 from OK Machine and Tool Corporation is a unique vacuum-based light-duty vise for precision handling of small components and assemblies. Featuring rugged ABS construction, it has 1½" wide jaws and 1¼" travel for maximum versatility. Also featured are an oversize knob for precise positioning and screw lugs for permanent installation. For further information, contact *OK Machine and Tool Corporation, 3455 Conner Street, Bronx NY 10475.* Reader Service number O5.

LUNAR'S MODEL LT-1 MODULAR TOWER

Lunar Electronics has announced a new line of towers. Manufactured in Lunar's San Diego plant, these towers are all-aluminum angle pieces, which bolt together to form a sturdy structure capable of supporting considerable antenna arrays. The modularity of the six-foot sections makes them a natural for site surveys, field operations, and portable communications tests of all sorts, including amateur radio EME (moonbounce) operations.

Taking advantage of a building's height, they readily mount on rooftops, flat or peaked. The use of a length of 2 x 4 under leg pairs provides a simple yet effective mount for the tower. Since it must be guyed, no bolts, nails, or other requirements are necessary. The 2 x 4s additionally serve to distribute the weight over several roof joists.

These portable units are readily UPS shipped, and may also be carried as luggage on any airline. The construction is not unlike a childhood toy erector set, with each module bolted together with supplied hardware. Optional stainless steel hardware is also available (S suffix). Rotor and thrust bearing mounting plates are included in the basic tower package (Model LT-1), which yields an 11-foot structure when erected. The 6-foot add-on modular sections (Model LT-2) increase the height up to nearly 30 feet.

Since the tower is built from angle pieces, it forms its own ladder when erected and guyed. The base is 43 inches square, and the tower sections are 9.5 inches square. For further information, contact *Lunar Electronics, 2785 Kurtz Street, Suite 10, San Diego CA 92110; (714)-299-9740.* Reader Service number L17.

INSTA-PAC

Something new has come upon the scene which promises ease and efficiency for the QSL fan. Its name is "Insta-Pac," and it affords the ham the oppor-

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Microcomputer Interfacing

Peter R. Rony
Jonathan A. Titus
Christopher A. Titus
David G. Larsen

MULTIPLEXED LED DISPLAY

Regardless of their application, most microcomputers need peripheral I/O devices for the input and output of data. The more common output devices included seven-segment displays, 5 x 7 dot matrix displays, teletypewriters, and cathode-ray tube (CRT) displays. We shall discuss several methods that can be used to interface seven-segment displays, as well as several different programs that are typically used to "drive" such displays, which are widely used in electronic games, calculators, point-of-sale (POS) terminals, gasoline pumps, children's toys, and taxi meters.

One of the simplest methods that can be used to interface a seven-segment display to a microcomputer consists of latching the appropriate data values from the data bus under software control (Fig. 1). The latch's inputs (7475) are wired to the microcomputer's bidirectional data bus and the latch's outputs are wired to a seven-segment decoder/driver (7447). The decoder's outputs (current sinking) are wired to the seven-segment display with 220-Ohm current-limiting resistors. When an OUT 125 instruction is executed, the content of the 8080's A register is latched by the display interface and the two BCD numbers represented by D7-D4 and D3-D0 are illuminated on the two displays. The instructions listed in Fig. 2 cause a 39 to be displayed.

To display a 10-digit number using this method, ten latches, ten decoder/drivers, seventy resistors, and ten seven-segment displays will be required. One method of reducing the "parts count" for this interface would be to use a device such as the 8255 Programmable Peripheral Interface (PPI) integrated circuit.[1] This device can be used as three independent eight-bit output ports, so it is the equivalent of six 7475 latches. Therefore, two 8255 PPI chips, along with 10 decoder/drivers, seventy resistors, and ten seven-segment displays would be required in the interface. One obvious disadvantage of this interfacing method is the large number of integrated circuits required. However, one advantage is that the software required to drive this interface is relatively simple. Also, the microcomputer only has to output this information once to the interface for the information to be continuously displayed. This, of course, is due to the latches or the 8255 chips in the interface. Thus, the microcomputer can output numeric information once and then go on to perform any other required operations.

Another interfacing method that can be used is digit *multiplexing*. Multiplexing reduces the display interface electronics (number of parts) to a minimum, but at the expense of longer and more complex display driver software. Multiplexing a display consists of enabling or turning on one particular digit with a *digit enable code* and providing the BCD numeric information for that digit to a multi-digit display interface. In this way, each digit is turned on, one at a time, as the actual BCD data for each digit is provided. Multiplexing is usually only used with multi-digit displays. As an example, suppose that the number 237 is to be displayed on a three-digit multiplexed display. To display this number, the BCD value for the digit seven would be output to the interface, along with the digit enable code for the right-hand display. After a short period (1 to 10 ms), the BCD value for the three would be output, along with the digit enable code for the middle digit. Again, after a short delay, the BCD value for the two and the digit enable code for the left-hand display would be output to the interface. By performing this sequence fifty or more times *every* second, each digit in the display *appears* to be on *all of the time.* This same display method is used in hand-held calculators. Even though the digits are being turned on and off, it is happening too fast for the eye to see. The interface for a 10-digit multiplexed display is shown in Fig. 3.

When an OUT 125 instruction is executed, bits D3 through D0 of the A register will determine which one of the ten digits in the display will be enabled (turned on). Therefore, these four bits constitute the digit enable code. Bits D3 through D0 are latched (7475) and are decoded with a one-of-ten decoder (7442). The decoded outputs of the 7442 are wired to the common cathodes of the individual digits in the display. Bits D7 through D4 will provide the BCD code of the value to be displayed (0 through 9). These bits are also latched (7475) and are decoded by a seven-segment decoder/driver (DS8857, National Semiconductor Corporation, Santa Clara CA). The DS8857 supplies the current required to turn on the various segments (A-G) within the enabled digit selected by the 7442 decoder chip.

A relatively simple program can be written in which five packed BCD words (two BCD digits per word) are output to the display so that a 10-digit number is displayed (Fig. 4). This program has to unpack the BCD words stored in memory, combine the BCD digits with a

Continued on page 150

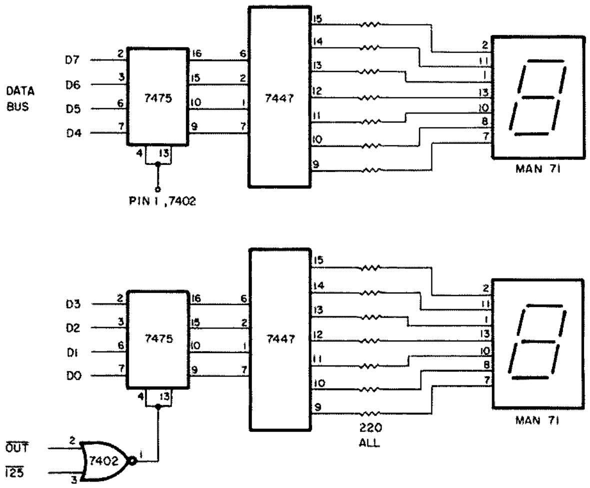


Fig. 1. A simple two-digit LED display interface.

```
/THIS SECTION OF A PROGRAM OUTPUTS THE
/BIT PATTERN 00111001 (OCTAL 071, HEX 39)
/TO AN OUTPUT PORT EQUIPPED WITH TWO
/SEVEN-SEGMENT DISPLAYS.

     .
     .
MVIA    /LOAD A WITH THE FOLLOWING IMMEDIATE
071     /DATA BYTE (HEX 39, BINARY 00111001)
OUT     /OUTPUT IT TO THE TWO SEVEN-SEGMENT
125     /DISPLAYS EQUIPPED WITH LATCHES
 .      /CONTINUE WITH THE REMAINDER OF THE
 .      /PROGRAM
```

Fig. 2. Displaying a 39 on the two-digit display.

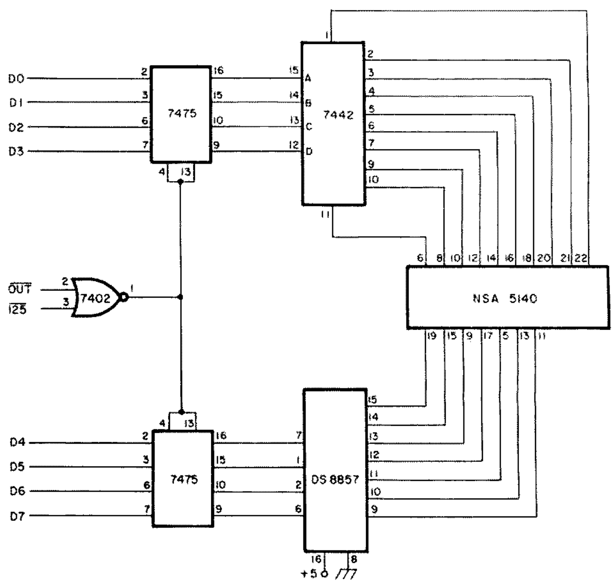


Fig. 3. A 10-digit multiplexed LED display interface.

Awards

Bill Gosney WB7BFK
2665 North 1250 East
Whidbey Island
Oak Harbor WA 98277

After months of planning and careful consideration, I'm particularly proud to announce this *73* exclusive—*the 73 Magazine Awards Portfolio.* Consisting of four domestic award incentives and four DX achievement programs, the awards portfolio promises to be a challenge and capture the interest of almost everyone on the band, whether you are a casual rag chewer or a big-time contester.

Read through the various award rules with caution. The requirements are not as easy as one might first imagine. We want our award recipients to know they had to earn their recognition and therefore designed each award to be somewhat of a challenge.

I will present each award in detail—the DX-oriented awards will be in the spotlight this month, and next month I will focus on the domestic ones.

Each of the sponsored awards will offer its own degree of difficulty. None was designed to be an overnight accomplishment, nor were any meant to duplicate any other awards in existence today.

So tune up those QRP rigs, kick in the blower on the kilowatt, rotate those beams, and fine-tune that dipole, as time's a wastin'; you've got some contacts to make and some awards to win! I plan to feature a special profile of the winner of the first award issued in each category. Subsequent recipients will be recognized in a monthly award summary.

73 DX COUNTRY CLUB AWARD

1. Sponsored by the editors of *73 Magazine.*
2. Available to licensed amateurs throughout the world.
3. To be valid, all contacts claimed must be made in a *single calendar year* (January 1 through December 31), beginning January 1, 1979, and after.
4. This award is available for all phone, CW, and mixed modes.
5. To qualify, a minimum of 73 DX countries must be worked and confirmed from the *73 Magazine* WTW (Work the World) DX Listing. All contacts must be made in the same calendar year.
6. Annual endorsement stickers are available for each succeeding year in which a minimum of 73 DX countries are worked.
7. To apply, prepare a list of claimed contacts in prefix order. Include each station's full callsign, date and time in GMT, mode, and band of operation.
8. Do not send QSL cards! Have your list of contacts verified by two local amateurs, a local club secretary, or a notary public.
9. Enclose your verified list and award fee of $3.00 or 8 IRCs for each award or endorsement. Send to: Bill Gosney WB7BFK, *73* Awards Editor, 2665 North 1250 East, Oak Harbor, Whidbey Island, Washington 98277 USA.

DX CAPITALS OF THE WORLD

1. Sponsored by the editors of *73 Magazine.*
2. Available to licensed amateurs throughout the world.
3. To be valid, all claimed contacts must be made January 1, 1979, or after. There are no mode or band restrictions.
4. To qualify, applicants must work and confirm fifty (50) different national capital cities located in DX countries shown on the WTW (Work the World) DX Listing.
5. To apply, make a self-prepared list of contacts made in prefix order indicating the station worked, date and time in GMT, band of operation, and the name of the capital city and DX country.
6. Do not send QSL cards! Have your list of contacts verified by two amateurs, a local club secretary, or a notary public.
7. Enclose your application list and award fee of $3.00 or 8 IRCs to: Bill Gosney WB7BFK, *73* Awards Editor, 2665 North 1250 East, Oak Harbor, Whidbey Island, Washington 98277 USA.

TEN METER DX DECADE AWARD

1. Sponsored by the editors of *73 Magazine.*
2. Available to licensed amateurs worldwide.
3. All contacts must be made on the 10 meter band using only channelized converted Citizens Band equipment or similar type commercial units operating a maximum of 15 Watts PEP output. External amplifiers may not be used.
4. To be eligible for award credit, all contacts must be made October 1, 1978, or after, on AM, SSB, CW, or FM. Mixed mode contacts are not valid.
5. To qualify, applicant must work and confirm at least ten (10) DX countries from the WTW (Work the World) DX Listing. Endorsements will be given for 25, 50, 75, and 100 countries confirmed.
6. To apply, make a self-prepared list of contacts claimed, giving the callsign of each station worked in prefix order. Include the date and time in GMT, band, mode, and a brief description of the equipment used in making each contact.
7. Do not send QSL cards! Have your list verified by two amateurs, a local club secretary, or a notary public.
8. Forward your application list and award fee of $3.00 or 8 IRCs to: Bill Gosney WB7BFK, *73* Awards Editor, 2665 North 1250 East, Oak Harbor, Whidbey Island, Washington 98277 USA.

WORK THE WORLD AWARD

To enhance the enjoyment of working DX, the editors of *73 Magazine* take special pleasure in introducing what we feel will be one of the most sought-after awards in existence today—the Work the World Award.

1. Sponsored by the editors of *73 Magazine.*
2. Available to licensed amateurs throughout the world.
3. To be valid, all contacts must be made January 1, 1979, or after. There are no band or mode restrictions. Only DX countries shown on the WTW (Work the World) DX Listing qualify.
4. The ultimate goal of this award program is the Work the World (WTW) Award, signifying excellence in DX communications. However, to qualify for WTW, applicants must first meet the requirements of the six Continental Awards, each of which is a worthy goal in itself.
5. Requirements for Continental Awards: North American Awards—work 13 North American countries; South American Award—work 12 South American countries; European Award—work 12 European countries; African Award—work 12 African countries; Asiatic Award—work 12 Asiatic countries; Oceanic Award—work 12 Oceanic countries.
6. The Work the World Award is issued at no cost to any applicant who meets the requirements of all six Continental Awards. The operator who earns WTW has truly "worked the world."
7. To apply for any of the six Continental Awards, prepare a separate list of claimed contacts for each continent, listing all callsigns in prefix order. Include date, time in GMT, and band.
8. Do not send QSL cards! Have your list(s) verified by two amateurs, a local club secretary, or a notary public.
9. Enclose your verified list(s) and award fee of $3.00 or 8 IRCs for each award applied for. Forward to: Bill Gosney WB7BFK, *73* Awards Editor, 2685 North 1250 East, Oak Harbor, Whidbey Island, Washington 98277 USA.

Throughout this column, reference has been made to the new WTW (Work the World) DX Listing. In order to avoid the impossible task of having to decide what is and what is not a country, the awards editor and the staff at *73* decided to accept the decisions of the national amateur radio societies of the world. Special care has been taken to ensure that no single organization will dictate the criteria used; instead, an accumulative effort by all concerned will be recognized.

Thus, as the basis for all the DX awards sponsored by *73 Magazine*, the official WTW DX Listing will be categorized by continents of the world. Within each continent, DX countries will appear in order of their callsign prefix.

Additional copies of the WTW DX Listing or rules of the various award programs are available on request. Please be sure to enclose a 4½" x 9" SASE with all inquiries. Forward your inquiry to my home address which appears throughout this column.

If DX isn't your cup of tea, then the domestic awards featured next month will interest you for sure.

Keep the cards and letters coming. Your comments concerning this column have been well received and appreciated. Should you learn of an awards program being featured in your city, state, province, or country, please forward this information on to me. Together we can share the many achievements being offered our readers throughout the world.

WTW DX LISTING

NORTH AMERICA

C6	Bahamas
CO	Cuba
FG	Guadeloupe
FG, FS	Saint Martin
FM	Martinique
FO	Clipperton Is.
FP	St. Pierre & Miquelon
HH	Haiti
HI	Dominican Republic
J3, VP2G	Grenada & Dependencies
KC4, KP1	Navassa Is.
KG4	Guantanamo Bay
KL7	Alaska
KP4	Desotheo
KP4	Puerto Rico
KS4, KP3, HK0	Serrana Bank and Roncador Cay
KV, KP2	Virgin Islands
OX, XP	Greenland
PJ6, 8	Saba Is.
VE	Canada
VE1	Sable Is.
VE1	St. Paul Is.
VO	Newfoundland, Labrador
VP2A	Antigua, Barbuda
VP2D	Dominica
VP2E	Anguilla
VP2K	St. Kitts
VP2L	St. Lucia
VP2M	Montserrat
VP2S	St. Vincent & Dependencies
VP2V	British Virgin Islands
VP5	Turks and Caicos Islands
VP9	Bermuda
W, K, N, A	United States of America
XE	Mexico
XF4	Revillagigedo Islands
ZF	Grand Cayman Islands
4U	HO, United Nations
8P	Barbados

Continued on page 155

Contests

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

Please note that with this issue all award and contest announcements are being split into their respective separate columns. Please forward all information directly to the individual responsible for the particular column. Any information sent via **73** *Magazine headquarters in Peterborough NH is only delayed and may not be received by the appropriate editor in time to appear in the magazine. Also, to the organizations sponsoring a contest, don't forget to send an abbreviated copy of the results for possible publication. They will be printed as space permits.*

KENTUCKY QSO PARTY

Starts: 0001 GMT September 15
Ends: 2359 GMT September 16

This contest is sponsored by the Bluegrass Amateur Radio Club. Only one contact per band or mode with each station. No repeater or pre-arranged contacts are allowed. Suggested frequencies are lower edge of General and Novice bands, 2 meter simplex and SSB, and 6 meters.

EXCHANGE:

RS(T), county, and consecutive QSO number; non-KY stations substitute state, country, or province for county.

SCORING:

Score 1 point per QSO. KY stations multiply by number of states, countries, and provinces worked. Non-KY stations use number of KY counties worked. Final multipliers are: 1.5 for all 10 meter contacts between 0200 and 1000 GMT; 2.0 for input of 15 Watts or less; 1.5 for input of 200 Watts or less; 2.0 for all VHF simplex QSOs. Novices or Technicians may take an additional 2.0 multiplier for CW only.

ENTRIES:

Mail logs by October 5 to: Donald Page WD4HPL, 309 Pocahontas Trail, Georgetown KY 40324.

WASHINGTON STATE QSO PARTY

Contest Periods:
0100 to 0700 GMT September 15
1300 GMT September 15 to 0700 GMT September 16
1300 GMT September 16 to 0100 GMT September 17

The 14th annual Washington State QSO Party sponsored by the Boeing Employees' Amateur Radio Society (BEARS) is open to all amateurs. All bands and modes may be used. Stations may be worked once on each band and mode for contact points and more than once each band/mode if they are additional multipliers.

EXCHANGE:

QSO number, RS(T), county or state/province/country.

SCORING:

Washington stations score two points for each phone contact and 3 points for each CW contact, including contacts with other WA stations. Then multiply by the total of different states, Canadian provinces, and other foreign countries worked. All others score 2 points for each phone contact and 3 points per CW QSO with Washington stations and multiply by the total number of different Washington counties worked (39 maximum). There will be an extra multiplier of one for each group of 8 contacts with the same Washington county for all non-Washington stations.

FREQUENCIES:

CW—1805, 3560, 7060, 14060, 21060, 28160.

Phone—1815, 3925, 7260, 14305, 21380, 28580.

Novice—3725, 7125, 21150, 28160.

AWARDS:

Certificates will be awarded to the highest-scoring station (both single- and multi-operator) in each state, Canadian province, foreign country, and Washington county. Additional certificates may be issued at the discretion of the Contest Committee. Worked Five BEARS Awards are also available to anyone working 5 club members before, during, or after the QSO Party unless previously issued. All QSO Party entries will be screened by the Contest Committee for possible awards. The Worked 3 BEAR Cubs Award is also available for working 3 Novice members.

ENTRIES:

Logs must show dates, times in GMT, stations worked, exchanges sent and received, bands and modes used, and scores claimed. Include a dupe sheet for entries with more than 100 QSOs. Each entry must include a signed statement that the decision of the Contest Committee will be accepted as final. No logs can be returned. Results of the QSO Party will be mailed to all entrants; an SASE is not required. Log sheets and summary sheets must be postmarked no later than October 17 and sent to: Boeing Employees' Amateur Radio Society, c/o Contest Committee, Willis D. Propst K7RS, 18415 38th Ave. S., Seattle WA 98188.

Calendar

Sept 8*	**DAFG Short Contest—VHF**
Sept 8-9	**North American Sprint**
	ARRL VHF QSO Party
	WAE—Phone
Sept 9*	**DAFG Short Contest—SW**
Sept 15-16	**CAN-AM Contest—CW**
	Kentucky QSO Party
	Scandinavian Activity—CW
Sept 15-17	**Washington State QSO Party**
Sept 15 & 22	**89'ers Run**
Sept 22-23	**Scandinavian Activity—Phone**
Sept 29-30	**Delta QSO Party**
	CAN-AM—Phone
Sept 30-31	**College Radio Scrimmage**
Sept 30-Oct 1	**Fall Classic Radio Exchange**
Oct 6-7	**QRP Annual October QSO Party**
	Arrowhead 50th Anniversary QSO Party
Oct 13-14	**ARRL CD Party—CW**
Oct 20-21	**ARRL CD Party—Phone**
Oct 28	**Crazy Eight Net QSO Party**
Nov 3-4	**ARRL Sweepstakes—CW**
Nov 10-11	**CQ-WE Contest**
	IPA Contest
Nov 11	**OK DX Contest**
Nov 17-18	**ARRL Sweepstakes—Phone**
Nov 24*	**DAFG Short Contest—SW**
Nov 25*	**DAFG Short Contest—VHF**
Dec 1-2	**ARRL 160 Meter Contest**
Dec 1-3	**Connecticut QSO Party**
	North Carolina QSO Party
Dec 8-9	**ARRL 10 Meter Contest**

* = described in June issue

89'ers RUN

Contest Periods:
Run #1: Saturday, September 15, 1400 to 1800 GMT
Run #2: Saturday, September 22, 2100 to 0100 (September 23) GMT

The object of this QSO party sponsored by the Sooner Chapter of Ten-Ten International is to collect as many 89'ers' numbers as possible and you do not have to have an 89'er number to enter. All contestants, other than local and charter members, may operate *only one* of the two four-hour runs listed above. Locals and charters will operate both runs. Locals and charters will not be competing for awards. Scoring will be the same as for the 89'er awards, except that contacts with people who have a Ten-Ten number only shall count one point. Send contest logs to WD5CSK by October 31. If you wish to apply for the certificate or any of the advanced awards, separate application must be made directly to WB5TKD. If you would like an information sheet and a list of awards, send an **SASE** to contest manager Ron Reid WD5CSK, 8832 NW 80, Yukon OK 73099. Contest logs will not be returned unless an envelope and sufficient postage is enclosed.

SCANDINAVIAN ACTIVITY CONTESTS

CW: 1500 GMT September 15 to 1800 GMT September 16
Phone: 1500 GMT September 22 to 1800 GMT September 23

Non-Scandinavian stations try to work as many Scandinavian stations as possible. The same station may be worked once on each band during the contest. Only CW-to-CW and phone-to-phone QSOs are valid, no cross-mode. Use all bands, 80 to 10 meters, but only within the following sections: CW—3505-3575, 7005-7040, 14010-14075, 21010-21125, 28010-28125; phone—3600-3650, 3700-3790, 7050-7100, 14150-14300, 21200-21350, 28400-28700 (as legal in your country!). The prefixes used in Scandinavia are: LA/LB/LG/LJ—Norway; JW—Svalbard and Bear Island; JX—Jan Mayen; OF/OG/OH/OI—Finland; OHØ—Aaland Island; OJØ—Market Reef; OX—Greenland; OY—Faroe Island, OZ—Denmark; SJ/SK/SL/SM—Sweden. All these prefixes are geographically not in Scandinavia, but they are considered so for the contest. Operator classes include: a) single operator; b) multi-op/single transmitter; c) multi-op/multi-transmitter. Club stations, even if operated by one operator during the contest, are in the multi-operator class. Multi-op/multi-transmitter entries are to use separate series of serial numbers for each band.

EXCHANGE:

Continued on page 147

Power Line DXCC (Distant Control Circuit)

—The ac lines are already there . . . why not use 'em for remote control?

Dave Brown W9CGI
RR5, Box 39
Noblesville IN 46060

I must first apologize somewhat for stealing this article's title from J. H. Everhart N2CX. His article, in the August, 1978, *73 Magazine*, was entitled "Power Line DX." But, I did not stop there! I stole even his circuits, almost intact. That, too, I must explain.

My intent is to praise him highly. The original article dealt with control of distant (DX) objects by remote control, via existing 60-Hz lines. He helped me by solving my worst problem in controlling my EME array, located on a tower building some 150 feet (by wire and zig-zag routing) from my basement ham shack. First, I built his circuits, and they worked —very well! Then I decided to lay out a PC board to speed matters up if I wanted more than one copy (I did). And then, I decided to do an article just for the PC boards, just to encourage others to try his methods—using his circuits—which, as I said, work very well indeed.

While laying out the first board and mulling over his idea for remote monitoring of his ham receiver, the way of laying out the PC boards shown in Figs. 1(a) and 2(a) evolved. Figs. 1(b) and 2(b) are just loading diagrams to hasten things along for you.

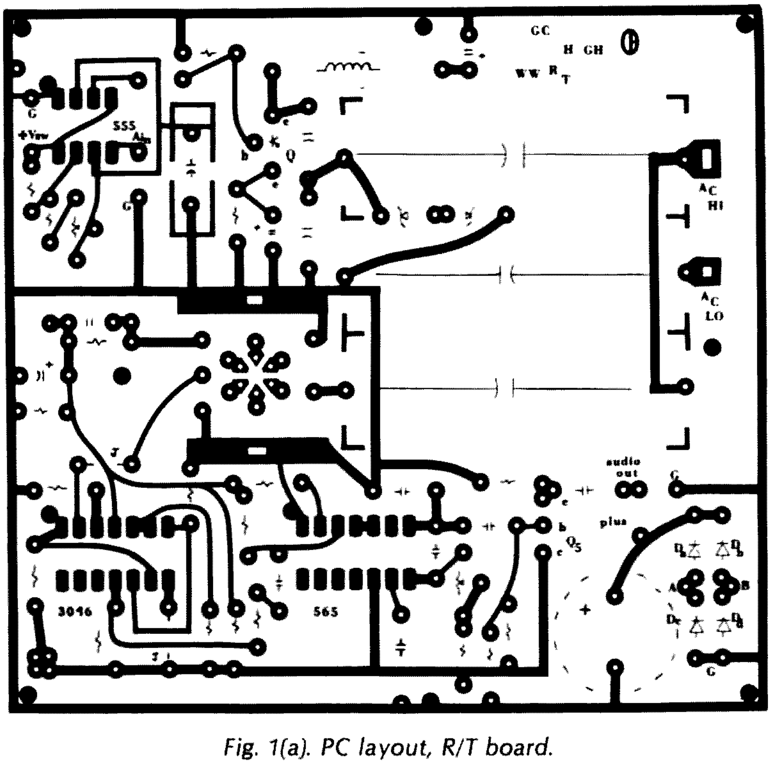


Fig. 1(a). PC layout, R/T board.

Fig. 1(a) is the PC board

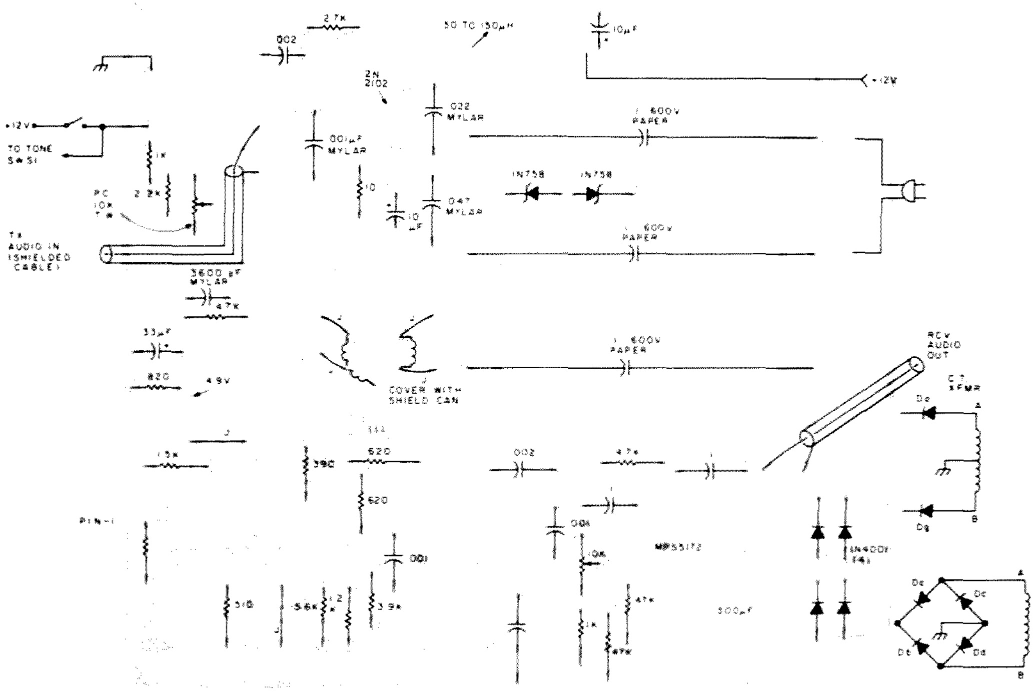


Fig. 1(b). Component layout, R/T board (foil side view).

layout for both transmitter and receiver, or what I call the R/T board. This is the heart of the system to allow hooking up to your power lines. Fig. 2(a) shows two boards—one that accepts up to three CD 4001 ICs and the components needed to handle the generation of up to six control tones (audio), and a second board that can be split up the middle. (See the vertical black line that appears to do nothing electrically.)

The left half of this layout is the audio amplifier (follower, really) and

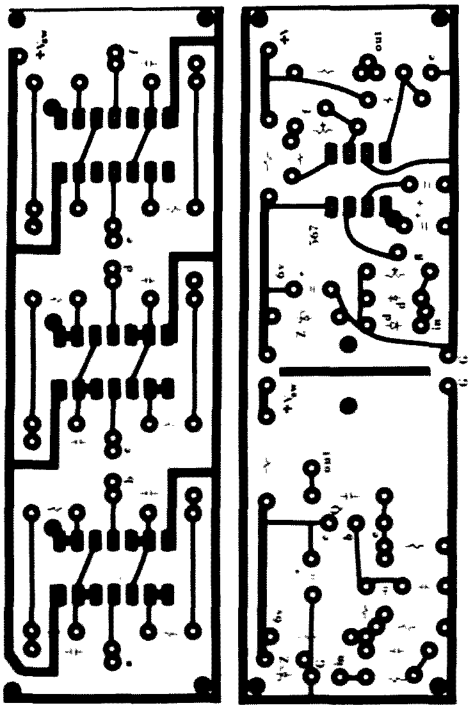


Fig. 2(a). PC layout, tone generator and audio amplifier/decoder-buffer boards.

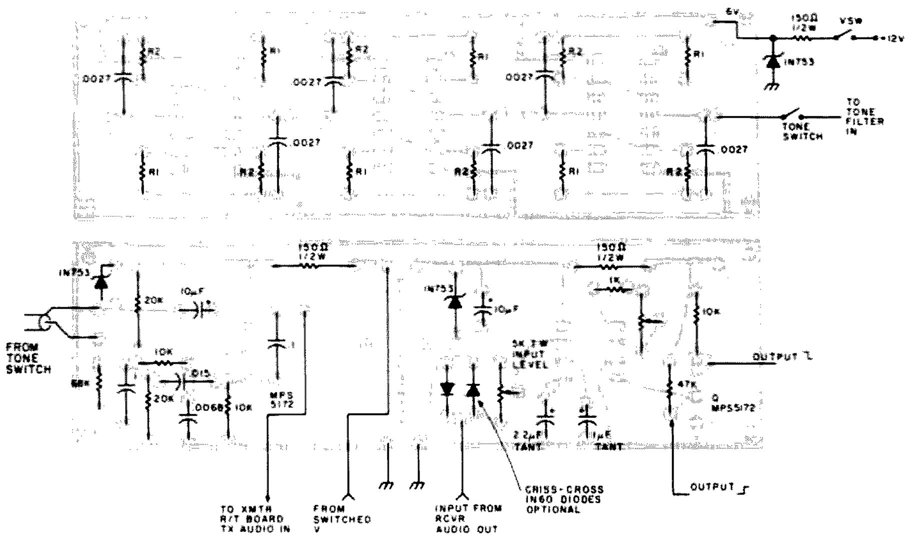


Fig. 2(b). Component layout, tone generator and audio amplifier/decoder-buffer boards (foil side view).

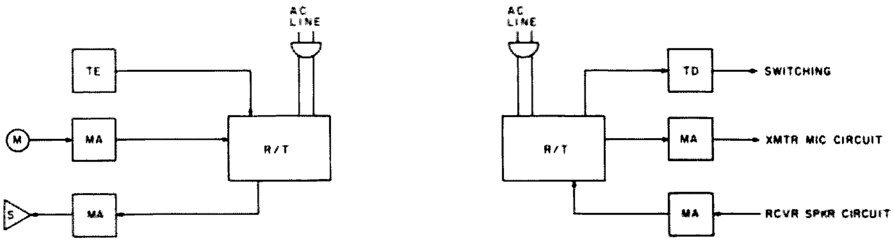


Fig. 3(a). M = microphone. S = speaker. MA = amplifier and matching transformer, if required. TE = tone encoder. TD = tone decoder. R/T = receiver/transmitter board (Fig. 1).

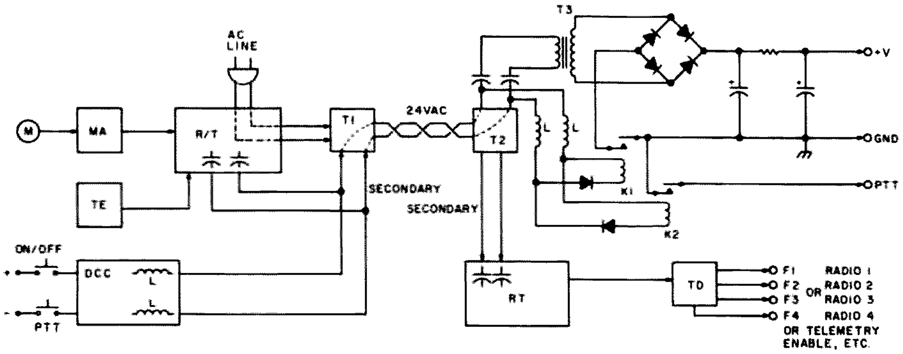


Fig. 3(b). DCC = dc control unit (as required).

X #	Tone	X #	Tone
L 1	69.7 kHz	H 1	120.9 kHz
L 2	77.0 kHz	H 2	133.6 kHz
L 3	85.2 kHz	H 3	147.7 kHz
L 4	94.1 kHz	H 4	163.3 kHz

Fig. 3(c).

the low-pass filter to follow the tone generators. It is shown as an MPS5172 in Everhart's article, Fig. 2, page 53. The right half of the board is all the circuitry to decode and/or buffer/invert a received tone. It is the same type MPS5172 (Q6) and NE567 shown in his Fig. 5.

Once these Figs. 1 and 2 of my PC layout have been done in the photo negative stage, they may be cut apart and boards made in any combination or quantity. The PC board layout removes all the headaches and a lot of the work of this job, so I hope more of you will try N2CX's ideas.

I planned Fig. 1, the R/T board, as a transceiver-type item, because I, too, would like to be able to monitor gear in the ham shack while I am in other parts of the house. I thought it would be nice to be able to have it a two-way circuit, as I'm sure many hams would. The end result of my efforts can be built into a small, attractive case with a carrying handle on it. This allows use anywhere in the house or outbuildings where there is a wall outlet.

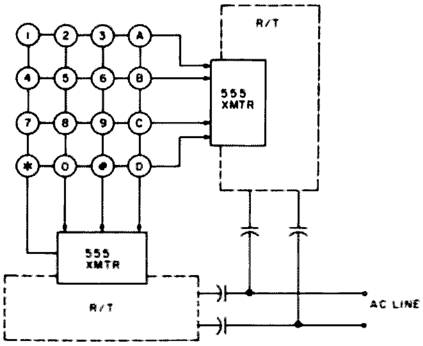
Build up two complete R/T units like that and you have one wireless intercom that can be carried about from room to room and plugged in, while the second unit babysits your child or your ham gear for you. The R/T board contains all the necessary components to take audio in and give rf output ready for, and attached to, the power line in transmit—and the same in reverse, in receive. All that is needed in addition is some obvious switching and an audio amplifier. This would boost up a microphone level that is too low (1.4 V required at the NE555 input) and a received audio that may be lower than you want. Then get the speaker and microphone of your choice.

I got around the latter by using an older Motorola speaker-microphone in one unit, with a coiled cord like those used on the FM handie-talkies. Use the small transformers shown to match up impedances where and when required by what you use. My audio amplifier was a 1- to 2-Watt per channel, with one IC that you often see in a child's record player of the less expensive variety.

To give you an example of how I use all this—I sample a small amount of audio from the speaker output lines through a shielded cable and feed it over to the one R/T board I have built into my audio control unit in my console. The audio unit allows me to add tones, touch-tones™, and the like to my rigs, and also has decoding for the receive side of things. By adding the R/T board to the unit, I now can place any of these tones, voice from the station microphone, or audio from the receivers into the transmitter portion of the R/T board and ship it anywhere on my property

where 120 V ac, 60 Hz is run.

Out on the remote end, where you have taken the R/T unit, this audio is taken back off the power line, decoded if required, and/or amplified up to speaker level. It has been a ham shack-to-garage and tower-house intercom, a control unit from shack to tower house for EME array control (a 150-foot unwired blessing), and even a two-way setup back to the woods almost half a mile away—where all I run out there is a low voltage, 24-V ac line to avoid electrical code (and cost) problems. See Fig. 3(b).



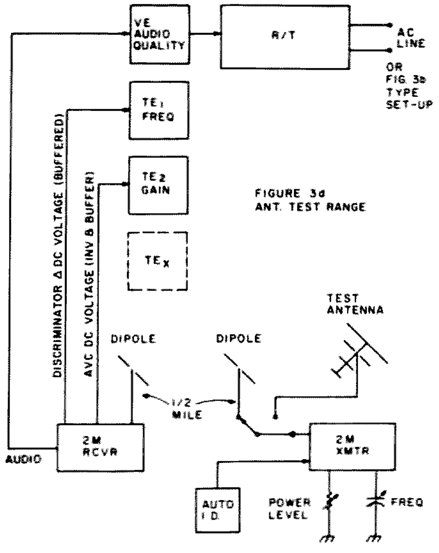


Fig. 3(d).

The two R/T units, in that case, are merely coupled into the 24-V ac secondary of the ham shack end and decoupled at the 24-V ac primary of the woods end. The woods-end transformer then transforms back up (to the 48 V ac I needed for a 30 V dc and allowing for line drop from the ham shack to the woods). Direct current control is sent down the same two wires for a one pair/three duties system.

My only concession in the R/T use was to utilize different rf frequencies each way, so that I can override receiver audio coming my way when I want to transmit either audio or a control tone. For monitoring the local repeater from anywhere in your house, it is great! A single tone is sent along with the microphone audio while you are transmitting. After the audio is demodulated from the rf carrier and leaves the R/T board at the ham shack end, it goes two ways. The audio goes through a parallel trap to reject the tone, to a one-stage audio amplifier (later found to be unnecessary), and, via a pot, to the microphone input circuit. The pot allows me not to have to change levels in the radio or station microphone setup.

The second audio direction is for the tone; it is through a series pass filter, to reject audio and pass tone, and back to the one-tone filter and decoder you see in Fig. 2. That, in turn, when sensed and decoded, pulls in a relay and keys the transmitter. In the other direction, the audio mentioned earlier, from a receiver-speaker circuit, is coupled into the transmitter half of the ham-shack-end R/T board and put on the ac power lines. Back where I am (remote), the receiver portion of my R/T board demodulates the audio from the rf carrier, amplifies the audio, and presents it to me at the speaker.

I have added some complications since I want to monitor more than one radio and I don't just want to listen to noise at the remote end. On FM, that is not bad, as the radio has a squelch that keeps the audio off the transmitter input line of the ham shack R/T board, but I also monitor 50.125 MHz on SSB. To get around this, I have an audio-type squelch in the audio console that, when the radio speaks, keys a tone along with the audio (sort of continuous-tone squelch style). When this tone gets to my unit (remote), it is handled just like the other direction, by splitting the audio and tone. The tone also lights an LED corresponding to what tone is controlled by which radio spoke. By using more than one tone at the remote end, I can control which radio I am putting the microphone audio into and keying. That about sums up one of my dandy uses, one of the reasons for writing this article, and the prime reason for my expanding it beyond just the PC board layouts.

I have changed some of the pin numbers of the ICs due to my board layout, so I have re-drawn the entire R/T board schematic as Fig. 4. The numbering on Fig. 4 and the layout now agree.

In the original article—in case they are not caught in the reader's column—let me say that there were a few errors and omissions. The pins on the "B" tone oscillator in Fig. 2 were omitted. I completely changed these, due to my layout, but in the original article, the left part should have inputs of 8 and 9 and an output of pin 10, and the right part, inputs of 12 and 13 and an output of 11. Left for right numbering can be traded, if it makes your wiring easier, but don't accidentally trade inputs for outputs.

The four parts of the IC are identical in operation. In the original Fig. 5, the ICs were labeled incorrectly as 576s. They are the familiar 567s. And while I am on the 567s, beware of too much tone input. 50 mV should be maximum, if you want to preserve any narrowband characteristics. Q5, in Fig. 4, can supply much more than that. I have added limiter diodes to the circuits and a level pot that you can adjust on the PC board. If you have tone-falsing and -failing problems, act accordingly.

One other comment on the original article. Fig. 6 shows how to re-wind the rf transformer. While this worked well, it was a lot of work. I allowed, on the PC layout, for you to use a much more common coil form put out by many vendors through most supply houses. Wind the transformer on it in exactly the same manner as shown in the original article, cover with a matching small i-f coil shield, and the results will be the same. I also left the coil pinout the same, so don't forget the jumper

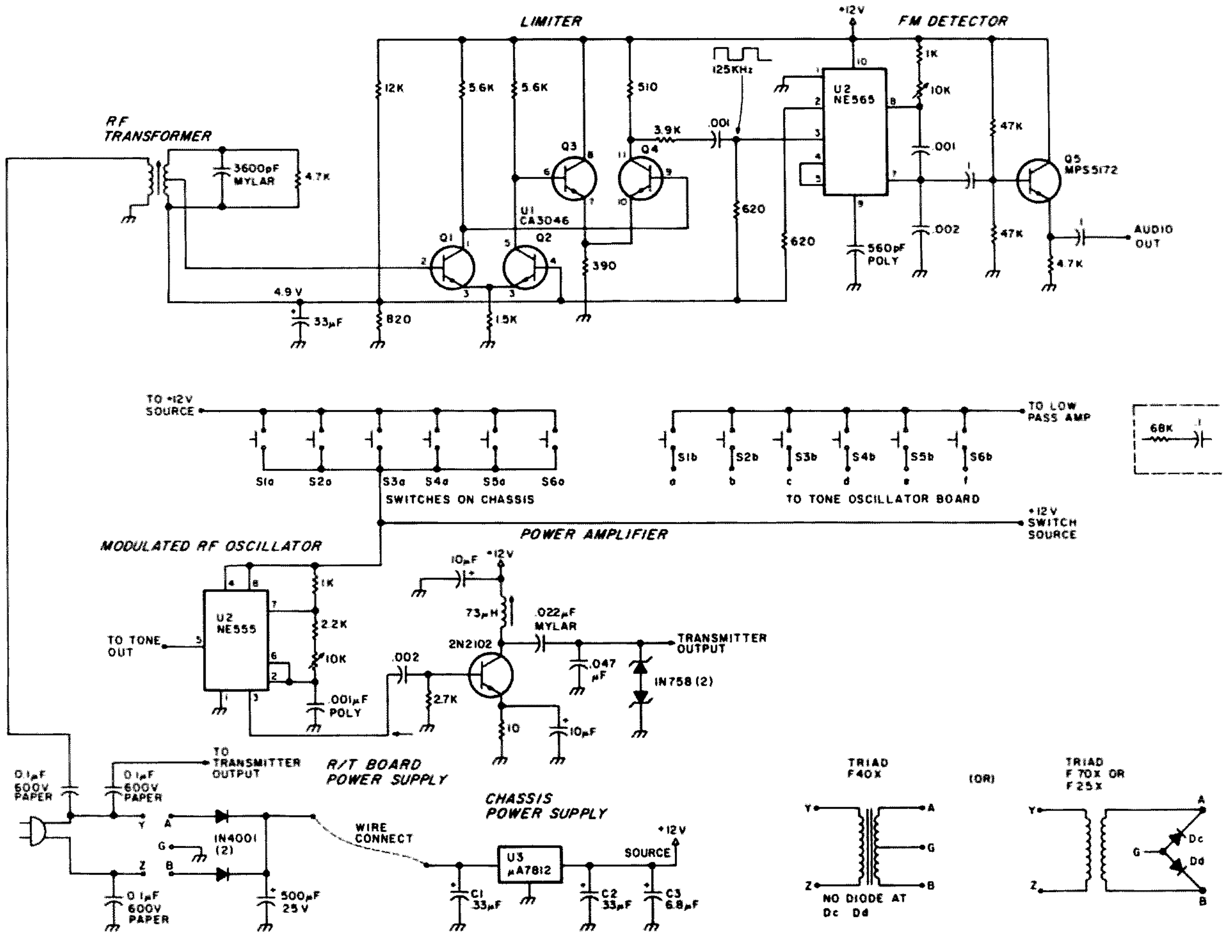


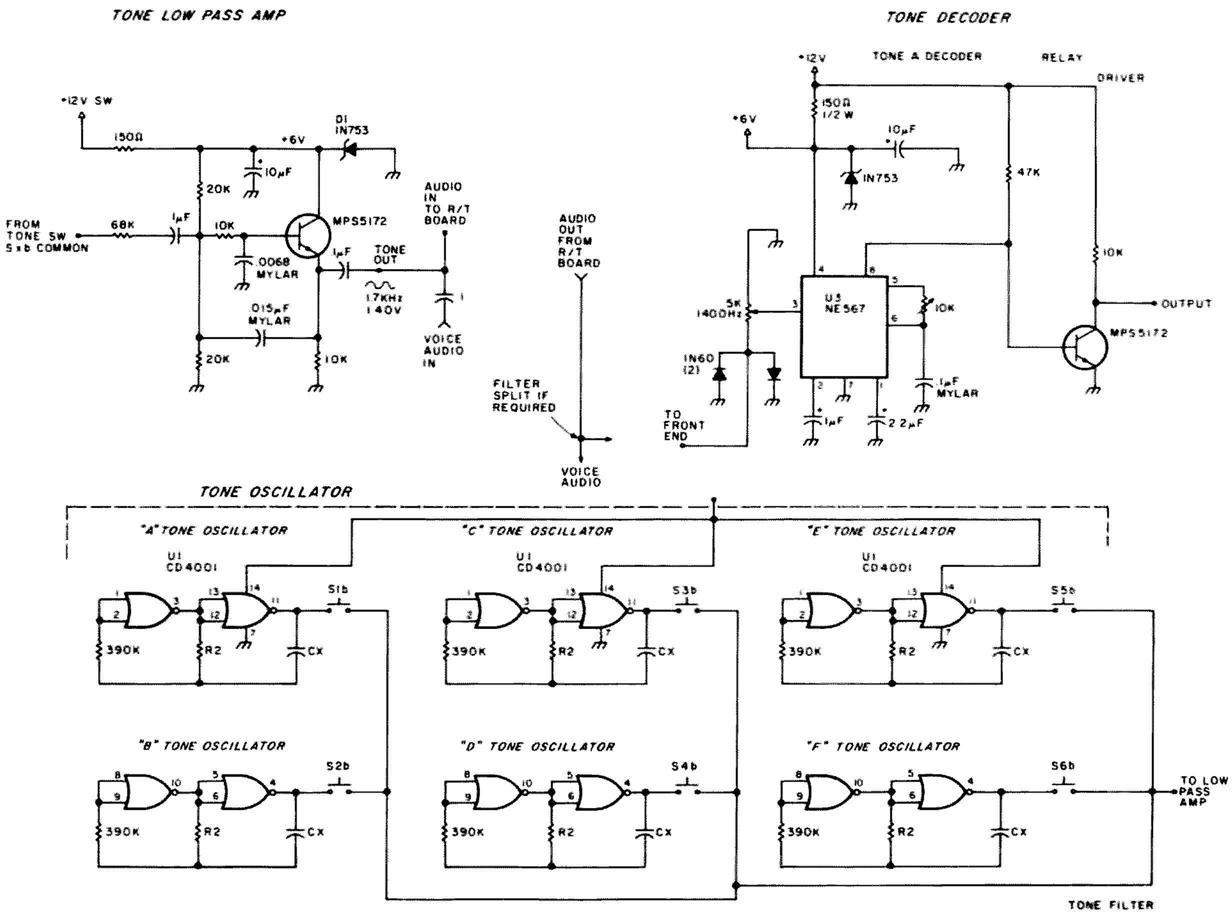
Fig. 4. Mount 7812 to chassis heat sink. Choose R2 and CX for desired tone. Recommended values are R2 = 100k pot and CX = .001 to .0047. Trim pot around center and change CX for coarse range.

wires (five are required) from the transformer base to each circuit. If any of the jumpers have to cross, be sure they are insulated wire.

I'll add in here a few useful notes on Fig. 3 concerning the hookups and the parts to use. Fig. 3(a) shows the simple form of wireless intercom unit used as a transceiver extension or remote. The mA units should be whatever matching transformers the microphone and speaker require to properly couple to the R/T board. The ham shack mA units are handled the same way, properly matching your rig with respect to microphone input and audio output (phones or speaker). Since this will vary so widely, I have chosen only to block-diagram it. Keep it as simple as possible at first, until you see what you really must have. For example, use a .1 capacitor from the speaker line to the R/T unit and from the radio audio gain-control to control-level. Add a pot for level later, and/or come off ahead of the rig gain control, to allow a quiet rig in the house with the XYL while you monitor from out in the garage or wherever you might be. Then add the audio amplifiers where required. There are many cases where audio amplifiers might not be needed at all.

Fig. 3(b) is a special case. I have found it very useful to reduce wiring between two points when there is *not* already a 120-V ac, 60-Hz line. See Fig. 3(b). If you run a safe wire, like rotor cable with good insulation, not many codes would prohibit such an installation. If 120-V ac wiring were run, all kinds of codes, regulations, electricians, and costs get into the act!

Skipping over Fig. 3(c) for a few paragraphs, since it is really a part of Fig. 3(d), Fig. 3(d) concerns a special situation not covered in Fig. 3(b). It allows a simple, remote transmitter-receiver pair to be located remotely from the ham shack/antenna location. The remote site then forms the heart of my antenna test range. Provisions are made for voice to return back over the wired circuit for both checking audio quality and intercom use when someone is at the remote site. Next, one channel (rf) of the wired remote is wired to use the buffered dc voltage from the receiver's discriminator (the VHF receiver). The buffer also shifts the level to allow direct use with the 555-modulation pin (all positive voltages), by shifting the discriminator minus 6 — 0 — plus 6 V dc (approx.) over to a 9- to 11-V dc shift. When the receiver is right on, the 10 volts then represent 0 V at the discriminator. Since the transmitter end (VHF) is where you are, the frequency is used to be sure you are sending right in the center of the receiver's (VHF) passband, where the receiver has been aligned, calibrated, and measured. That is, uV antenna strength equals some arbitrary avc reading, recorded. You use your reference dipole—see Fig. 3(d)—to



TONE FILTER
TONE DECODER
TONE GENERATOR

the remote-site dipole first each time, and if the frequency reads all right, then any differences should be in the path (not likely at ½ mile, but weather affects it some) or in the receiver itself, due to some factor such as temperature or aging. Then you proceed with your test antenna, compared to previous antennas, and the reference dipole using the avc voltage reading on a separate rf-wired channel.

Using the separate wired channels of rf allows continuous monitoring of all, simultaneously. I intend actually to monitor three voltages (plus frequency) in this measurement, along with a low-power transmitter whose output I can both accurately measure and vary continuously from 1 to 10 Watts. The remote receiver can be any FM unit on the frequency of your antenna interest, but preferably solid state to reduce power consumption on your 24-V ac line out to the site. Then you measure and send back (by three rf channels) the two limiter and avc readings.

By varying the transmitter level, you can keep the receiver down out of limiting where the avc is linear or, at least, repeatable. Remember, you are not trying to recover audio from the VHF transmitter at the VHF site at this point, but only to compare the signal strength of two antennas: the reference dipole vs. your new model. The range is approximately ½ mile, or 2640 feet, or 417 wavelengths on two meters, and gets better as you go up in frequency. This keeps reflections and stray ground clutter to a minimum, as well as allowing you to plot your antenna, and any stray lobes, accurately. You require only a well-calibrated antenna rotor and readout. My remote site is due east (90 degrees) from me; that becomes 0 degrees on the antenna plot. The north rotor stop is a pain you live with, but I avoid extra work by starting at 270 degrees plot (due north—compass) and plotting around through straight at the site and through 360 degrees in 5-degree increments.

If you try this kind of work, always allow a full 360 degrees around—and then back in 5 degree increments. Trying two or three such trips and averaging the results is even better. This allows for any rotor over-travel or coast when stopping. Whatever you do when comparing antennas, or how you do it, never—repeat never—believe the reports of signal strength changes from antenna to antenna that you get from another station. Modulation, keying, etc., is all right, but unless you like to climb towers, changing antennas back and forth and never seeming to get anywhere, stick with a measured system. This is not to say you can never have another amateur whose setup and serious attitude matches your own or the level of confidence you want, but to suggest you don't buy the casual-type observer. He may have changed rigs, antennas, and use his deaf ear for an S-meter! Why do you think I went to the trouble of a range?

Fig. 3(c) was thrown in to show how I can control 16 channels of rf using only eight frequencies and up to as many audio tones as you

can discriminate between or use without ending up in a crossfire mess. If the numbers and the control pad look familiar—they should! I claim no credit for this idea, beyond acknowledging that a lot of work and research (translation: money!) went into the selection of the touchtone™ frequencies used by the phone companies. Such things as harmonic relationships and beats were all thought out for me; I just shifted the tones up to rf frequencies and used the same 567 decoder scheme used by many autopatch setups, but at rf frequencies. The 567 is good up to 500 kHz, so I am well within limits. Add to the fact that audio down a power line would compete with the 60 Hz and be hard to separate, and the 10% bandwidth at rf is several cycles you can easily zero in on versus a few cycles at audio, and you realize why the shift up and the manner I did it.

Fig. 4, as stated earlier, is just schematics—the same, almost, as the originals electronically, but divided up as they appear on the PC boards and numbered in the PC board manner for easy troubleshooting.

I'm sure you will find at least as many uses for this terrific circuit combination as I did, so I hope the PC boards make it a lot easier for you. Any other uses or ideas using these little gems I'd like to hear about, and an SASE is required only if you need a reply. Electronics or circuitry questions should go direct to N2CX, and PC board or uses questions to me, to keep things sorted out. Give remote control a try—you'll like it, I bet! ■

New Products

from page 24

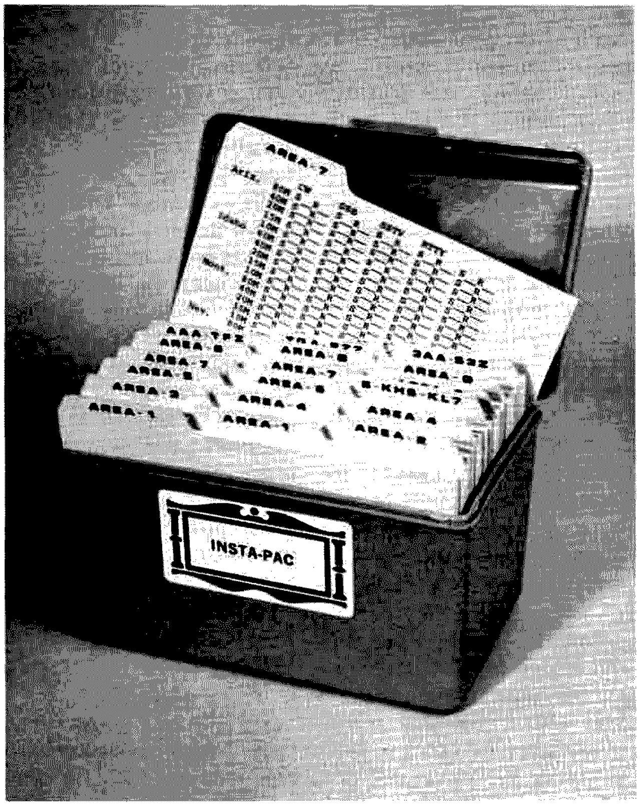
tunity to save time and money in QSLing as well as have an instant reference right at his fingertips. Duplicate QSLing will become a thing of the past. You know at a glance what you have worked, on what bands and modes, and, most important, what needs to be confirmed. Each call area of the United States is divided by state, band, and mode. An extra column is provided for new modes or notes. As an added feature, a section is provided for every country of the world. "Insta-Pac" is attractively packaged and would be an asset to any ham shack. It has been developed by KH6ITY and is offered with an unconditional money back guarantee if not completely satisfied.

For further information about this new system, contact *Insta-Pac, PO Box 22974, Honolulu HI 96822.* Reader Service number 143.

NEW BEARCAT® POCKET SCANNER RECEIVES BOTH AIRCRAFT AND GROUND-CONTROL COMMUNICATIONS

The world's first pocket-size scanner radio capable of receiving both the VHF-AM aircraft channels and UHF-FM channels has been introduced by Electra Company. For the first time, airport officials, operating personnel, pilots, and others interested in airport operations can carry in their pocket a single radio which can keep them informed of both tower-to-plane and ground-control communications. The new "Bearcat® Thin Scan Aircraft" scanner is just 2¾ inches wide and 1 inch thick, and weighs a mere 10 ounces, making it a true pocket portable. The radio is capable of receiving up to 4 channels in any mix of the two bands covered. Each channel is provided with a lockout control for bypassing when desired.

Continued on page 157



The Insta-Pac.

The Bearcat® Thin Scan Aircraft scanner.

Tim Scarlett WD5BNL
428 East Spring Valley
Richardson TX 75080

Blueprint for Biofeedback Experimentation

—fertile ground for pioneers

The idea for this article came from an experiment into the capabilities of human movement and control. The main question was how it would be possible for a person to control electrical devices and effectively communicate without movement of any kind. This restriction included the use of speech, sound, or any alteration of respiration.

Upon first consideration it seemed an impossible task, as the only apparent control would be over thought. This is where the idea of control by brainwave came to mind. No, I'm not talking about ESP or psychokinesis, but biofeedback. Biofeedback is the process of monitoring and controlling certain body functions . . . in this case, alpha brain waves.

The main purpose of biofeedback is to provide greater relaxation and creativity by controlling certain types of brain waves. In this article, we will be concerned with alpha waves.

A device called a "biofeedback monitor" is used to amplify and detect alpha waves in much the same way as an electroencephalograph. A band containing electrodes is fitted around the head, and when the brain is producing an abundance of alpha waves, the monitor gives indication with a tone or light. By learning to control the tone or light, you learn to control your alpha waves.

At this point, I'm sure you are beginning to see the *modus operandi* of the alpha control. Fig. 1 shows a simple block diagram demonstrating the basic principles involved. In this diagram, a photocell light and its counterpart, a tone-voice-operated microphone, are used to show a working system in its simplest form.

While the system described would work, it was not made to replace electronic switching and logic circuits, which would be more accurate. Schematics for an actual control circuit have been omitted, as the design and construction would vary greatly with the type of monitor ouput.

There are three major types of outputs used in the majority of monitors. They are: threshold tone, frequency-modulated tone, and light or LED indicator.

As for the monitor itself, you can get it pre-assembled or in kit form. There are models with simple one-mode outputs and ones with more complex multimode outputs. The range of control can be increased by the addition of a transmitter connected to the monitor and a receiver connected to the actual control circuit. A wireless microphone and receiver would work nicely, and possibly allow the utilization of existing equipment.

The next logical step would seem to be to develop a means of controlling more than one device. One possible but untested idea would be the use of a row of lights that would flash in sequence, somewhat like a public band scanner. By having the lights represent controlled devices, or letters, any number of appliances might be controlled simply by stopping the scan on the desired light and device it represents. Of course, the speed in which one could control his alpha waves would be a factor in the speed of the scan. In such a manner, a person totally paralyzed could communicate and, to some extent, control his environment.

It has been my honest effort to present these ideas in more than the light of a laboratory or scientific curiosity, and I now leave further experimentation and development to your able ingenuity. ■

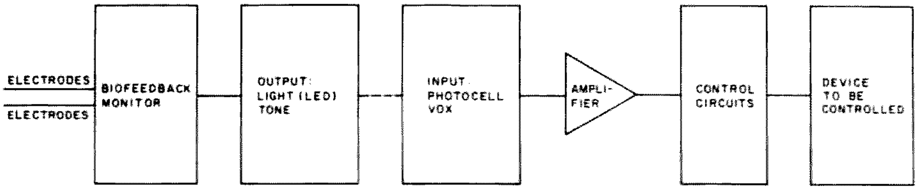


Fig. 1.

Eric Shalkhauser W9CI
527 Spring Creek Road
Washington IL 61571

The History of Ham Radio

—part X

Reprinted from QCC News, a publication of the Chicago Area Chapter of the QCWA.

The Second Radio Telephone Conference, called by Secretary Hoover, convened on March 20, 1923, to solve the deplorable situation brought about by the controversy over wavelength assignments. Broadcasters, the amateurs, the Army and Navy, the ship operators, and the commercial interests could not come to a common agreement as to wavelength allocations and thereby avoid woeful interference. Clearly, from an administrative standpoint alone, the broadcast listeners were desperate. The impasse which existed required a solution.

After several months of meetings, serious discussions, and lengthy deliberations, not even the amateurs had guidance or a clear go-ahead on how to interpret their standing with the Commerce Department. The American Radio Relay League had made a series of suggestions. The amateurs in all parts of the country, now almost 21,000 in number and licensed to operate in the narrow 200-meter range, found solace in the fact that they had pooled their ideas and suggestions through their respective district directors.

The ARRL Board of Directors based high hopes on all of these inputs. So, when recommendations were issued on June 28, 1923, by the Department of Commerce in the form of General Letter #252, directed to all government district radio inspectors, they read as follows:

C.W. Licenses

DO you fellows know that your station license provides that the apparatus described in the application shall not be changed without permission? And that a license granted a spark station is not good for the use of C.W. equipment? It sounds queer, considering that any complaintant ought to prefer a tube set to a spark, but if anybody wants to "get" you on it they can.

A broadcast listener recently filed a complaint with a radio inspector against a well known eastern spark amateur, alleging the use of an illegally broad and too-long wave. Called upon the carpet, there was no evidence that his spark, which was good as such animals go, was not entirely legal. But he volunteered the information that he was experimenting with C.W. anyway and the interference probably would be still further reduced. Whereupon, altho his spark set was O.K., he was informed that the use of C.W. was in violation of his license, and it was suspended for three months.

Moral: If the equipment you are using is greatly different from that for which your license was issued, take up the matter with your Inspector and "get right."

QST - March, 1923

General Letter #252

"General and Restricted Amateur Radio Station Licenses will be issued permitting the use of any type of transmitter (CW, spark, ACCW, ICW, SC, and phone) with the restriction that when using pure CW, they are authorized to use wavelengths from 150 to 200 meters. When using spark, ACCW, ICW, unfiltered SC, and phone, the wavelengths from 175 to 200 meters only can be used. The types of transmitters must be specified in the application and the license.

"Special Amateur Radio Station Licenses will be issued permitting the use of pure continuous wave transmitters only, authorizing the use of wavelengths from 150 to 220 meters.

"For the purpose of application of Amateur Stations, pure CW is defined as follows: A system of telegraphing by continuous oscillations in which the power supply is substantially direct current as obtained

from (1) a generator, (2) a battery, or (3) a rectifier with an adequate filter. (A filter is not deemed adequate if the supply modulation exceeds five percent.)

"On licenses issued for Amateur Stations you will include the following: 'This station is not licensed to transmit between the hours of 8:00 and 10:30 p.m., local standard time, nor Sunday morning during local church service.'

"Special Amateur Stations must be operated by persons holding an extra first class grade Amateur operator's license, or a commercial extra first class operator's license. Applicants must also meet the requirements of Regulation 63.

"A new class of Amateur operator's license is hereby established, to be known as 'Amateur Extra First Grade.' Licenses of this grade will be issued to persons passing the required special examination with a percentage of at least seventy-five and code speed in sending and receiving at least twenty words per minute, five characters to the word; who have had at least two years experience as a licensed radio operator; and have not been penalized for violation of the radio laws subsequent to the date of these regulations."

The government supervisors, located in the several United States radio districts, upon receiving the new regulations, were requested to notify all amateur radio licensees, general and restricted, to submit their respective license papers to the supervisor's office and have them modified in accordance with the new regulations. After they were so certified with a copy of the new rules appended, they were returned, officially endorsed, extending the wavelengths range and specifying the quiet hours. No changes were made in their expiration date.

All amateurs who held *special* licenses were notified that their licenses were cancelled and new licenses would be issued in accordance with the new permits now granted. Up to the present, all amateur licenses were issued specifying the wavelength of the operating transmitter to be used. From this date on, a license permitted a station to change the operative wavelength to accord with the bandwidth permitted and as the type of emission specified.

Variable frequency transmitter circuits were not generally known among amateurs. The progress of the art and the know-how was still lacking in 1923 in this respect. Even the well-informed and up-to-date amateur solved the changing frequency problem by having more than one transmitter available, usually a pure CW of low power and another with either ICW or ACCW plate supply. Every license issued by the Commerce Department required that the licenses specify not only the wavelength limits of the transmitter, but also the emission type and the apparatus to be used including the antenna length and construction. If an amateur qualified as an extra grade operator, he could apply for two licenses, a special and a general. The special was then given a "Z" call.

The ARRL had recommended that the amateur with two years of experience and a twenty-words-per-minute code speed be issued an extra first grade amateur operator's license using a wave transmission length up to 220 meters. (Even at this date all authorities assumed that this stipulation was a decided advantage for DX.)

It also was understood that transmissions on wavelengths other than 200 meters by the amateurs could be allowed on the issuance of a license specifically noted on the application. A second wavelength, perhaps somewhere between 175 to 180 meters, could be granted. The 150 to 220 meter band specified in the 1923 Regulations gave the Secretary authorization to grant licenses upon request provided the amateur could meet the stipulated requirements and so requested in his application.

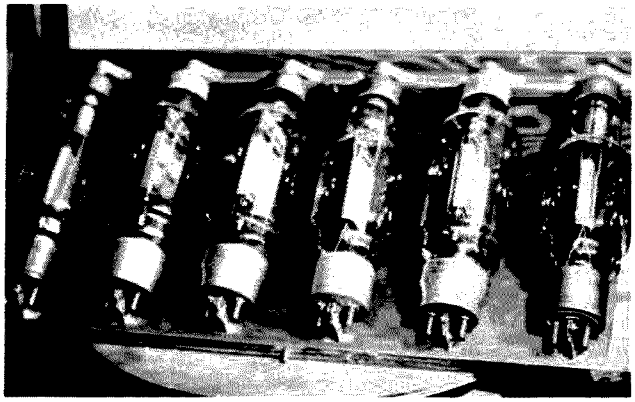


Fig. 1. The 250-Watt UV204.

How the Need for "Plate" Power Was Met

In the early wireless days, the conversion from simple spark coil to high voltage rotary-gap transmission was not difficult. But going over to the vacuum tube for CW operation was by no means an overnight accomplishment. To put continuous wave power into the antenna, the amateur initially had available a small amplifier tube and a larger five-Watter, known as the UV202. Subsequently the fifty-Watt 203 was available, followed soon by the 250-Watt UV204, a real "power-house" for most DXers (Fig. 1).

With the introduction and development of the power tubes, there naturally was need for a direct current supply to energize the plate circuit. Much of the spark gear the amateur had accumulated and used for a power source was now destined for the surplus stockpile. The new regulations specified pure CW or nearly so, and this necessitated some type of direct current source, often up to several thousand volts. Various methods to obtain this voltage were outlined in the ham literature: (1) a motor generator, or (2) a battery, or (3) a type of rectifier with filter. Much experimenting took place. This voltage was referred to as the "B" voltage supply.

The Motor Generator

Although not the most practical source of high voltage dc nor the least expensive, a generator was the easiest and simplest way to quickly come up with plate power of one- to two-thousand volts. The ESCO machine from Electric Supply Co., of Stanford CT, could be found in many ham shacks. Early commercial broadcasters also used this equipment. However, the supply required filtering to reduce the ripple modulation to a point where it would meet the specified five percent. Using a motor generator required ac starting controls, considerable power wiring, and usually a remote and out-of-the-way installation of the entire unit to reduce hum and noise when operating voice modulation. Weight and expense were

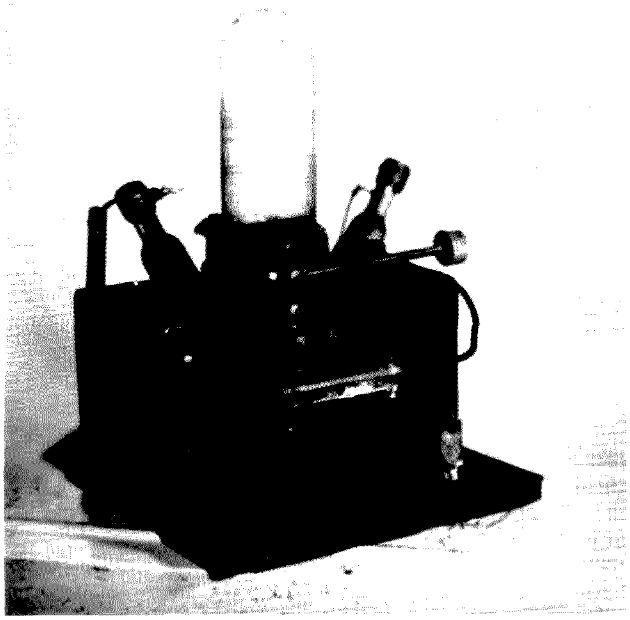


Fig. 2. A one-kilowatt transmitter.

responsible for the few installations of this kind.

Edison and Lead-Acid Batteries

Edison-type batteries were available built in small but compact units. They were kept charged with a Tungar charger-rectifier connected to house current. The lead cells could be obtained in compact assemblies giving sufficient wattage for the smaller transmitting tubes. All these units were messy and, besides giving off a gas odor, ruined many floors and carpets.

Typical of what certain amateurs were capable of and determined to build is illustrated by the enviable installation of radio NU9BHT. This beautiful layout required assembling and building one thousand individual lead-acid cells. They were contained in 4½″×5½″ hard rubber cases, with one positive and two negative plates per cell. Hard rubber trays contained 25 cells each and were treated with acid-resistant paint to provide protection and longevity. With each bank delivering 50 volts, separate switches were used to make appropriate connections for charging each bank, either separately or in four bank series of 200 volts. A motor generator battery charger delivering 250 volts kept the batteries fully charged.

Installations of this type necessitated adequate ventilation, care, considerable service, and a separate building to house the equipment. The circuit diagram of the station transmitter adapted itself to frequent modifications and changes to keep it up-to-date.

With the development of crystal control and other experimental features added from time to time, NU9BHT established an enviable record while in service. Operating primarily on 40 meters CW and occasionally on 20, as an official ARRL relay station, it contacted all Australian districts, making five-continent QSOs in one evening. This was an exceptional accomplishment back in 1923. Not many installations of this type prevailed in hamdom. With a battery voltage source, no filtering was required. This was *pure* dc!

The Rectifiers, Mostly Chemical

Over the next few years, the various amateur publications carried a series of suggestions for methods of building rectifying equipment for the B supply.

How did the amateur go about putting together a chemical rectifier? He was on the lookout for—item one: chemically pure aluminum sheets; item two: chemically pure sheet lead; item three: a quantity of pint-sized jars; item four: several pounds of borax; item five: plenty of distilled water.

For each cell assembly he figured that approximately 40 volts could be rectified from a 60 cycle source. This translated to about 50 cells required for a 2000-volt output. Forming and placing such a home-built rectifier initially into operation required a great deal of experimenting to overcome a whole series of mishaps. Rectified ac output of this type was always accompanied by a 60-cycle ripple hum, which

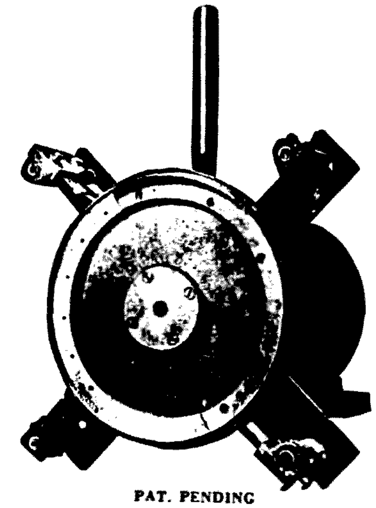
THE SUPER-SYNC

The synchronous rectifier that can be filtered

The Super-Sync is the only rectifier that delivers a pure D.C. tone and gives 100% rectification at all times.

It is the only rectifier that is adaptable to either high or low power sets as it easily handles up to 4,000 V. at 250 M.A.

The commutator on the Super is eight inches in diameter and is driven by a ¼ H.P. 110 V. 60 cycle 1800 R P M synchronous motor.



PAT. PENDING
PRICE $75.00 F. O. B.

With the Super there are no materials to change—just connect the motor and high voltage leads and forget about it as the only attention required is an occasional oiling of the bearing.

The Super practically eliminates interference caused by other types of synchronous rectifiers.

Write for descriptive literature.

MARLO ELECTRIC CO., 5241 Botanical Ave., St. Louis, Mo.

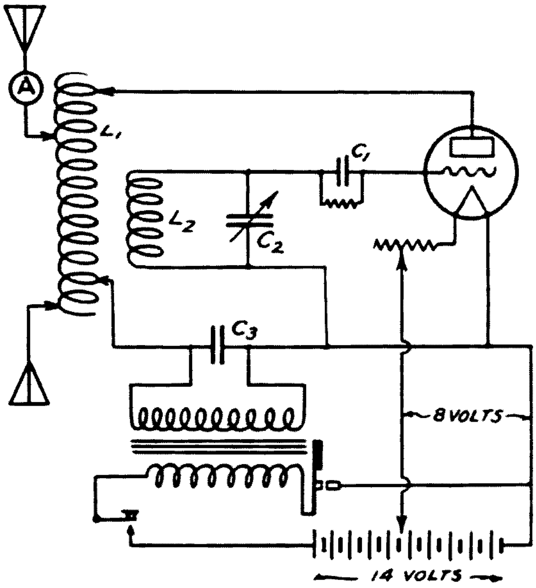
Just an Efficient and Reliable Form of Rectification

Fig. 3. A synchronous rectifier.

With a half inch spark coil a hard receiving tube may be used; either the Cunningham C.301 or the Radiocorp U.V.201 is suitable. For larger coils the 5-watt C.302 or U.V.202 may be used but less filament power is consumed by the Western Electric "E" or VT-1 tube. No 50-watt tube with proper plate insulation for spark-tube work is available just now but the C.303 or U.V.203 can be made to do.

Various circuits have been described in our pages in a paper called "A Spark Coil C.W. set," by Samuel Kopelson of 2BCF (May 1922—p. 66), and in "A Spark Coil C.W. Transmitter," by F. J. L. Duffy (March 1922—p. 28). In *The Modulator* for January 1923 there appeared on page 17 a concise paper by M. Joffe describing his spark-tube set at 2BYO.

The best plan of all is to remove the secondary entirely and re-wind the coil with wire 6 or 8 sizes larger. Robert Kraus of 2CEI finds that for a Ford spark coil the best secondary is one having 5000 turns of number 32 A.W.G. (B&S) double-cotton-covered wire. When the secondary is re-wound in this fashion no shunt condenser is needed in Fig. 4 and even for the other circuits it can be reduced to .001 microfarad. Three sheets of 4 x 5 tinfoil between 5 x 7-inch glass sheets 1/8 inch thick is more than enough.



L1—25 turns bare No. 10 wire on a 5-½ inch tube.
L2—20 turns No. 18 S.C.C. copper wire on a 3 inch tube.
C1—Mica condenser of .00025 to .0005 micro-farads capacity.
C2—Variable condenser, .0005 microfarads.
C3—Glass or other sending condenser.

Fig. 4. Specially-wound spark coils.

had to be adequately filtered before it could meet the prescribed specifications—especially if it was to be used for a near-pure CW purpose. Filters were needed to eliminate key clicks. With batteries, there was complete absence of blinking lights, buzzing, whining, vibrating generators, and many ac growls on the air.

Other Substitutes For B Supplies

A convenient and inexpensive unit known as the mercury arc rectifier, equipped with an electrolytic "keep-alive" mechanism, was extensively used to give up to 3000 volts of B supply power. Both voltage and current outputs satisfied a one-kilowatt transmitter (Fig. 2).

Also available was a synchronous rectifier, as shown in Fig. 3. A synchronous motor, 1800 rpm, carried a large-diameter split wheel, with which two husky commutator brushes made contact. In this way, the 60-cycle current was rectified and the pulsating directional output then filtered. These units were marketed under the name of Super-Sync and provided plate energy rated at up to 4,000 volts.

Some of the early plate supplies were obtained from specially-wound spark coils—see Fig. 4. Such transmitter assemblies put out an ICW signal, were extensively used, and solved the high-cost problem. It was necessary to adjust the vibrator frequently to obtain a smooth tone, the pitch being immaterial but often adjusted to satisfy the contacted operator at the other end.

Radio amateurs in the early 1920s were an experimental and ingenious lot. They solved their problems in the best amateur tradition. ■

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Charleston WV 25312

Maximum Security for the 22S

—remote control puts your Icom in the trunk

Probably one of the most versatile and easily modified radios on the market today is the Icom 22S. A multitude of frequency combinations can be selected simply by soldering inexpensive diodes into one of the 22 matrix board divisions.

The purpose of this article is to look at a few easy and inexpensive modifications which can be done to allow either greater frequency selection flexibility or remote control of the Icom "Mobile Marvel."

Upon examining the Icom 22S, one of the first things one usually notices is that, although the radio is advertised as a 22-channel rig, the programming matrix board and selector switch have 23 positions. To initiate 23-channel operations, all one need do is connect a short piece of wire from switch lug 23 to the 23rd diode row and program the row with appropriate diodes for the extra frequency of your choice.

The second easy modification is the use of the 23rd position in conjunction with a few diodes and a DIP switch to allow the selection of any combination of available frequencies. Articles in the *73 Magazine* issues of June, 1977 (p. 152), and May, 1978 (p. 158), showed DIP switch mounting methods which required external components subject to easy breakage, or required defacing the cabinetry of the radio. An alternate method which allows easy DIP switch programming without defacing the exterior of the radio, while providing a secure and strong DIP switch mount, is shown in Fig. 1.

All one needs to do is simply (1) remove the 24-pin accessory plug from its holder, cover it with tape to prevent shorts, and push it inside the case, and (2) glue a section of perfboard on the accessory plug support bracket, mount your DIP switch on the perfboard, and wire as shown in Fig. 2. At this point, your 22-channel radio can be programmed for any of the frequencies listed in the owner's manual, without resoldering diodes.

The final modification I will describe was inspired as much by my laziness as by security needs. Often I find myself needing to stop in town for some small item. As in most urban areas, this requires that either you remove your radio from the car or trust fate that it will be there when you return.

Not being one who enjoys disconnecting my rig and placing it in the trunk four or five times a day, I conceived the idea of remote controlling the Icom and mounting it in the trunk.

To my great surprise, this modification is both easy

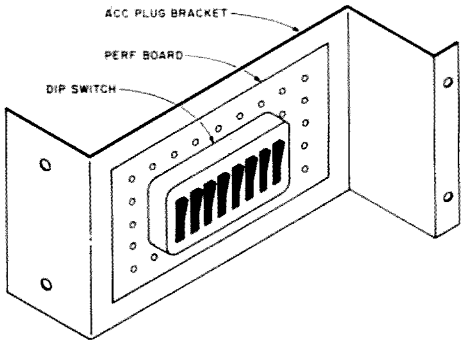

Fig. 1.

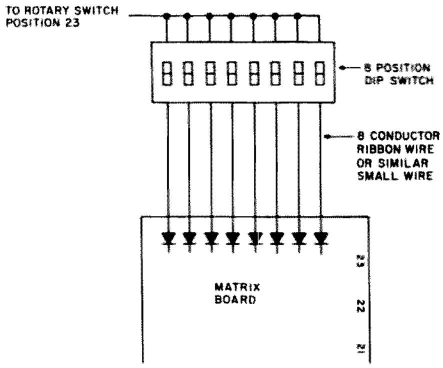

Fig. 2.

and inexpensive. All that is required is some wire, two potentiometers, two knobs, one male and female 4-pin mike jack, a speaker and miniature phone jack, a rotary switch, and a small box, such as the Radio Shack #270-236.

To accomplish remote frequency selection, run a wire from an unused channel position on the matrix board (Point A in Fig. 3) to the common of the remote 23-channel selector switch, via the accessory jack, as shown in Fig. 3. Note that the previously-mentioned DIP switch location cannot be used with remote control. It will be necessary to mount your DIP switch elsewhere (see Leon Baldwin's article in the May, 1978, issue of *73 Magazine*). Next, run your return leads from the rotary switch back to the matrix board via the accessory jack. All 22 previously-programmed channels cannot be remotely selected due to the use of the accessory jack to carry volume, squelch, and duplex controls.

If you do not have a 23-position rotary switch, an alternate method may be to use a double-ganged, 12-position rotary switch and toggle switch combination, as shown in Fig. 4.

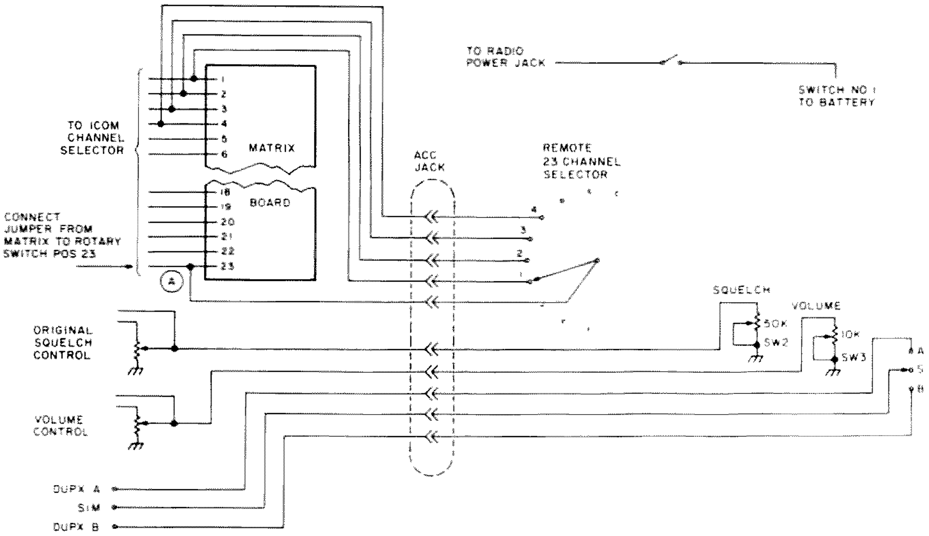

Fig. 3.

To vary the volume and squelch level, simply install a pot in parallel with the wiper on the original controls, as shown in Fig. 3. Slight problems may arise in the volume control circuit. Usually, this is due to a pot which will not adjust to a low enough value. It may be necessary to substitute a pot other than the one specified.

Duplex-simplex control also is accomplished as shown in Fig. 3. Power for the unit is delivered from switch 1 in the control panel.

To operate remote, install the unit with the power switch on the radio in either high or low position. Turn the squelch controls on the radio to maximum, and the volume to about mid-point. Place the channel selector in position 23, and control as usual from the remote unit.

I hope that this article will stimulate interest in Icom owners to build the remote unit, and possibly to try other remote control modifications to which this versatile little unit might well be suited.■

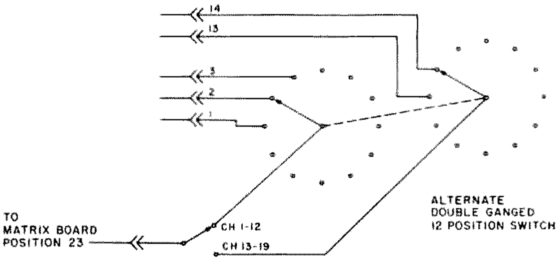

Fig. 4.

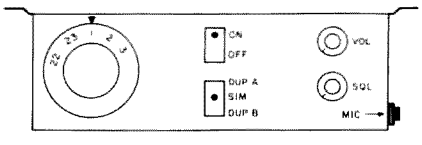

Fig. 5.

Phil Salas AD5X
1700 Stockton Trail
Plano TX 75023

The Big Blinker

—a visual signal for the deaf

A friend recently asked me for something which could be used in conjunction with an alarm clock in order to awaken his deaf nephew in the morning. The circuit which I finally came up with is shown in Fig. 1.

Basically, it works as follows: The sound of the alarm is picked up by a crystal microphone element, amplified by U1A and U1B, and detected by the full-wave rectifier consisting of U1C and diodes D1 and D2. The rectified voltage is next applied to a comparator (U1D). When the input signal is loud enough and of a long enough duration, the rectified voltage on the inverting input of U1D exceeds the reference on the non-inverting input, causing the output of U1D to go to Vee. This turns on transistor Q1, which then enables U2, a 555 timer operating as a one-second oscillator. The output of the 555 drives a triac, which in turn causes a lamp plugged into the ac socket to flash at a one-second rate.

For best results, tape the microphone to the alarm clock and adjust the comparator threshold so that only the alarm clock sound triggers the unit. Transient noises will not enable the circuit due to the RC time-constant at the detector output.

All of the parts are readily available at your local Radio Shack. I used an LM324 quad op amp, but any quad, two dual, or four single op amps can be used. The pin numbers shown were for my particular layout but, of course, any of the op amps can be interchanged.

This unit performs quite well, and is certainly more of an attention-getter than the original timer used. The original timer was used to simply turn on a light. The triac used can handle up to 6 Amps, so several lamps can be plugged into the unit. The lamps will continue to flash as long as the alarm is sounding. ■

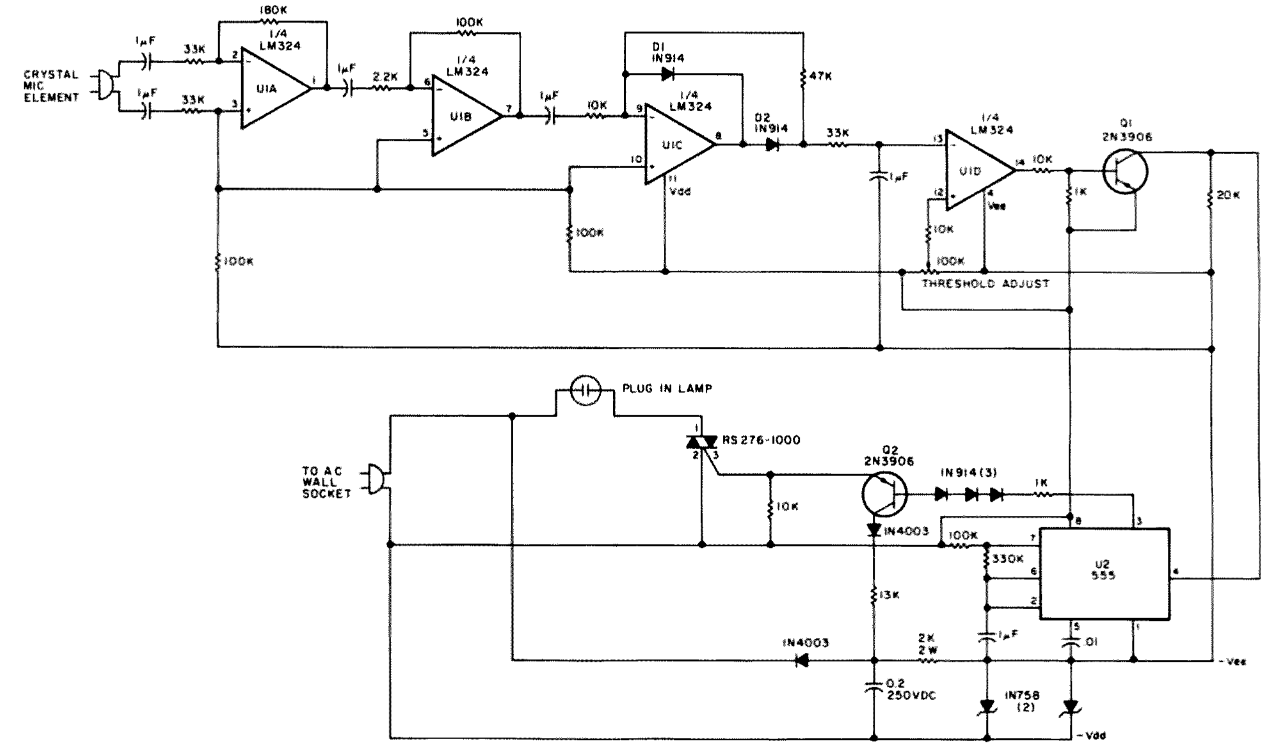

Fig. 1.

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Morse Converter for DMMs

—super gadget for blind hams

A digital converter which will take the binary coded decimal (BCD) output of a digital multimeter (DMM) and convert it to Morse code would surely be an asset to any blind or partially blind person's workshop.

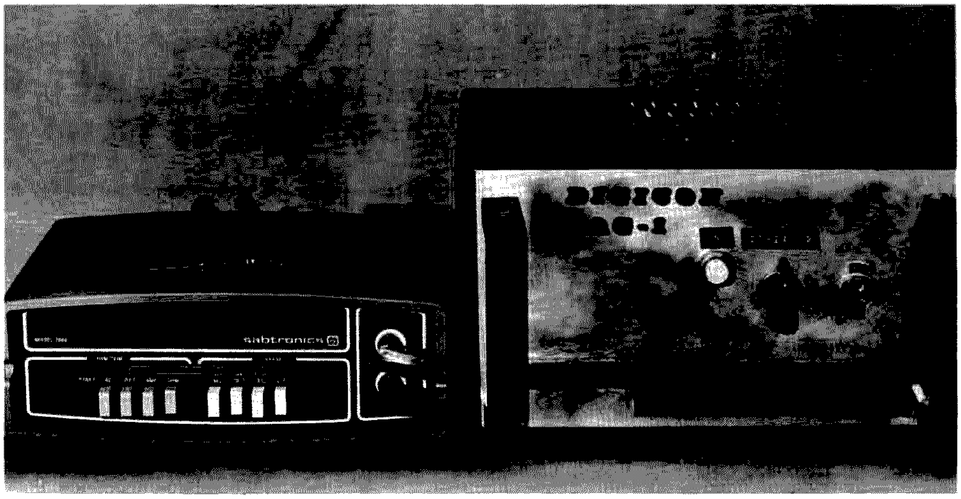
After graduating from a CREI home study course in electronics engineering technology (minicomputers and microprocessors as the major elective), I had a strong desire to make some practical use of the knowledge.

Shortly after finishing the home study course, I was talking with my dear friend of nine years, W6LZV. He was mentioning that a Morse clock could be helpful to him in his daily on-the-air operations. After thinking about a Morse clock versus another type of device which could be converted to a Morse code output, I asked Jean if he could use a digital multimeter with Morse code output. Though Jean is completely blind, he is very active in the building and repairing of electronic equipment. Therefore, it was no surprise to me when he said that the DMM-to-Morse code converter would be more functional.

This article is for the person who wants the challenge of using an instrument which was originally made for the sighted person. This article can open doors that have inhibited the handicapped person in delving into a world of technical discovery—a world which can be just as satisfying for him as for the sighted person.

While researching what chips might be commercially available to handle the BCD-to-Morse code conversion in a very simplified manner, I ran across the July, 1977, issue of *73 Magazine*, which has an article entitled "The Morse Clock." After reading and rereading the article, trying to fully understand the logic, I decided that I would use the article as a starting point for my design of the DMM-to-Morse code converter.

The digital multimeter used for this prototype project was the Sabtronics 2000 DMM. At first, I had only a schematic of the DMM to work from, but it was apparent that converting the output of the MC14433 A/D converter chip into Morse code would not be too difficult. After building the DMM and seeing how the MC14433 chip worked, I decided that since the position of the decimal point depends only upon the function button and range button selected and upon whether the X10 range switch is used, I would disregard the decimal point. Only the minus sign and the 3½ digits were dealt with.



The converter at work. The DMM indicates −108.5 Ohms. (The minus sign is peculiar to the Ohms reading on this DMM.) When the INI button is pushed, the converter will respond with — —(minus) · — — — — — — — — — — — — · · · · · · ·.

Features of the DMM-to-Morse Code Converter

The converter was designed to provide the following:

1. Morse code output of the 3½ digits.
2. Morse code character "m", which signifies that a minus sign is present.
3. An audible over-range indicator.
4. A method by which the user can perform "continuity tests."
5. Three selectable code speeds.
6. A Morse code zero (0) for a "blanked" first digit.

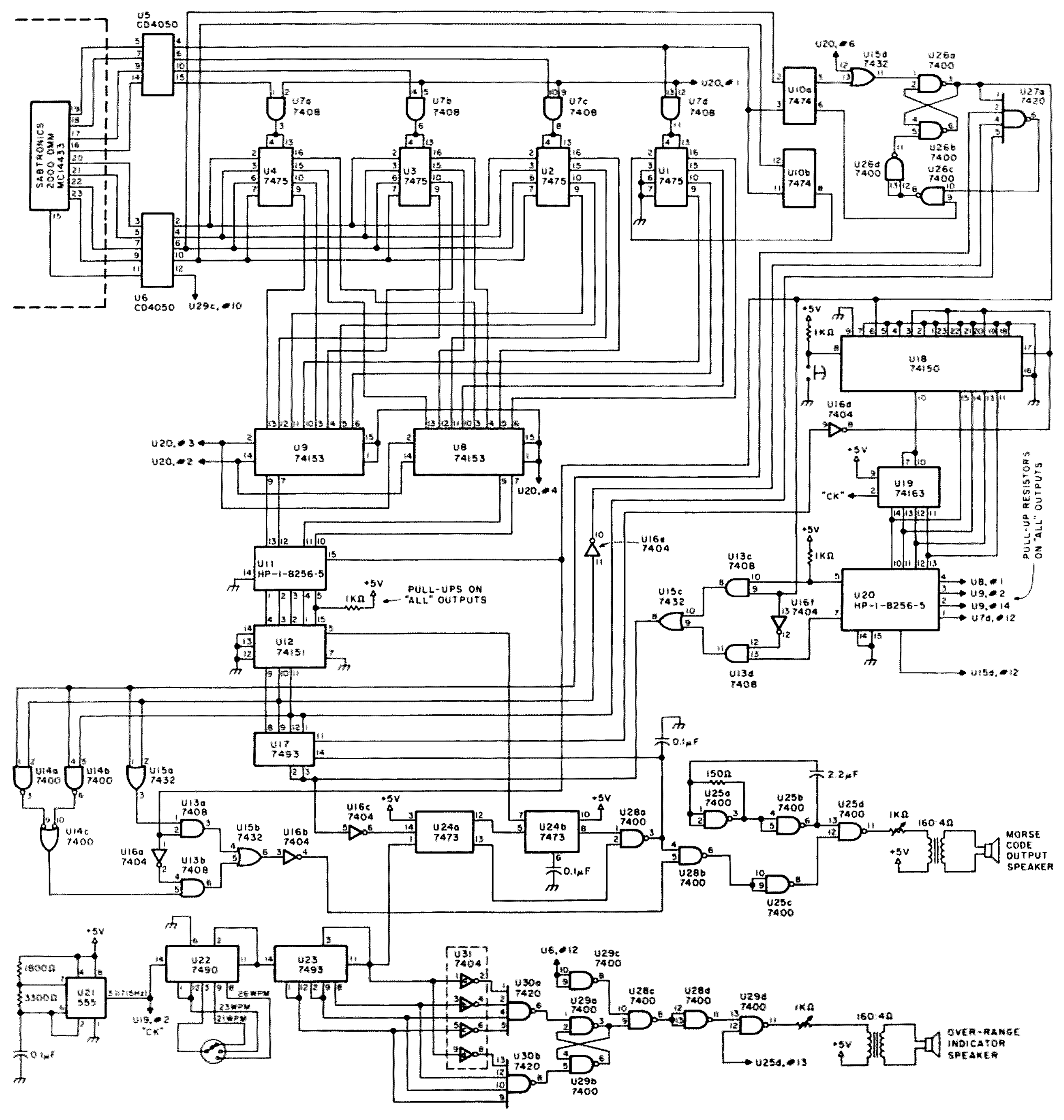


Fig. 1.

This was done because I am not audibly providing the position of the decimal point. By giving the user the contents of all 3½ digits, the mental determination of the decimal point's placement is made easier.

Circuit Description

The MC14433 A/D converter chip (enclosed in the DMM) is the heart of the converter. The chip has BCD outputs available for the 3½ digits, but they must be demultiplexed "off-chip" by using the display triggering lines. Since the demultiplexing and selection of each digit is not available "on-chip," the chip count of the DMM-to-Morse code converter is higher than for the Morse clock.

Since I have never tackled a complete project from the design stage to the building stage, various aspects of the MC14433 chip posed some minor stumbling blocks. After reading the article entitled "Super DVM" (August, 1977, issue of *73 Magazine*), I selected a single 7474 (dual D flip-flop) to demultiplex the ½ (first) digit and the minus sign. The 7474 chip solved the minor stumbling blocks.

The Minus Sign

The minus sign demultiplexing, sampling, storage, and recovery circuits are made up of U10A, U15D, U26A and B, U26C and D, and U27A (respectively).

When a minus sign is present, the 7400 SR flip-flop (U26A & B) provides the following actions: 1. Selects the appropriate

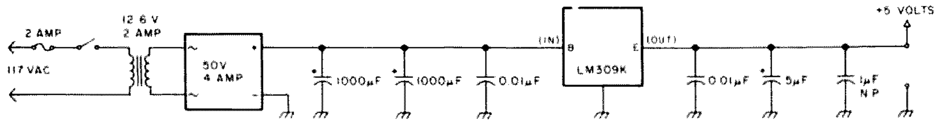
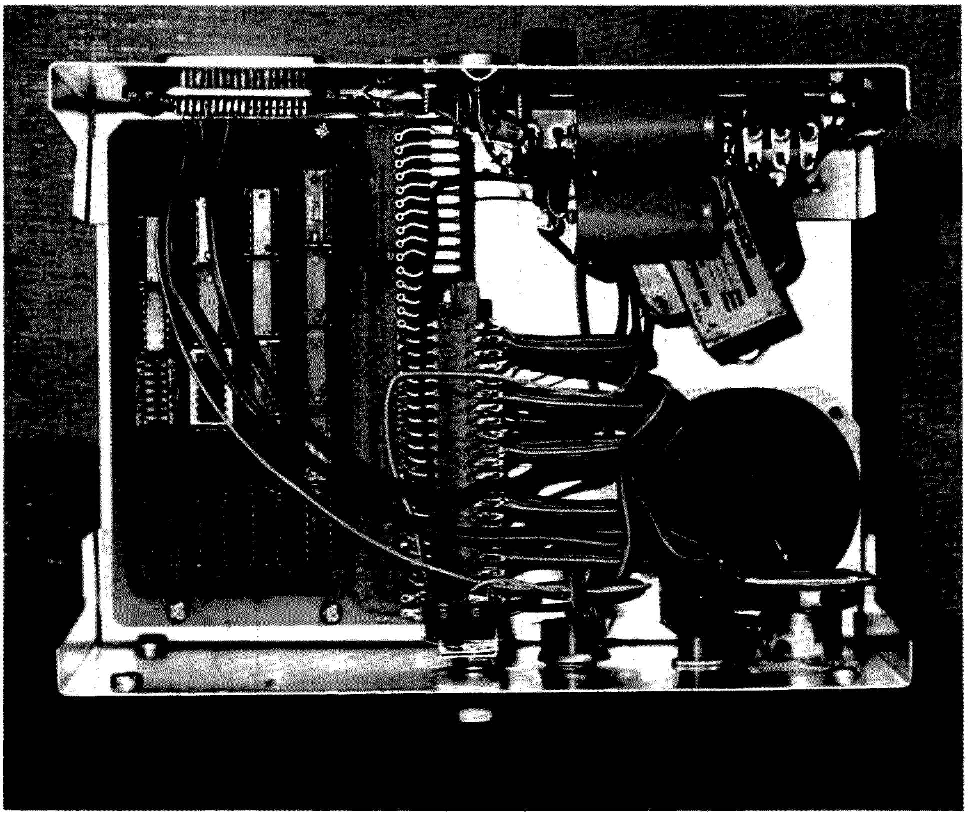


Fig. 2.

State	IRENABLE (+), U13D/pin 13	MINUS SAMPLING, U15D/pin 12	IRENABLE (−), U13C/pin 10	74153 (enable), U8/pin 1	74153 (B), U9/pin 2	74153 (A), U9/pin 14	DIGIT LOCK-UP, U7D/pin 12	Remarks
0000	X	X	X	X	O	O	X	Wait for "next instruction"
0001	X	O	X	X	O	O	O	Address (−) Minus sign
0010	X	X	O	X	O	O	O	Send (−) Minus sign
0011	X	X	X	X	O	O	O	Clear BCD-Morse code converter
0100	X	X	X	O	O	O	O	Address 1st digit
0101	O	X	O	O	O	O	O	Send 1st digit
0110	X	X	X	X	O	X	O	Clear BCD-Morse code converter
0111	X	X	X	O	O	X	O	Address 2nd digit
1000	O	X	O	O	O	X	O	Send 2nd digit
1001	X	X	X	X	X	O	O	Clear BCD-Morse code converter
1010	X	X	X	O	X	O	O	Address 3rd digit
1011	O	X	O	O	X	O	O	Send 3rd digit
1100	X	X	X	X	X	X	O	Clear BCD-Morse code converter
1101	X	X	X	O	X	X	O	Address 4th digit
1110	O	X	O	O	X	X	O	Send 4th digit
1111	X	X	X	X	O	O	O	Clear BCD-Morse code converter

Table 1. Contents of the "control" ROM (U20).



Top view of completed unit.

output line (IRENABLE−) from the state-machine ROM; 2. Selects the appropriate logic used for giving the "space" between the Morse code characters; 3. Disables the BCD-to-Morse code ROM. When this ROM is disabled, all of its outputs are driven HIGH, thus providing the needed output for making the Morse code character "m"; 4. Signals the input multiplexer (U18, 74150) that the "m" and the "space" between characters has been sent (no-code condition). Spacing between the Morse character "m" and the first digit is longer than between "each" digit. This characteristic provides a distinguishable pause between the "m" and the start of the first digit.

The First Digit

The ½ (first) digit demultiplex and storage circuitry is made up of U10B and U1 (respectively). Since the ½ digit is only a zero (0) or a one (1), I tied the binary 2, 4, and 8 inputs of U1 to ground (binary zero) and let the output of the 7474 dual D flip-flop (U10B) determine whether a zero or a one is showing in the ½ digit's place.

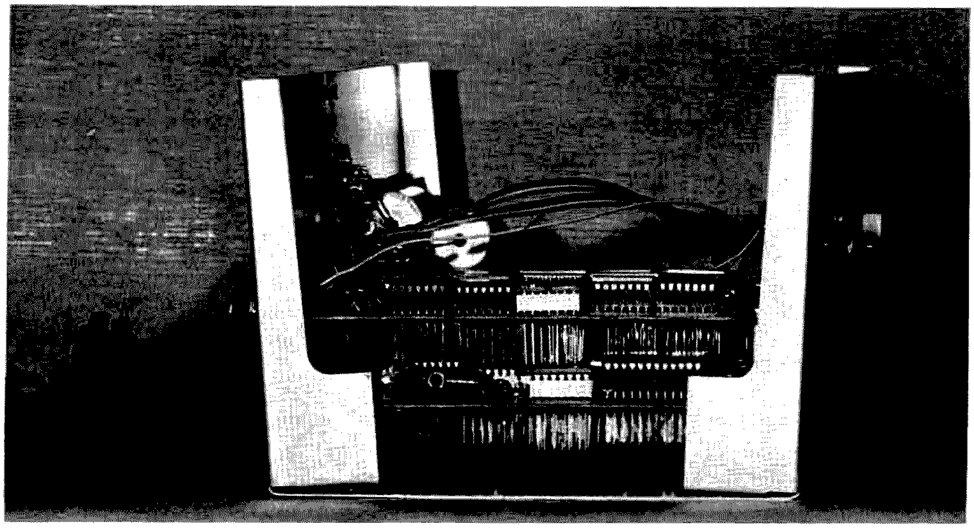
The Over-range Indicator

A 7493 counter (U23), wired as a divide-by-10 counter, is used to provide the counter-states which make up the "ditters" when an over-range condition exists. The 7493 counter-states of 2 and 7 are decoded and driven to a 7400 $\overline{SR}$ flip-flop, which provides the ditter sensation.

Besides providing the user with an indication of an over-range condition, the over-range indicator circuitry can also be used to provide a continuity test. When the DMM is placed in the OHM function and an OPEN condition exists between the input terminals, all digits are

blanked (to the sighted user) and the over-range ditters are HEARD. With this condition in mind, the user takes the test leads and makes the necessary connections for determining if there is an open or a shorted condition. After making the connections, if the ditters persist, an open condition exists (verified by pressing the "initiate" button and hearing "m" 1 9 9 9). If the ditters cease, the user either has a shorted condition or some actual value of resistance. A shorted condition can be verified by pressing the "initiate" button and hearing either "m" 0 0 0 0 or just 0 0 0 0.

When the function switch is in the OHM position, the user must ignore the "m" (minus sign) which is active due to the design of the DMM. During the OHM function, the minus sign shows up (for the sighted person) to tell the user that the input jack (positive jack) is in fact the negative probe, and that the DMM is in fact turned ON.



Side view of completed unit.

Construction/Miscellaneous Notes

Excluding the MC14433 in the DMM, the prototype project has a chip count of 31. All ICs used in the project were of the commonly-available type. All parts were either obtained locally or through various electronic parts catalogues.

I used the wire-wrap technique because it gave the amount of versatility in construction that I wanted. I was able to build each functional section bit-by-bit.

Interfacing of the CMOS 14433 with the TTL 7475 and 7408 was achieved by using two CD4050s (hex buffers).

I am sure that there are many alterations which can be made to my present design. These could include feeding the Morse code output and the over-range output through a "summing" op amp amplifier, thereby needing only one speaker. Also, U5 and U6 could be deleted if we dealt with CMOS technology throughout the converter.

The cost of the converter parts (including the cabinet and wire-wrap PC boards) was approximately $120.00, but the cost could be brought down easily to approximately $60.00 if the builder has a well-stocked junk/spare-parts box and if he shops around.

My sincere thanks to WB3EVS for his technical assistance, to WA6DLI for his superb photographic shots of the converter, and to WA1MXV and WA5VQK for their very enlightening articles. ■

References

1. Robert J. Souza, "The Morse Clock . . . Timely Repeater ID," *73 Magazine*, July, 1977, p. 54.
2. Tim Ahrens, "Super DVM . . . Uses the MC14433 and LCD," *73 Magazine*, August, 1977, p. 108.
3. Don Lancaster, *TTL Cookbook*, Sams Publication.

Digit	ROM Address	ROM Contents
0	0000	11111
1	0001	11110
2	0010	11100
3	0011	11000
4	0100	10000
5	0101	00000
6	0110	00001
7	0111	00011
8	1000	00111
9	1001	01111
blank	1111	11111

Table 2. Contents of the "code conversion" ROM (U11).

How to Home-Brew Your Own Crystal Filters

— the series-string method

73 Magazine *Staff*

One of the prime limitations that discourages many amateurs from pursuing various interesting projects is the cost of good crystal filters. One example is with the construction of rf speech processors or clippers. Clippers are relatively easy to build and very effective, but they require the use of a good SSB filter.

One of the simplest forms yet of a good home brew crystal filter was recently discovered. Hopefully, it will allow many amateurs to pursue some of those projects they have been putting aside because of the expense of commercial filters.

The crystal filter to be described can be built around a group of almost any commonly available MHz-range crystals of the same frequency. The crystals which are manufactured for TV games or color TV sets are particularly suitable since they are manufactured to close tolerances and are inexpensive. For instance, the 3.579545 MHz crystals for color TV set circuits are readily available for only around $1.00 because they are mass produced in such quantities. In fact, with a bit of hunting through sales flyers, one often can find them on sale at 6 for $5.00.

As the title of this article implies, the circuit for the crystal filter is nothing more than a series-connection of the crystals, as shown in Fig. 1. The input and output of the filter are terminated by 1k-Ohm resistors. The trimmer capacitors are used to obtain the overall desired response. The type of response that can be obtained is shown in Fig. 2. The frequency scale has been expanded somewhat on the graph, so at first glance the filter response may seem rather broad. Actually, it is quite good if one studies the response in a bit more detail. The −60-dB bandwidth is about 8 kHz. The ultimate out-of-passband rejection could not be measured much beyond −60 dB with the equipment available, but the ultimate rejection is probably −80 dB or better. Just for comparison, the response of a medium-priced ($40 range) imported filter is shown by the dot-dash lines inside the series-string filter

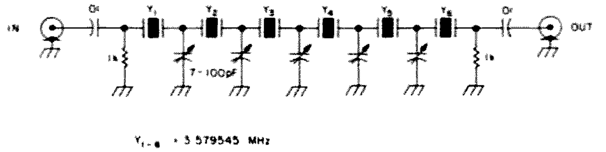


Fig. 1. The series-string crystal filter.

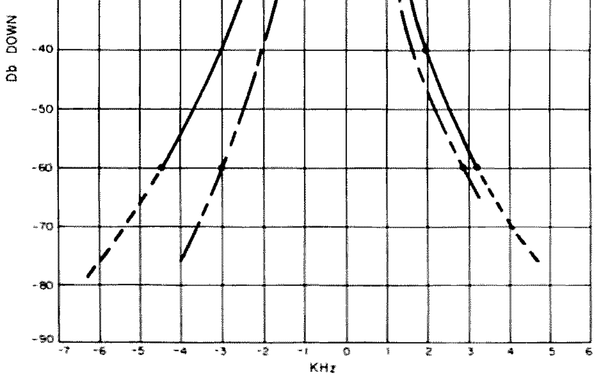


Fig. 2. Response of the series-string crystal filter (outer curve) compared to that of a moderately-priced commercial filter (inner curve).

response. The commercial filter is better, of course, and one will notice some difference on receiving, but it is a moot point as to whether any difference would be noticed when SSB filtering is considered for transmitting purposes or when rf speech processing equipment is being considered.

In order to achieve the response described, the filter must be constructed carefully, although this is not a tedious task. The filter is constructed basically as shown in Fig. 1, so the input-output terminals are as far apart as possible. Fig. 3 shows the layout used on an approximately 1½" x 5¼" piece of copperclad (single-side) PC board. There is no need to do any etching unless one just prefers to do this. The isolated-pad type of construction works very well, where a small hole is drilled for each crystal lead or pin (depending on the type of crystal used). The copper around the hole is removed for a small radius with an isolated-pad tool or with a sharp knife. The crystals are simply interconnected, and the few components required are soldered directly to the crystal leads or pins. The input-output cables are connected to any form of isolated terminal post. The trimmer capacitors used are Arco 423 units which have a range of 7-100 pF, but any similar units can be used. In fact, if one doesn't devote a little effort to finding reasonably-priced trimmer capacitors, they can cost more than the crystals!

The adjustment of the five trimmer capacitors will have a great deal of influence on the bandpass shape of the crystal filter. If one has fancy test gear available, such as spectrum display units, the work is, of course, relatively simple. But, even if one has only relatively simple test equipment—rf generator and a suitable oscilloscope or a receiver—the filter can be adjusted easily enough.

First, set up the filter so the middle trimmer-capacitor is at minimum value, and the other capacitors are at maximum value. Then, as one goes through the passband of the filter with the rf generator, note how the response changes as the center trimmer is increased in value and the other trimmers are decreased. If one keeps a record of the responses for each adjustment of the trimmers, it will not be difficult to discern the pattern that develops. No attempt was made to adjust the trimmers by ear when the filter was used in a receiver, but possibly, with enough patience, it could be done.

The application of the filter to a piece of equipment, or the use of the filter in an accessory item, can follow the scheme shown in Fig. 4. This little setup made use of various International Crystal Company modular mixer and oscillator units to translate the crystal filter response to another i-f frequency that was of interest. However, this setup, or one similar to it that is suitable for the frequencies involved, can be used for many applications.

For instance, one can use it just to improve the i-f selectivity in an older piece of equipment, or those who are a bit more advanced in circuit construction can build a complete outboard rf speech processor for an SSB transmitter, using two crystal filters. (See Fig. 5.) A DSB signal is first generated, and one filter used to produce an SSB signal. The signal is then clipped and passed through the second filter to clean up the distortion products. The product detector is used to obtain the final af signal. In this application, the two crystal fitlers should have identical passband responses—but this should not be difficult to achieve if they are constructed and adjusted together. During the adjustment process, one should note where the 20- to 30-dB down points are, on either the upper or lower side of the crystal filters, since either one of the two frequencies can be used as the carrier oscillator frequency.

Construction has been started on such a project, but it is not yet completed. Even using a modular approach as much as possible, by using kit-type modules of the kind shown in Fig. 4, the total cost for the project seems to be coming out in the $25-$30 range. That is not bad at all when one considers that it includes the cost of two crystal filters, and one can pick up several dB of extra intelligibility under QRM conditions. Even if one does not achieve the full theoretical improvement possible with rf clipping, one can easily do better than by using an outboard audio compression or clipping accessory, and at nearly the same cost.

It is possible to use the crystal filter also as part of an adapter to add rf clipping to an SSB transmitter, by connecting it into the SSB generation chain. Unfortunately, one cannot generalize on how this can be done, since the response of the filter in the outboard adapter as compared to the response of the filter in the transmitter, along with the carrier oscillator frequencies, all have to be taken into account for a specific transmitter. ■

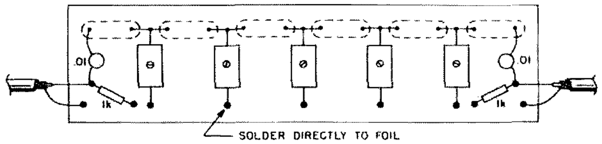


Fig. 3. Layout of a crystal filter board, foil side up. (Crystals are on the non-foil side.)

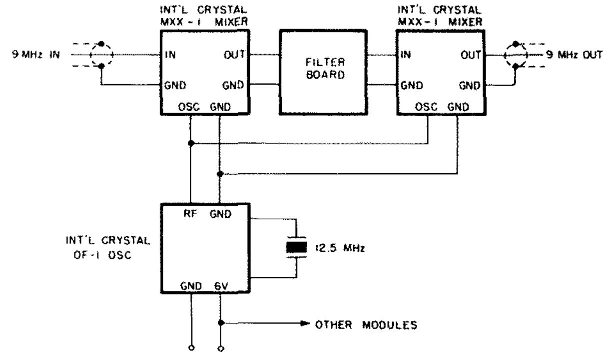


Fig. 4. One example of how the filter can be used in an i-f chain by frequency translation, using readily-available mixer/oscillator modules.

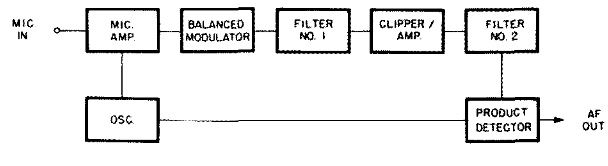


Fig. 5. Block diagram of a separate rf speech processor which now can be built at low cost using two series-string filters.

Four Bands on a Bamboo Pole

—try a Chinese vertical slanter on 10 through 40

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Many of us hams like to work DX. My friend, Harry, who lives down the street, had worked many DX stations. I had worked no DX at all! I asked Harry what I could do to work DX.

"Get a long, bamboo fishpole and build a vertical J like mine," he replied. "Get the bottom of the antenna higher than the electric light wires. Get the thing resonant, and you'll work across the big pond."

Harry was my "consulting engineer," and taking his advice usually brought good results. I purchased a 23-foot bamboo fishpole and mounted it high on the house using some lightweight 1 by 2 lumber. A vertical J antenna was suspended from the top of the fishpole. The matching stub was tuned to frequency, and the 600-Ohm open-wire feedline was attached and adjusted for the best transfer of rf energy into the antenna system. As usual, Harry was right. I got a big thrill the next day when I worked my first European station!

Seeing the big bamboo fishpole, one of my friends called it a "Chinese antenna." When I mentioned this to Harry, he laughed and remarked, "Maybe we can shanghai some DX." Since that time, bamboo fishpoles have been used in most of my vertical antennas, and the "shanghaiing" has been very good. (Fiberglass fishpoles 20 feet long also work well in antenna construction, but they are more expensive and are hard to find.)

This article will present information from some books and a magazine article and explain how this information was applied in making a four-band "Chinese vertical slanter" antenna system that is the best non-beam DX antenna that I have ever used.

In the December, 1978, *73 Magazine*, antenna axioms were presented.[1] Among these were: (1) The antenna system should be resonant at the frequency being used. (2) The rf from the antenna must be effectively put into the antenna. (3) There is no substitute for height; the higher the antenna, the better. (4) At easy-to-attain heights, vertical antennas have lower angles of radiation than do horizontal antennas. This makes them good for DX.

Because of their lower angles of radiation, vertical antennas have been known to outperform horizontal beams in making DX contacts, especially in cases where the horizontal beam was not any higher off the ground than the center of the vertical antenna. The value of low-angle radiation in working DX is beautifully explained in Capt. Paul Lee's book in Chapter 1, "Optimum Design For DX."[2] This chapter also contains other valuable information useful to antenna designers.

Vertical antennas longer than a quarter wavelength radiate rf at lower angles to the horizon than do quarter-wavelength ground-plane antennas. The angles of a quarter-wavelength ground-plane antenna are from 10 to 55 degrees. For a 3/8-wavelength vertical antenna, the angles are from 8 to 40 degrees. A half-wavelength vertical's angles are from 5 to 35 degrees. The angles of a 5/8-wavelength vertical are from 3 to 27 degrees.[2] For 3/4-wavelength verticals, "there is some slight deterioration of the low angle vertical pattern, but this is not serious."[3]

Vertical antennas longer

than a quarter wavelength also have power gain as compared with a quarter-wavelength ground-plane antenna.[4] A half-wavelength vertical antenna has a power gain of 1.8 dB as compared with a quarter-wavelength ground-plane antenna. A 5/8-wavelength vertical antenna has a power gain of 3 dB as compared with a quarter-wavelength ground-plane antenna. One can surmise also that a 3/4-wavelength antenna has some power gain as compared with the ground-plane antenna.

From this information, it is clear that vertical antenna lengths between 1/4 and 3/4 wavelengths will be better for making DX contacts than the popular coax-fed ground-plane antenna. To use these ideas in a multiband vertical antenna, tuned feeders must be used to take the rf from the transmitter to the radiating wires. When tuned feeders are used, balanced antennas can be built with wires almost any length, provided that *the length each side of the tuned feeders is the same.* Furthermore, such an antenna can be "loaded up" and used on several bands.

My friend Harry was somewhat impressed with this information. He suggested, "Why don't you make a chart comparing a tuned-feeder vertical with the popular trap vertical that is about 22 feet tall? After you get that one figured out, figure out what length of wires would make the best all-around DX antenna for 40, 20, 15, and 10 meters."

My "figuring" was as follows. For all practical purposes, the trap vertical is a quarter-wavelength ground-plane antenna on all bands, with the highest frequency radiators closest to the ground. As such, the angles of radiation with respect to the horizon are from 10 to 55 degrees on all bands. Except for the 40-meter band, on which all 21½ feet radiate, the trap vertical does not have its radiating antennas as high in the air as does a 22-foot "vertical slanter." (Axiom No. 3: "There is no substitute for height.")

With the vertical slanter, all 22 feet radiate on all bands. With respect to power gain and angles of radiation, the vertical slanter has the following as compared with the ¼-wavelength ground-plane antenna with its 10 to 55 degrees angles of radiation on all bands: On 10 meters, the vertical element is 5/8 wavelengths with a gain of 3 dB and angles of 3 to 27 degrees. On 15 meters, the vertical element is 1/2 wavelength with a gain of 1.8 dB and angles of 5 to 35 degrees. On 20 meters, the vertical element is a bit shorter than 3/8 wavelength, would have some gain as compared with the trap vertical, and the angles of radiation would be somewhat lower than those of the trap vertical.

With a ground-plane antenna using 4 equally-spaced radials, the radials do not radiate because the fields of the radials cancel out each other. Drooping the radials increases the gain of the ground-plane antenna.[5] Therefore, it is logical that a vertical-slanter tuned doublet, or a one-radial tuned ground-plane antenna might have some gain compared with a quarter-wavelength ground-plane antenna because there are no other radials to cancel radiation from the lower half of the antenna.[6]

Another great advantage of a vertical-slanter tuned doublet is that it can be tuned to exact resonance at any frequency, phone or CW, on any band, 10, 15, 20, or 40 meters. This means that the antenna will load up equally well on phone and CW in all of these bands.

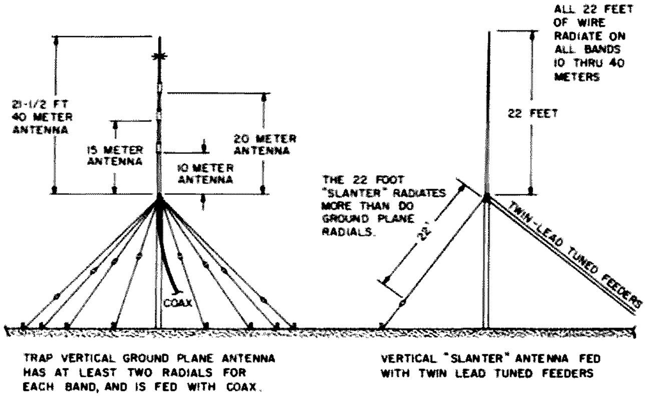

Fig. 1. Typical trap vertical and "vertical-slanter" four-band antenna fed with tuned feeders. The bottom of each vertical element is 20 feet above the ground.

Harry made this suggestion: "When you figure the best wire lengths for your four-band DX vertical slanter, make the wires as long as you can without degrading the performance on 10 meters. Of course, if you want better performance on 40 and 20 meters and don't care about 10 meters, you could make your wires as long as possible without degrading the 15-meter performance."

With this in mind, I chose 26 feet as the wire-length for the best performance on 10, 15, 20, and 40 meters. Twenty-six feet is 3/4 wavelength for 10 meters. If I did not care to work 10 meters, I would have chosen 33 feet, 3/4 wavelength for 15 meters.

The gain and angles of radiation for the 26-foot wire vertical-slanter antenna are conservatively stated as follows: 10 meters (3/4 wavelength), "guesstimated" 2.5 dB, with angles 5 to 35 degrees; 15 meters (5/8 wavelength), 3 dB, with angles 3 to 27 degrees; 20 meters (.39 wavelength), "guesstimated" 1.4 dB, with angles somewhat less than the 10-50 degrees of a quarter-wavelength ground-plane antenna. On 40 meters, 26-foot-long wires would work better than 22-foot-long wires.

Since in theory a vertical-slanter antenna fed with tuned feeders seemed to be much better than a four-band trap vertical, I decided to build one and try it out. I had an old, used piece of no. 12 Romex, 25' 8" long. This was very close to 26 feet, so I took out the two wires and used them in the antenna. A bicycle whip taped to a bamboo fishpole clamped to a small sailboat mast supported by two 8' two-by-fours clamped to a fence post was used to support the vertical part of the antenna. The black wire was taped to the supporting structure as the vertical element. (The black color helped to absorb heat and melt the ice after an ice storm.) The white wire was used as the slanter which was drooped down and out towards the south. 300-Ohm twinlead was used for the tuned feedline. The "Chinese vertical slanter" antenna looked interesting, but would it really work?

I thought that 40 meters would be the band on which the antenna would be least effective. (If thought of as a one-radial tuned ground-plane antenna, the vertical element is less than a quarter wavelength long. If thought of as a center-fed tuned

doublet, the total antenna length is a shortened half wavelength.)

On Friday, December 8, 1978, I decided to try out the antenna on 40 meters (worst band first!). The first station called, DJ4IT (West Germany), came back with a 579 report. At the end of this QSO, SP7EJS (Poland) was calling and reported a 559 signal when contact was made. After supper, LZ1KUF (Bulgaria) was called, but he did not come back. (I was not sure whether or not he had called CQ.) The next two calls resulted in QSOs. DL7PR (West Germany) reported 569, and YU1QFX (Yugoslavia) reported 599. (I suspect that this report was exaggerated for the sake of international goodwill. Hi!) These QSOs convinced me that the antenna worked well on 40 meters. Since that time, with very little time on the air, many DX QSOs have been made on 20, 15, and 10 meters. On several occasions, the DX station chose to answer me instead of one of the other stations calling him. This "Chinese vertical slanter" antenna is the best non-beam antenna that I have ever had. After a storm took down my quad, I could continue to have fun working DX.

Remember that a vertical slanter fed with tuned feeders will load up equally well on both CW and phone frequencies. The above-described antenna even loaded up and made a few contacts on 80 meters. However, the wires are much too short for good performance on the 80-meter band.

For even better performance, a system of radials each about 35 feet long, buried in the ground, could be added to the antenna system. The center of the radials should be under the vertical element. The more radials, the better. However, the antenna works well without radials as the above information indicates.

I have no trap vertical with which to compare the "Chinese vertical slanter" using on-the-air contacts. Certainly DX can be worked using trap verticals and other coax-fed groundplane antennas. However, antennas with more gain, lower angles of radiation, and more effective feed systems will certainly outperform any comparable coax-fed groundplane antenna when it comes to making DX contacts.

I think you'll enjoy the "Chinese vertical slanter antenna." Build one, use it, and find out for yourself how good a non-beam antenna can be for working DX. ■

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1. "Tuned Feeders and Other Good Stuff," William R. Stocking W0VM, *73 Magazine*, December, 1978, p. 118.
2. Capt. Paul H. Lee (USNR) K6TS, *The Amateur Radio Vertical Antenna Handbook*, p. 13.
3. Edward M. Noll, *73 Vertical, Beam, and Triangle Antennas*, p. 35.
4. William I. Orr W6SAI and Stuart D. Cowan W2LX, *Simple, Low-Cost Wire Antennas for Radio Amateurs*, p. 43.
5. William I. Orr W6SAI and Stuart D. Cowan W2LX, *The Radio Amateur Antenna Handbook*, pps. 88 and 92.

6. This idea does not take into consideration ground losses. It might be that four drooping radials, each the same length as the vertical element, would enhance the performance of the antenna because there would be less ground loss. Radials buried in the ground under the vertical-slanter antenna might improve its performance, and they are suggested near the end of the article.

✓ Reader Service—see page 195

The Triton IV Goes QRP

—simply and efficiently

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My last tube rig (I sold it 20 years ago) had something like 1400 volts at 300 mA on the plates of the final tubes. It amuses me, while getting good reports on 20 meters, to glance at a meter and see that I am running 3½ volts on the finals of my Triton IV! Basically, this is a good way to run the popular Ten-Tec Triton transceiver efficiently at very low power input levels. In this article, I will show how you can modify the Triton IV for such operation and yet drill no holes and make no changes which could not easily be redone to put the rig back into original specifications. This idea originated with Mac Harper W1FYM, who made the same modifications to his Triton IV and suggested I modify mine so that our two rigs could form the basis for the portable QRP station at W1FYM/1 for Field Days 1977 and 1978. The Field Day setup was battery-powered, including our computer logging and TV monitor equipment, and it has performed quite well through 2 Field Days. But the computerized QRP Field Day station is another story . . . one that W1FYM must write.

The modifications described here allow the Triton IV not only to operate very efficiently at 10 Watts input for Field Day, but also they allow such operation any time you wish, merely with the changing of the 6-connector power plug to the transceiver. The design idea could easily be altered to suit other solid-state rigs as well. Now you may say, "But my solid-state rig is easily capable of QRP operation as is. I just back down the drive to the finals until I'm drawing about 0.8 Amps at 12 volts and I'm running about 10 Watts input." "Ah, yes," I reply, "10 Watts input, but very little output!" Instead of 1 or 2 Watts out, your rig could be putting 6 or 7 Watts out for the same 10 Watts input if you ran the finals more efficiently. A good way to do this is to run them at much lower voltage. A very satisfactory choice for the 5-to-10-Watt power class is about 3.5 volts. The necessary modifications for this are described in two parts: modifications to the Triton IV and construction of an integrated circuit variable voltage regulator.

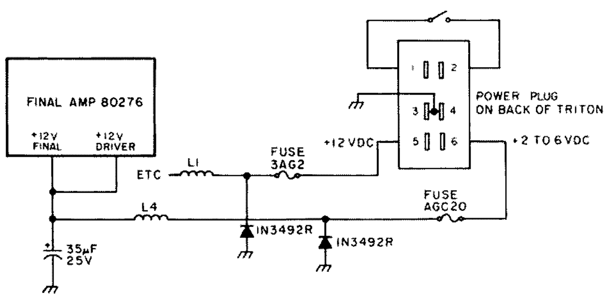

Fig. 1. Schematic of Triton IV as modified for efficient QRP operation.

Modifying the Triton IV

Basically, what we want to do here is allow the driver and final amplifier transistors to have their own voltage feed separate from that which feeds the rest of the transceiver and auxiliary equipment. Ten-Tec uses a 6-connector power plug and socket to run power leads and ac switching from the model 252 and 262 power supplies to the transceiver. Pins 1 and 2 are for ac switching and need not be altered. Pins 3 and 4 are grounded and likewise may be left untouched. Pins 5 and 6 are for +12 V dc. This pair is originally soldered together at the power plug to reduce pin resistance. To modify the Triton IV, proceed as follows (refer also to Fig. 1): Separate pins 5 and 6 at the power plug at the left rear of the Triton IV. Resolder the red #14 stranded wire onto pin 6 alone. Follow this red wire to its other end, through the AGC 20-Amp fuse to the cathode end of the 1N3492R diode (diode D1), at the 3-terminal strip. Disconnect this red #14 wire from diode D1 and run it in a 2-turn loop through the ferrite bead directly to the "+12 Final" terminal on the back of the final amplifier metal box; solder it securely. The "+12 Final" terminal is the large one with the solder lug. What you have now done is make pin 6 on the power plug of the Triton dedicated to providing dc solely to the driver and final amplifier transistors. For

safety, in case you mistakenly reverse your battery polarity, it might be wise to buy another 1N3492R high-power diode and install it across the line to ground in reverse-bias polarity position. This can be mounted on the opposite end of the 3-terminal strip from the other 1N3492R diode. Solder the cathode end (marked with a bar) to the #14 red wire going to the final amplifier transistors and the anode end to ground. Then, should you goof and reverse the battery leads (such as happened at 3:00 am in the middle of Field Day to yours truly), the diode will conduct, blow the 20-Amp fuse, and save your rig.

Now, take a new (say, orange-colored) piece of #14 stranded insulated wire and solder it to pin 5 of the Triton power plug. Push it through one of the cable holes in the metal shielding around the low-pass filter section and leave a few inches extra. Now take a small screw-mounting 3AG fuse holder and mount this to the outside of the low-pass filter shield. There is a screw very near coil L4 on the low-pass filter board which holds the board to the shield. The fuse holder can be mounted very easily on the back side of this aluminum shield. No holes need be drilled. Note: The toroid-core coil, L4, on the low-pass shield board is not the same coil as "L4" in my Fig. 1. The latter is a ferrite bead through which the final dc supply line is wound for 2 turns of rf shielding.

Now that you have mounted the 3AG fuse holder, connect your orange wire to one end and install a small, 2-Ampere fuse in the holder. From the other end of the fuse holder, run the same size orange wire along parallel to the back of the final-amplifier metal box until it reaches the 3-terminal strip where diode D1 is mounted. Solder the orange wire to the near end of the terminal strip; this is the same point where the cathode end of diode D1 and also 2 small #24 red wires are soldered. You have now completed the Triton modification. The orange wire from pin 5 of the power plug runs through a 2-Amp fuse and continues on to supply +12 V dc to all of the rig except the driver and final stages. Your regular 6-connector power socket from your model 252 or 262 power supply will work the same as before except that now you have the option to supply pins 5 and 6 on the power plug with different dc voltages if you choose. A way to supply different voltages is described below.

Variable-Voltage Regulation Using an IC Regulator

All you really need to do to supply the Triton final transistors with low voltage for highly efficient QRP operation is provide dc at from 2 to 6 volts at anywhere from 1 to 5 Amps. If you already have a small multi-voltage dc supply, fine. Or you can consult one of the ham handbooks and find a circuit which supplies dc at only a single voltage level. This would work perfectly well, for you can vary power input of the Triton using the drive control. I will describe here a variable-voltage regulated supply which provides 2 to 6 volts out and easily handles 5 Amperes (see Fig. 2). This was constructed in W1FYM's shack in one evening using some purchased and some scrap parts. The circuit was mounted on PC board. I purchased a heat sink somewhat larger than necessary, and the pass transistor (HEPS7004) is rated at 15 Amps! Since the case of this large power transistor is not at ground potential but at +12 V dc, we mounted the circuit board on the heat sink, which in turn was mounted on 2 insulating pieces of nylon scrap. The μA723 IC was mounted in a socket rather than being soldered. I always avoid soldering IC chips, if possible, because everybody ends up frying a chip now and then and it's a lot easier to test or change a chip which is socket-mounted.

Ten-Tec sells a small accessory 625-mV meter (ammeter model 207) which plugs into the various power supplies of their 250 and 260 series, using a phono plug. We wanted to monitor our current input during Field Day and other QRP operation but didn't want to buy or permanently install a meter, so we put a phono jack on the board and wound a wire shunt of about 0.7 Ohms value so that the meter reads 5 Amps full scale. Of course, you could use a different meter movement with a different shunt value. The 1k pot is an Ohmite ANP 102K or similar and its value, as well as that of the 330-Ohm ½-Watt resistor, is not critical. The IC used by us was a Fairchild μA723, but equivalents are available from firms including Motorola (MC1723), National (LM723), and Signetics (μA723). Q1 is a 1-Ampere-rated pass transistor, Texas Instruments TIP29B or equivalent; Q2 is the 15-Ampere-rated HEPS-7004. We used #12 stranded copper wire with large battery clips to supply the 12 V dc from the battery to the regulator power plug (pin 5 and pins 3-4). I would recommend using #14 or #16 stranded copper wire from the emitter of Q2 to the shunt and on to pin 6 of the power socket.

The construction and use of the regulator is straightforward. The 1k pot can easily be adjusted for output voltages from about 2 to 6 volts. W1FYM has had only to replace one fried IC chip in a year and a half of occasional use and I have had absolutely no troubles at all. Believe it or not, I've often had 579 and 599 reports on both CW and SSB into Europe and South America on 20 meters. Those reports aren't due only to the Triton IV QRP . . . I use long vee-beams 6 to 8 wavelengths on a leg and multi-element wire collinear beams at my QTH. Still, I've described a fairly-easy-to-make modification to the Triton IV and the construction of a modest voltage regulator which not only makes for a competitive Field Day rig, but also allows one to use a medium-powered solid-state rig such as the Triton in highly efficient QRP operation. ■

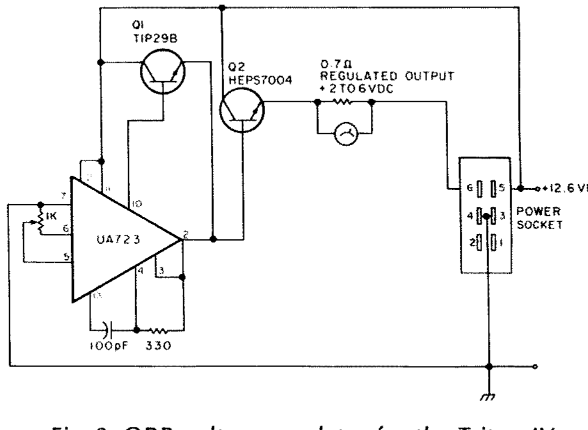

Fig. 2. QRP voltage regulator for the Triton IV.

Experimenter's Corner: The MM5369N

—how many uses can you find for this one-chip crystal oscillator?

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Would you like a simple, versatile, crystal-controlled oscillator? Would you like it to operate from below 500 kHz to over 16 MHz, with rich harmonic content, simply by changing crystals? Too good to be true? Read on, it gets *better*!

The MM5369N—see Fig. 1(a) and (b)—is a CMOS integrated circuit that is configured to provide a crystal oscillator (you supply the crystal) with a buffered output (maximum available load about 500 uA) and an internally-connected divide-by-59659 (or $2^{15.864452175}$) divider chain which provides, in the manufacturer's intended use, a 60 Hz output for dc-operated digital clocks when used with an inexpensive 3.579545 MHz crystal. This, and numerous other uses, will be mentioned as we proceed.

How It Works

The crystal oscillator is biased by a crystal and RC network (Fig. 2) consisting of R1, C1, and C2. R1 is nominally 20 megohms to bias the oscillator stage for class A operation.[1] Capacitor C1 provides the necessary parallel capacitive load, which, with R1, causes the oscillator to start reliably. C2, in parallel across X1-C1, permits the oscillator output to be trimmed to an accuracy of ±100 ppm of the desired operating frequency with an accuracy of ±2 ppm obtainable with careful component selection.

The buffered oscillator output frequency is available at pin 7 of the IC which gives you a convenient point to monitor the oscillator output without loading, while trimming to the desired operating frequency. The buffered output is at CMOS levels, and for that reason must drive only CMOS-compatible circuits. If other than CMOS levels are required, it will be necessary to provide the needed digital or analog buffers. Several CMOS-to-digital-level buffers are available from many of the suppliers listed in the advertisements in this magazine; additionally, all parts called for in this article are available from Surplus Electronics, 9600 Baltimore Blvd. (rear), College Park MD 20740. The CMOS-to-analog-level buffer is not available as a single chip, but may be constructed in the form of a one- or two-transistor amplifier to allow the oscillator to be used in just about any circuit configuration you can imagine. These can include local oscillators, QRP transmitters, frequency counters, and so on. Note that the output

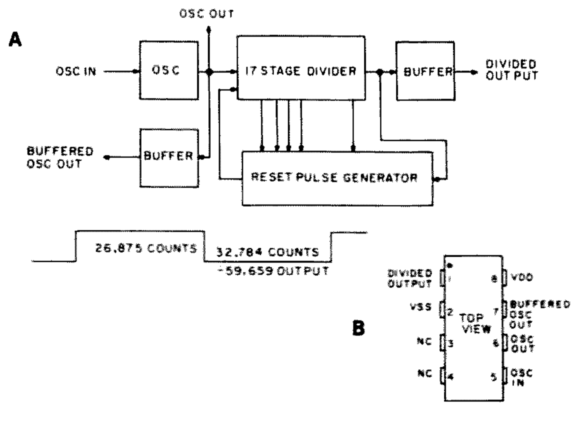

Fig. 1. (a) MM5369N block diagram and timing.[1] (b) MM5369N pinout.[1]

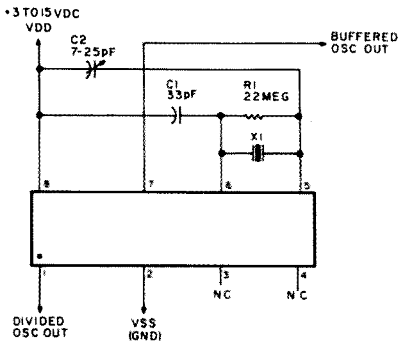

Fig. 2. Basic operating circuit.

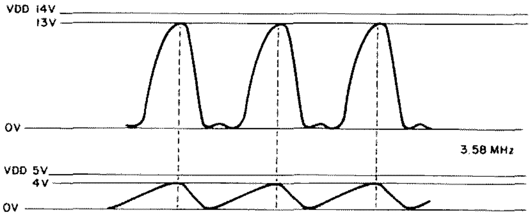

Fig. 3. Output waveforms taken at 3.58 MHz from pin 7. (Note loss of rise and fall times at very reduced Vdd.)

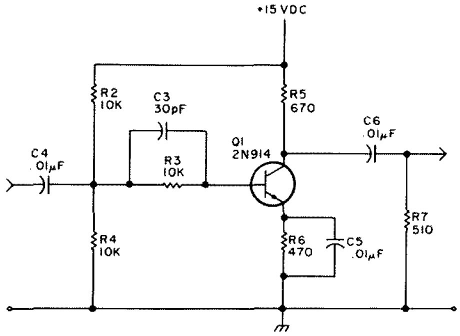

Fig. 4. Modified buffer amplifier for CMOS-to-analog level translation.[3]

load on the buffered oscillators output must be kept below 500 uA to avoid exceeding the manufacturer's specifications.

The divider section in the standard MM5369N is a mask-programmed, 17-stage divider set to divide the input frequency by 59659. This is accomplished in conjunction with a six-input reset pulse generator which, by virtue of its mask programming, sets the internal divisor length. The MM5369 is also available with custom mask programming. Should you have the need and the bucks (kilo, no doubt), National Semiconductor would, most likely, happily mask-program a few thousand for you with any divisor from 10000 to 98000. The divided output duty cycle stays very close to 50% for a Vss of 8-15 volts and can drop as low as 20% for a Vss of 3 volts at the same frequency. The current drain is nominally 2-4 mA for frequencies of 500 kHz to about 6 MHz, with up to 20 mA drawn for frequencies up to 16 MHz.

Operational Considerations

The MM5369N is a versatile crystal oscillator chip requiring a bare minimum of supporting parts for proper operation. The oscillator is very tolerent of supply voltage variations, and the only noticeable effect of an abnormal voltage change is a possible loss of duty cycle and a degradation of the rise and fall times of the output waveform (see Fig. 3). Although the MM5369N is specified to operate from dc to 2 MHz at 6 V dc and dc to 4 MHz at 10 V dc, I have found that the oscillator will run reliably in excess of 16 MHz at 10-15 V dc with a very good sine-type output.[1] Also, if you are inclined to experiment, you will find that the crystal can be replaced by an inductor and the circuit operating range extended to about 40 MHz. But you will pay the price—not too exorbitant—in the loss of crystal stability and output voltage level.

Although the output of the oscillator is already buffered, I feel it is advisable when using this circuit in any application to add at least an additional stage of isolation, whether it is digital or analog, to avoid undue loading of the oscillator. The output load should be limited to less than 500 uA and be as low as possible for best stability. This is not difficult to obtain with a one- or two-transistor buffer amplifier (Fig. 4). The amplifier was adapted from "Brew Up a Signal Generator" (*73*, January, 1978). The circuit as shown has been tested from 500 kHz to 16.5 MHz, operates quite reliably, and adds only an additional 20-25 mA to your power supply requirements. If you are planning to operate this buffer amplifier exclusively under 5 MHz, you can omit the 30 pF capacitor across R3.

Stand-Alone Crystal-Controlled Calibrator

So far you have been presented with a bunch of theory and "how to" and little else. Here's your chance to include all of the above plus a little more and have a reliable test instrument standard for your lab. First dig out that old 1- or 10-MHz rock you bought at the last hamfest. We're going to combine it with the MM5369N, a TTL buffer amp, a few ICs, and end up with a crystal calibrator with multiple divided outputs. It will serve you well when the time comes to calibrate your scope, and, in between, serve as the timebase for a frequency counter, if you wish. The output of pin 7 on the MM5369N (Fig. 5) is fed to the TTL buffer amp and then to the first 7490; each

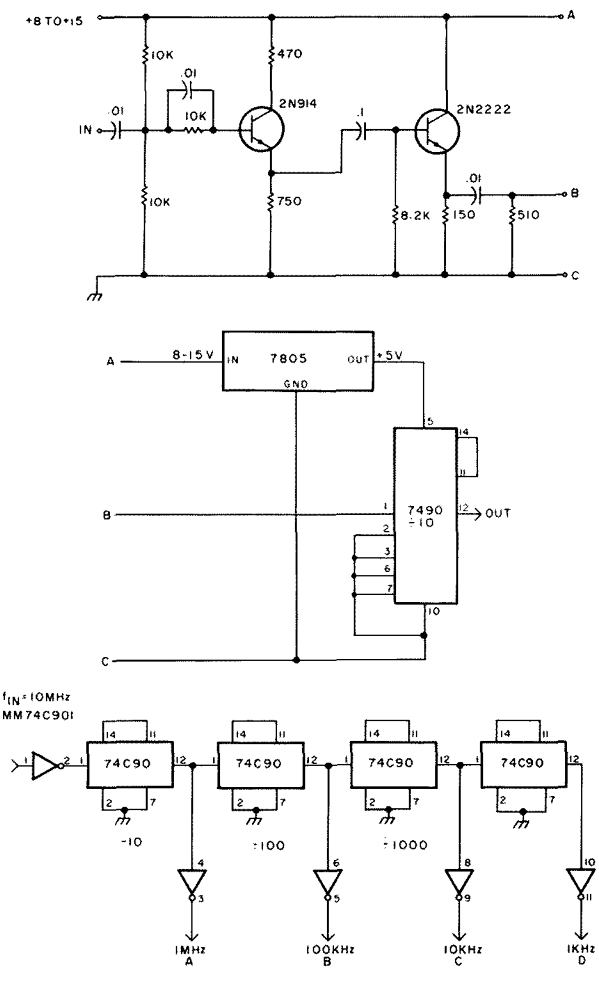

Fig 5. TTL digital interface and divider chain.

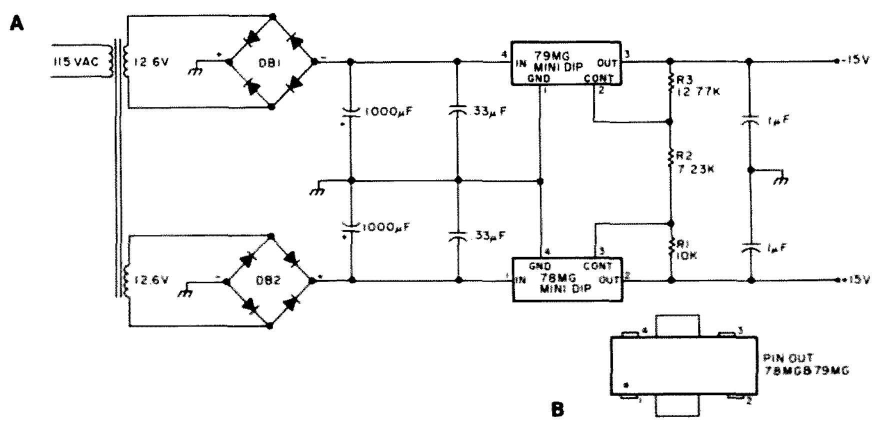

Fig. 6. (a) UA78MG and UA79MG power supply. The negative portion of the supply is not required for this project. It is provided to allow the user greater latitude in using the power supply in other projects as well. (b) UA78MG and UA79MG pinout.

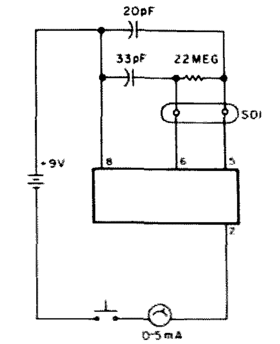

Fig. 7. Crystal checker schematic.

divided signal is then fed to the following IC stage in turn. At each 7490 output, the signal is brought out to a TTL buffer chip where it is available for use as you please. At approximately 100 kHz you may wish to substitute 74C90s for the 7490s to keep the current drain to a minimum.

If you choose this route you should use 74C901 or 74C902 CMOS-to-TTL buffers. These outputs are fed, in turn, to a rotary switch and from there to the output. There is also a signal provided that has been divided by 59659 that is available at pin 1 of the MM5369N. This also can be buffered and used as a known signal *source for a* press-to-test function if you use this circuit for a frequency counter timebase. You will note that the TTL buffer is a two-stage amplifier driving a conventional 7490÷10 IC. This is necessary as it still is difficult to find 74C90s that operate at 16 MHz. So far we have touched on the parts required to have a crystal oscillator but we don't have a source of power to run it—yet.

The Power Source

The power source—see Fig. 6(a) and (b)—is a simple voltage-regulated source that will help eliminate the aforementioned "abnormal voltage drop." It consists of the usual transformer, full-wave diode bridge, and capacitor arrangement followed by a really neat voltage regulator chip, the UA78MG, made by Fairchild Semiconductor. The UA78MG is a 4-terminal positive voltage regulator (UA79MG is the negative version) which is adjustable from 5 to 30 volts at a current of 500 mA. This versatile device can be used with a series pass transistor for higher output currents when needed.[2] For those who are interested in the gory details of how to design power supplies with this chip, a few of the basic rules I have found to be useful are set forth below:

1) Set the control current through R1, R2, and R3 to 1 mA.

2) The UA78MG control voltage is 5 V, the UA79MG is 2.23 V. R2=7.23/1 mA=7.23k Ohms. If the power supply is just plus or just minus, then that respective leg is referenced to ground, and R2 is the control voltage divided by the control current.

3) The value of R1 and R3 is found by Rx=Vout (desired)−Vcontrol/Icontrol.

4) If you prefer an adjustable supply, R1 and R3 can be replaced by trim pots and their respective voltages set independently.

5) Include a .33-uF input and a .1-uF output capacitor for each circuit to improve the circuit's output transient response time.

If you wish, a 25-volt center-tapped transformer may be modified to provide the dual output voltages called for by Fig. 6. Take a *sharp* knife and carefully follow the c-t lead through the paper until you find the point where the lead is soldered to the output winding. When you find this point, carefully unsolder and split the two winding wires, attach separate output wires, and cover the connections with the proper size heat shrink or tape. Re-wrap the transformer with tape, *check for shorts*—and you're done.

Other Nonstandard Uses

Other nonconventional uses include a portable crystal checker (Fig. 7). Just add a 0-5-mA meter, and replace the power supply with a 9-volt transistor battery. Note and mark the

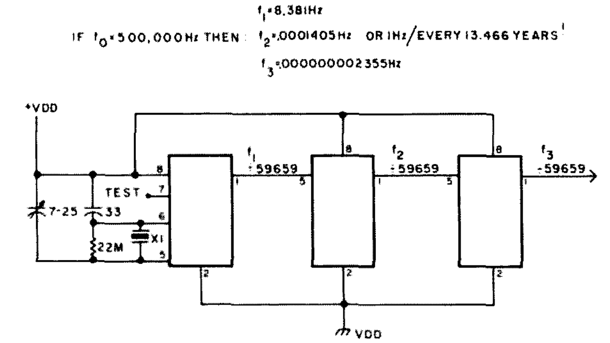

Fig. 8. Long-interval timer-option schematic.

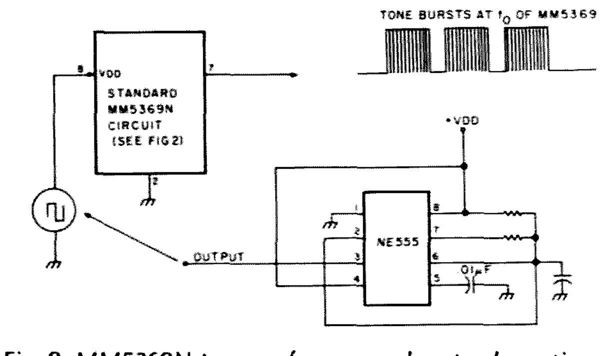

Fig. 9. MM5369N tone or frequency burst schematic and block diagram.

current drawn without a crystal in the circuit and mark this on the face of the meter. Crystals that operate at 5 MHz and below will cause a current drop from the mark, while 7 MHz and above will cause the current to increase. If there is no charge in the amount of current drawn, then the crystal is open, or very close to 6 MHz.

The MM5369N also can be used as a long-interval timer. You can cascade the MM5369N without using the active oscillator part of the IC by feeding the output of the first oscillator (pin 1) to the input of the next oscillator (pin 5). (See Fig. 8.) By this scheme, you select the desired output period and multiply by 59659 or multiple thereof, and find the inverse to get the operating frequency needed. If you wish to have 1 Hz every 1.88 years you have to use an operating frequency of 3.579545 MHz and divide it through 3 MM5369N dividers to obtain the desired output.

Another option is to use the MM5369N as part of a tone or frequency burst oscillator (Fig. 9). The NE555 timer provides a low frequency square wave that is used to supply power to the Vdd pin of the MM5369N. Every time the square wave goes positive, the oscillator is gated on for the duration of the positive portion of the pulse. The oscillator will produce whatever frequency has been selected for it by its crystal.

Construction

These circuits can be wired either point-to-point or by printed circuits. Although my circuit debugging is started on perfboard or breadboarding strips, I have always found it more enjoyable, in the long run, to make all my test equipment on printed circuit board. Not only does it make assembly easier, but when properly accomplished, can add to the usefulness and longevity of a circuit. Should you also find this to be the case, PC layouts have been included (Fig. 10).

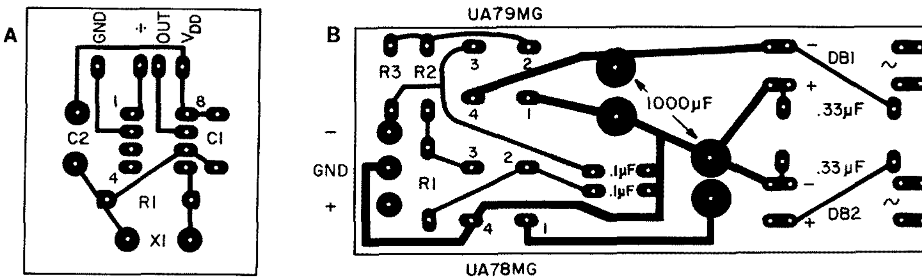

Fig. 10. (a) MM5369N PC board layout for basic circuit and crystal checker. (b) UA78MG and UA79MG power supply PC board layout. Both PC board layouts are shown from the component side.

Calibration

Calibration of the MM5369N output frequency is a relatively simple matter and can be accomplished with a bare minimum of fuss. Hook the output of pin 7 on the MM5369N to an oscilloscope or frequency counter and trim C2 until the desired frequency is obtained. Do this slowly as the trim cap is small and it's easy to overshoot the desired frequency. If you opt for the counter method of calibration and your counter drifts very little, you can record the oscillator output over a period of time while recording the ambient temperature, and make a frequency vs. temperature chart that will allow you to temperature-compensate your oscillator. This is done by finding the rate of frequency drift with temperature and selecting a replacement capacitor for C1 that has the opposite coefficient of the temperature curve. To select the proper capacitor, note the frequency and temperature at several points. Divide the difference in frequencies (desired and actual) by the desired frequency, then divide the result by the number of degrees that have changed from your ambient setting and you should have your temperature coefficient in parts per million/degree. This is what capacitor temperature coefficients are expressed in. Simply choose the one that is closest to the opposite of your recorded findings and you will be on your way to maximum stability.

Conclusion

This article is intended to present the experimenter with a versatile, crystal-controlled building block that proves to be useful in a wide range of circuits and is functional as a general-purpose crystal-controlled frequency standard that is not limited to such a mundane chore as a digital clock timebase. ■

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Digital Readout Rotator Control

—can the microcomputer connection be far behind?

Modernize your TR-44.

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With almost everything switching to digital readout these days, I decided to design a new control box for my TR-44 rotator. For my own personal use, the new control box would have to: use LED displays, be relatively simple, interface directly to the rotator with no internal modifications, remain accurate during ac line variations, and match my other station equipment.

Photograph of the new control box. (The display was enhanced so that it would stand out better.)

Research

Fig. 1 shows the schematic of the TR-44's unmodified sensing circuit. This circuit is a simple voltage divider, which causes more or less current to flow through the meter as the sensing potentiometer (inside the rotator) changes position. When the potentiometer is at the bottom end of its range (rotator fully counterclockwise, as viewed from the top of the rotator), no current flows through the meter, and the meter needle remains in the resting position. When the rotator is at the top end of its range (rotator fully

clockwise), approximately one milliampere flows through the meter, and the needle indicates full scale.

With the above ideas in mind, I decided that a simple dc voltmeter, with proper voltage scaling, could be used to indicate the position of the rotator potentiometer. If you apply a voltage to the potentiometer so the wiper-voltage changes from 0 to 3.6 volts during a complete revolution, you have a voltage which changes at the rate of .01 volts per degree.

A preliminary data sheet for the Motorola MC14433 integrated circuit, which is

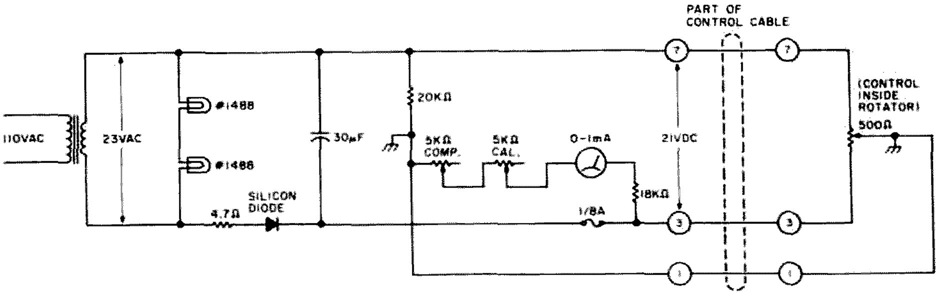


Fig. 1. Unmodified sensing circuit for the TR-44 rotator.

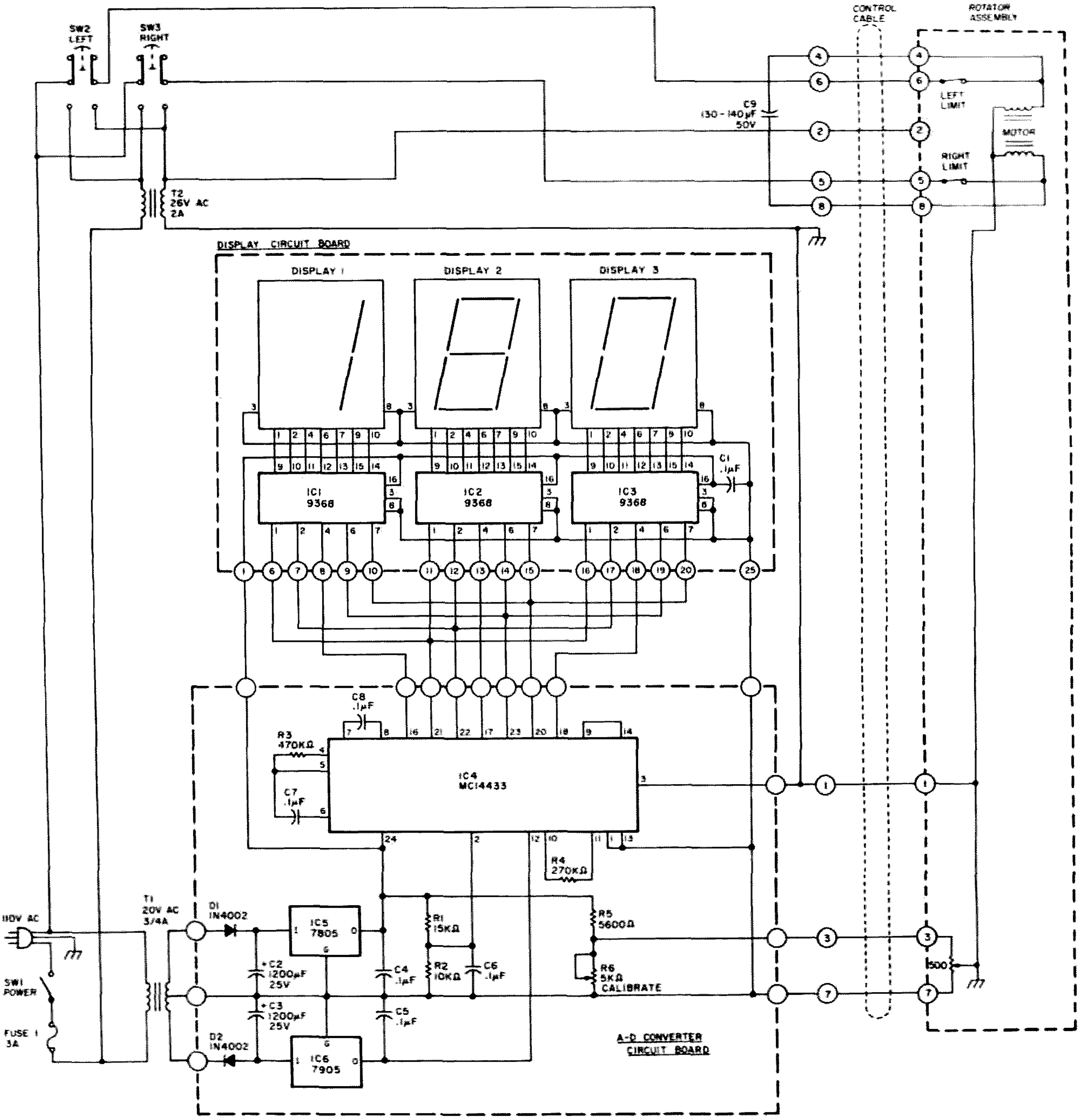
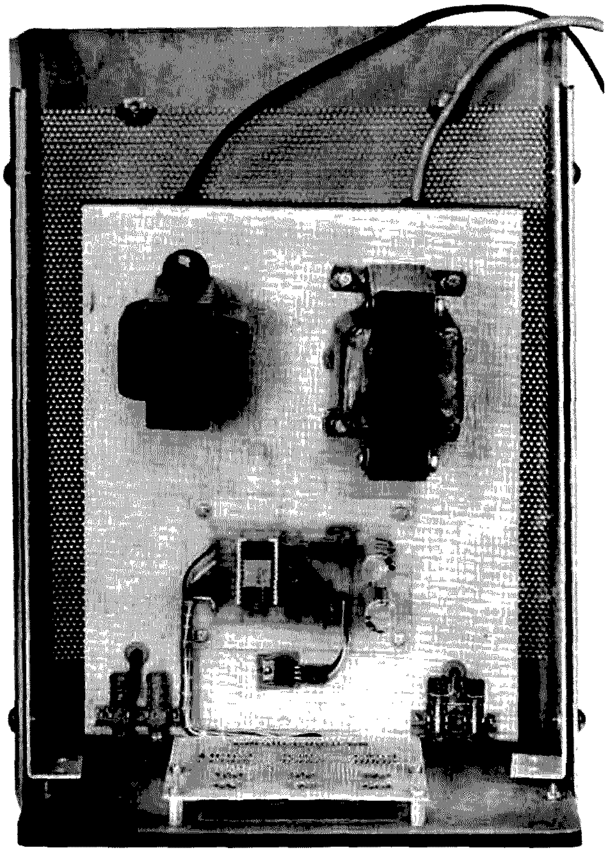


Fig. 2. Schematic diagram of the new control box (shown connected to the original rotator assembly).

a 3½-digit analog-to-digital converter, contained the schematic of a simple 3½-digit digital voltmeter. To suit my particular requirements, I deleted the overrange and polarity sensing circuitry to further simplify the circuit. I then modified the circuit to work with some decoder-driver ICs and LED displays that I already had. Fig. 2 is the schematic diagram of the completely redesigned rotor control box (shown connected to the rotator assembly).



Internal layout of the new control box.

Construction

With one minor exception, construction of the control box is not critical. Since the potentiometer wiper inside the rotator is mechanically grounded to the case (control cable wire #1), you must take care to keep all other circuit points isolated from ground.

If you use the same +5-volt regulator as I did, heat-sink it to the chassis. Be sure to use an insulator between the IC and the chassis to keep it electrically isolated from the chassis. The −5-volt regulator IC does not need a heat sink and may be mounted on the circuit board.

Figs. 3, 4, 5, and 6 show the foil and component layout of the two circuit boards. Although the two circuit boards could have been combined into one, I used separate boards so that they could be used on future projects.

Be sure the power transformer you use in the sensing circuit has at least an 18-volt, center-tapped, secondary winding. This will allow the regulator ICs to remain within acceptable operating parameters with varying ac line voltages. With a 20-volt, center-tapped transformer, you should be able to keep an accurate display indication while the ac line voltage varies between 90 and at least 130 volts.

I mounted an extra pushbutton switch on the left side of the front panel to help balance the appearance of the panel. You

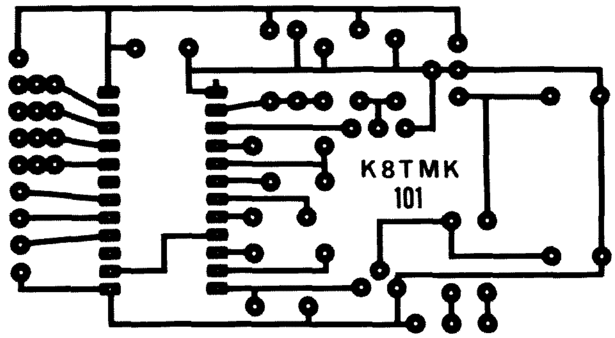


Fig. 3. Actual size foil pattern for the A-D converter circuit board (shown from the foil side).

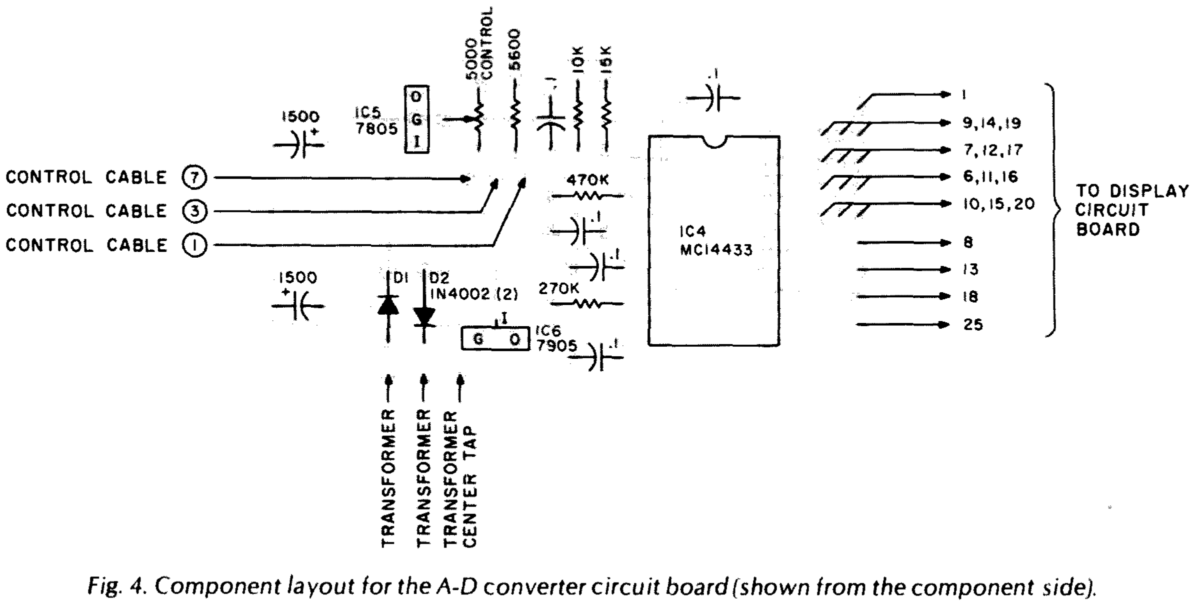


Fig. 4. Component layout for the A-D converter circuit board (shown from the component side).

could use this switch for brake release, if you use the control box with the Ham-M rotator.

Calibration

Calibration of the new control box is quite simple. You should not have to repeat it unless the ac line voltage changes drastically or the length of the control cable changes.

Connect the new control box to your rotator control cable and depress the POWER button. Use the RIGHT push-button to turn the rotator to its fully-clockwise position. The display will stop changing when you come to the end of travel. *Note:* If the display goes toward zero as you turn the rotator in a clockwise direction, interchange control cable wires 3 and 7. Now adjust the control on the A-D converter circuit board until the display indicates 360. The display should automatically indicate 0 when you turn the rotator to the left end of travel.

Operation

To determine the position of your antenna, simply depress the POWER button. The display will indicate the position in degrees. If you desire, you can leave the POWER button depressed for a continuous indication.

If you wish to turn the rotator to a new position, simply push the LEFT or RIGHT button until the display indicates the desired position.

Conclusion

I have been using the new control box for a few months with no noticeable problems. It is a great pleasure to hear a DX station, look up his bearing in a table, and turn the rotator to the exact position without having to interpolate between the lines on an analog meter.

In the future, I plan to redesign the control box for use with a microprocessor. This will allow me to punch in a prefix on a keyboard, for example, and then simply wait for the rotator to reach the correct position automatically. ■

Parts List

Component Number	Description
C1, C4, C5, C6, C8	.1 uF disc ceramic capacitors
C2, C3	1200 uF, 25-V electrolytic capacitors
C7	.1 uF mylar™ capacitor
C9	130-140 uF, 50 V, non-polarized capacitor
D1, D2	1N4002 silicon diode
DISP 1, DISP 2, DISP 3	FND-500 LED displays
F1	3-Ampere, 3AG fuse
IC1, IC2, IC3	9368 7-segment decoder-driver-latch ICs
IC4	MC14433 3½ digit A-D converter IC
R1	15k Ohm, ¼-Watt, 5% resistor
R2	10k Ohm, ¼-Watt, 5% resistor
R3	470k Ohm, ¼-Watt, 5% resistor
R4	270k Ohm, ¼-Watt, 5% resistor
R5	5600 Ohm, ¼-Watt, 5% resistor
R6	5k Ohm linear control
SW1	DPDT locking push-button switch
SW2, SW3	DPDT momentary-contact push-button switch
T1	Power transformer (20 V ac center-tapped, ¾-Ampere secondary)
T2	Power transformer (26 V ac, 2-Ampere secondary)

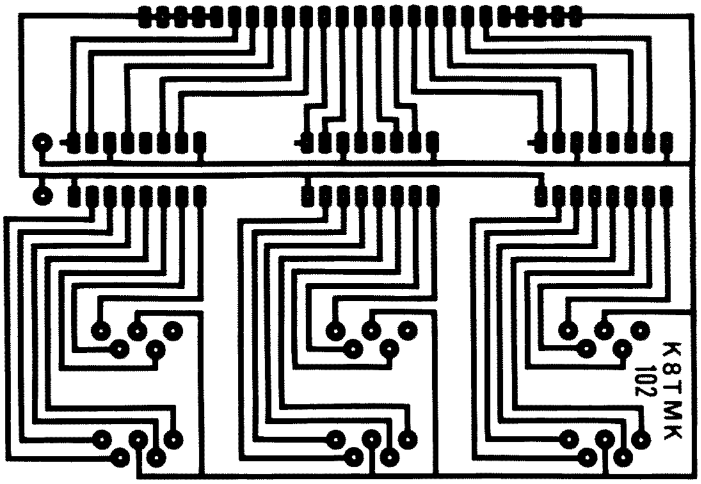


Fig. 5. Actual size foil pattern for the display circuit board (shown from the foil side).

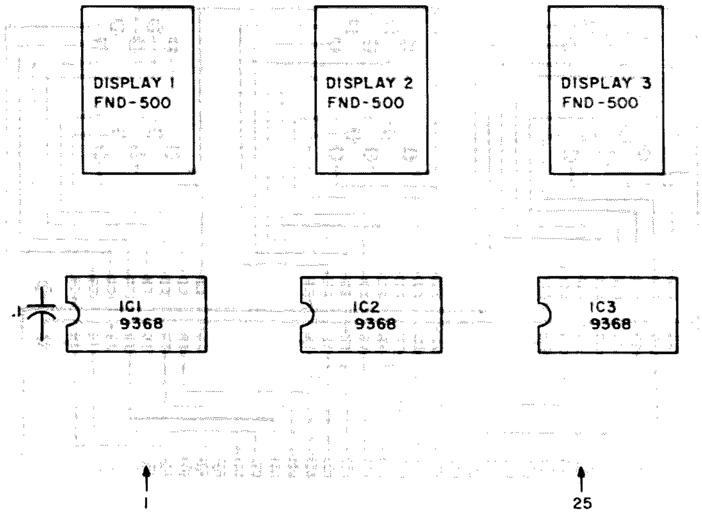


Fig. 6. Component layout for the display circuit board (shown from the component side).

Build the KIM Keyer

—with a 3-message memory

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The short application program listed in Table 1 allows the KIM-1 to send any of three messages by pressing one of three keys (A, B, or C) on the KIM-1 keyboard, and, with the interface circuit shown in Fig. 1, the KIM-1 becomes an electronic keyer as well. Any microcomputer with a 650X microprocessor and one of the MOS Technology PIA or VIA chips may be used with only minor modifications to the program. An important feature of the program is the ability to precisely set the code speed between 5 and 99 words per minute by entering the speed, in decimal, at storage location 0000 in memory. The program converts this decimal number to hexadecimal, then does a division routine to convert the speed to a time duration of the basic dot element, and the interval timers on the 6530 PIA do the rest.

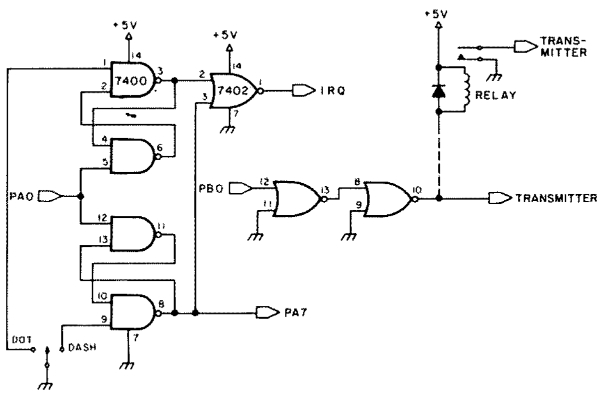


Fig. 1. Interface circuit. Some transmitters may require the optional relay for keying, with a 1N914 diode across the coil for protection against transient voltages. The Triton IV may be keyed directly from pin 10 of the 7402. All grounds should be the same as the KIM-1 ground, and the 5 volts may be stolen from the KIM-1 power supply.

Anyone who does much contest operating will realize how useful an automatic message sender is. Even the casual CW operator can use it for sending CQ or other routine messages. Code tests for Novices can be programmed and sent at precisely 5 wpm by storing the entire test in memory. At 5 wpm, at least 5 minutes of code may be sent. For Field Day (1977), we used a similar program to send CQ CQ CQ FD DE KØEI KØEI K as message A, then when a station responded, we sent (   ) DE KØEI UR 599 MO 599 MO K, where the blank was the call of the station to be keyed by the operator, after which he hit key B to give the remainder of the message. It worked very smoothly with no discernible pause between the call letters and the message. (Don't try to look up our score, because KØEI was not the call we used.) The operation of the keyer is exactly like most electronic keyers; holding the paddle in the dot position will cause a series of dots and spaces to be sent. Dashes occur with the paddle in the dash position, and the timing of all the characters is controlled by the program and the crystal on the microcomputer.

Operation

Assuming the program has been loaded and the interface circuit connected, operation proceeds as follows. The code speed at which you wish to operate is loaded into storage location 0000. Any decimal number from 05 to 99 may be put into this location. Next, the starting and ending addresses of each message must be loaded into memory. Since all three messages are in page 2 of memory, only the low-order bytes of the starting and ending addresses need be given. Suppose message A starts at 0200 and ends at 0251, message B starts at 0252 and ends at 0265, while message C starts at 0266 and ends at 0278. (These are completely weird numbers chosen at random from my skull and have absolutely no other significance.) Then one would load 00, the starting address of message A, at location 0001; 52, the starting address of message B goes in at 0002; and 66 is entered at 0003. The respective ending addresses go into memory locations 0004 to 0006, that is, 51 into 0004, 65 into 0005, and 78 into 0006.

How do you load the messages themselves? For each character you want to send, you must load the corresponding hex number shown in Table 2. Suppose, for no reason whatsoever, message A is to be "DE KØEI K" and is to start at 0200. You then load the hex numbers 90 40 00 B0 FC 40 20 00 B0 from locations 0200 through 0208; 00 goes into 0001 and 08 into 0004.

Probably the best way to proceed is to first load the three messages including spaces, noting the starting and ending addresses of each message on a piece of paper. Then go back to page 0 and put the starting and ending addresses in their proper locations. Go to location 0300 and hit the GO button to start the program running. Test to make sure everything is working before you put the thing on the air.

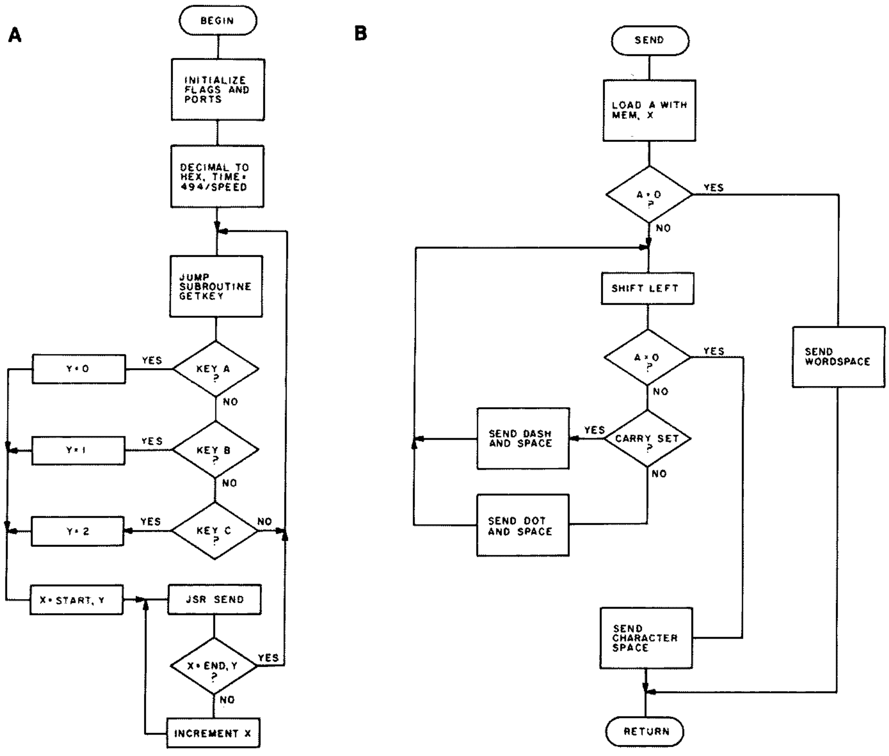
Programming Details

The flowchart shown in Fig. 2 and the comments in the program should give the reader a good feeling for the structure of the program. It consists of three principle parts: the main program, subroutine SEND, and the interrupt routine, all of which have individual flowcharts shown. Minor components are subroutine DIT (which holds PBØ at logic 0 for the dot length followed by a logic 1 for the space length), subroutine DAH (which holds PBØ at logic 0 for three dot lengths—1 dah = 3 dits—followed by a space), and subroutine TIMER (which loads the timer on the KIM-1 with the precise length of 1 dot and then waits for this time to elapse).

We now look at some specific details of the program. The speed in words per minute must be converted to hex before the computer can do any further calculations with it. This conversion may best be explained with an example. Suppose we wish to operate at 20 wpm, so 20 is entered into location 0000. What we mean by 20 is 2 in the tens place and 0 in the ones place, but what the computer thinks this means is 2 in the sixteens place and 0 in the ones place. At least we agree on the ones place, so initially we mask the ones place out with an AND statement; later we retrieve it and simply add it to the result of our decimal-to-hex conversion of the 2. To trick the computer into thinking the 2 in the sixteens place is the 2 in the tens place we intended it to be, we change the sixteen to a ten with this trick: $10 = 16/2 + 16/8$. The sixteens place divided by two is accomplished by one shift-right statement (LSR), while the sixteens place divided by 8 is accomplished by three shift-right statements. So, the 2 in the sixteens place is shifted right once, stored, shifted right two more times, and these two results are added. We now have 2×10 in the computer (in hex, of course) rather than 2×16. Adding the results from the ones place completes the conversion.

Using the keying speed definitions from *The Radio Amateur's Handbook*, one can calculate that the dot length in milliseconds is 1200/S, where S is the code speed in words per minute. If the divide-by-1024 timer on the KIM-1 is used, 1 count corresponds to 1.024 milliseconds. Converting the dot length to timer counts gives TIME = (1172/S) base 10 = (494/S) hex, where TIME is the number to be loaded into the divide-by-1024 timer to give a code speed of S wpm. So, the computer must divide S into 494. This is determined by successively subtracting S from 494 until the result becomes negative. The number of subtractions is the quotient of 494/S.

Pin PBØ on the KIM-1 is used as the keying output from the computer. When power is applied to the computer and the reset button is depressed, PBØ comes up in a logic 1 state. This dictates that logic 1 corresponds to the transmitter being off. Consequently, PBØ is buffered and inverted twice by the NOR gates. Inverters such as the 7404 would work, but since I needed a NOR gate in the keyer interface, I simply used the other NOR gates on the same



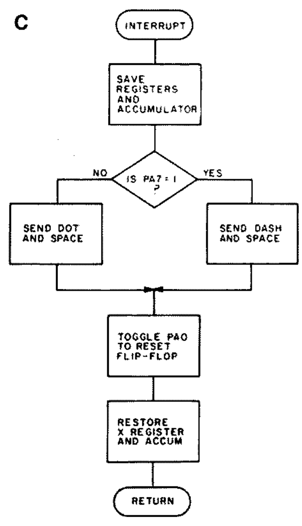


Fig. 2. Flowchart for the keyer and message sender. (a) Main program. (b) SEND subroutine. (c) Interrupt routine.

```
Address Instruction  Label  Op Code Operand  Comments
0300    78           BEGIN  SEI              Prevent interrupts.
0301    D8                  CLD              Binary mode.
0302    A9 C9               LDA $C9          Set interrupt vectors.
0304    8D FE 17            STA IRQL
0307    A9 03               LDA $03
0309    8D FF 17            STA IRQH
030C    A9 01               LDA $01          Initialize I/O Ports A
030E    8D 02 17            STA PBD          and B.
0311    8D 03 17            STA PBDD         PBØ is output pin.
0314    8D 01 17            STA PADD         PAØ is output pin.
0317    8D 00 17            STA PAD
031A    CE 00 17            DEC PAD          Toggle PAØ to reset debounce
031D    EE 00 17            INC PAD          circuit.
0320    A5 00               LDA SPEED        Get decimal value of speed
0322    48                  PHA              from location 0000 and convert
0323    29 F0               AND $F0          it to hex.
0325    4A                  LSR A            Multiply tens digit by ten.
0326    85 10               STA SCRATCH
0328    4A                  LSR A
0329    4A                  LSR A
032A    18                  CLC
032B    65 10               ADC SCRATCH
032D    85 10               STA SCRATCH      Result of multiplication here.
032F    68                  PLA              Get SPEED again.
0330    29 0F               AND $0F          Add ones digit to SCRATCH.
0332    65 10               ADC SCRATCH
0334    85 10               STA SCRATCH      Decimal to hex complete.
0336    38                  SEC              Division routine begins here.
0337    A2 00               LDX $00
0339    A9 94               LDA $94
033B    85 08               STA LO
033D    A9 04               LDA $04
033F    85 09               STA HI
0341    A5 08        UP     LDA LO
0343    E5 10               SBC SCRATCH
0345    85 08               STA LO
0347    A5 09               LDA HI
0349    E9 00               SBC $00
034B    85 09               STA HI
034D    E8                  INX
034E    B0 F1               BCS UP
0350    86 07               STX TIME         Division Complete.
0352    20 6A 1F     RPT    JSR GETKEY       Read keyboard subroutine.
0355    58                  CLI
0356    A0 00               LDX $00          Test keys.
0358    C9 0A               CMP $0A
035A    F0 0A               BEQ MESSA
035C    C9 0B               CMP $0B
035E    F0 05               BEQ MESSB
0360    C9 0C               CMP $0C
0362    D0 EE               BNE RPT
0364    C8                  INY
0365    C8           MESSB  INY
0366    BE 01 00     MESSA  LDX STRT,Y       Start message.
0369    20 76 03     CNT    JSR SEND
036C    8A                  TXA
036D    D9 04 00            CMP END,Y        End message?
0370    F0 E0               BEQ RPT
0372    E8                  INX
0373    4C 69 03            JMP CNT
        ****************************************************
0376    8A           SEND   TXA
0377    48                  PHA
0378    BD 00 02            LDA MEM,X        Get code element.
037B    F0 1E               BEQ WDSP
037D    0A           HERE   ASL A
037E    F0 10               BEQ FINSH
0380    48                  PHA
0381    B0 06               BCS DASH
0383    20 A0 03            JSR DIT          Send dot.
0386    4C 8C 03            JMP ARND
0389    20 B9 03     DASH   JSR DAH          Send dash.
038C    68           ARND   PLA
038D    4C 7D 03            JMP HERE
0390    A2 02        FINSH  LDX $02
0392    20 BE 03     AGN    JSR TIMER        Character space.
0395    CA                  DEX
0396    D0 FA               BNE AGN
0398    68                  PLA
0399    AA                  TAX
039A    60                  RTS
039B    A2 04        WDSP   LDX $04          Word space.
039D    4C 92 03            JMP AGN
        ****************************************************
03A0    A2 01        DIT    LDX $01
03A2    CE 02 17     BACK   DEC PBD
03A5    20 BE 03     SPA    JSR TIMER
03A8    CA                  DEX
03A9    D0 FA               BNE SPA
03AB    AD 02 17            LDA PBD
03AE    4A                  LSR A
03AF    B0 07               BCS DONE
03B1    EE 02 17            INC PBD
03B4    E8                  INX
03B5    4C A5 03            JMP SPA
03B8    60           DONE   RTS
        ****************************************************
03B9    A2 03        DAH    LDX $03
03BB    4C A2 03            JMP BACK
        ****************************************************
03BE    A5 07        TIMER  LDA TIME         Delay for the number of
03C0    8D 07 17            STA TMER         1.024 millisecond units
03C3    2C 07 17     CHK    BIT TMER         stored in TIME.
03C6    10 FB               BPL CHK
03C8    60                  RTS
        ****************************************************
03C9    48       INTERRUPT  PHA              Save registers.
03CA    8A                  TXA
03CB    48                  PHA
03CC    AD 00 17            LDA PAD          Is PA7 = logic 1?
03D0    30 06               BMI PAST         Yes, dah. No, dit.
03D2    20 A0 03            JSR DIT          Send dot.
03D5    4C DA 03            JMP ACRS
03D8    20 B9 03     PAST   JSR DAH          Send dash.
03DB    CE 00 17     ACRS   DEC PAD          Toggle debounce circuit.
03DD    EE 00 17            INC PAD
03E0    68                  PLA              Restore registers.
03E1    AA                  TAX
03E2    68                  PLA
03E3    40                  RTS              Return from interrupt.
```

Table 1. Source listing for the message and keyer program.

chip. If PBØ could sink enough current, it might drive the relay directly, but I preferred the buffering shown in Fig. 1. Mark elements of the Morse code are sent by decrementing (DEC) PBØ for the appropriate length of time, while space elements are sent by leaving PBØ at logic 1.

The program idles in the loop starting with JSR GETKEY and ending with BNE RPT, testing each of three keys (A, B, and C) to see if they were depressed. If no key is depressed, the program remains in this loop. If a key is depressed, register Y is set to 0, 1, or 2 depending on which key was struck. Y is then used as an index to look up the starting address (low-order byte of page two of memory) of the message (STRT,Y) and later the ending address (END,Y) of the message. The starting address is used as an index to find the first code element of the message (MEM,X), and it is incremented until the ending address is en-

Morse Character	Hex		
		V	18
		W	70
A	60	X	98
B	88	Y	B8
C	A8	Z	C8
D	90	1	7C
E	40	2	3C
F	28	3	1C
G	D0	4	0C
H	08	5	04
I	20	6	84
J	78	7	C4
K	B0	8	E4
L	48	9	F4
M	E0	0	FC
N	A0	Word space	00
O	F0	$\overline{\text{SK}}$	16
P	68	$\overline{\text{BT}}$	8C
Q	D8	$\overline{\text{AR}}$	54
R	50	/	94
S	10	.	56
T	C0	,	CE
U	30	?	32

Table 2. Morse character to hex conversion.

Location	Contents
0000	Speed in decimal (words per minute)
0001	Starting address of message A (low-order byte)
0002	Starting address of message B
0003	Starting address of message C
0004	Ending address of message A (low-order byte)
0005	Ending address of message B
0006	Ending address of message C
00F1	04 (Prevents interrupts while in monitor)

Table 3. Storage locations to be loaded by the operator.

countered.

The conversion of an 8-bit word of memory to a Morse code character has been described in other references in detail and will not be repeated here. There are a number of schemes available,[1,2] but the most efficient schemes appear to be those in references 3 and 4, and those were the techniques used here.

The keyer is implemented by the interrupt routine, which in turn uses subroutines DIT, DAH, and TIMER. It will send at exactly the same speed as the messages. The keyer interface circuit is simply debouncers which are reset at the end of an interrupt. If the key is still in the dot or dash position, the reset has no effect and another interrupt occurs. The flowchart indicates that the state of PA7 determines which element is to be sent.

One last thought: If you want to be able to key in a few characters in the middle of a message, just load a few word spaces there and key the characters in when the blank occurs. This is handy for giving signal reports and also in some contests where the number of contacts is updated after each QSO. ■

References

1. Pollock, James W., "1000 WPM Morse Code Typer," *73*, January, 1977, p. 100.
2. De Jong, Marvin L., "A Complete Morse Code Send/Receive Program for the KIM-1," *MICRO*, April-May, 1978, p. 7.
3. Pollock, James W., "A Microprocessor Controlled CW Keyboard," *Ham Radio*, January, 1978, p. 81.
4. Ockers, Stan, "Code Test," *The First Book of KIM*, ORB, Argonne, Illinois, 1977, p. 56.

✓ Reader Service—see page 195

No More TRS-80 Cassette Woes

—E-Z Loader does the trick

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Evanston IL 60202

David F. Miller K9POX
7462 Lawler Ave.
Niles IL 60648

You can eliminate most of your Level II TRS-80 cassette-loading problems once and for all! It's true, the circuit described in this article will go a long way toward eliminating your CLOAD problems. If all of the data is there on the cassette, this gadget will find it and load it into your TRS-80 Level II machine . . . it's the greatest thing since the Level I manual!

If you've worked with Level II for any time at all, you know that it is somewhat sensitive to playback volume on a CLOAD command (what an understatement!). Playing back a *good* recording through this circuit—let's call it the E-Z Loader—will allow you to set the playback volume on the Radio Shack CTR-41 recorder anywhere from 2 to 10! A *not-so-good* recording will have somewhat less range, but it will still be quite broad, and you *will* be able to load it. Even the head azimuth (vertical alignment of the record vs the playback head if not the same machine) becomes fairly noncritical, and you can even vary the playback volume up and down while loading with no adverse effect.

Sound too good to be true? It seems that in this day and age we're besieged with all manner of claims and counterclaims, but E-Z Loader really works . . . try it and see for yourself!

The Problem

When you type CSAVE and ENTER, the TRS-80 puts out a positive- and negative-going square wave at the cassette port. However, when the audio recorder "processes" this square wave and lays it down on tape, it isn't exactly square any longer. Take a peek at Fig. 1 and see what we mean!

The output of the cassette recorder as depicted in Fig. 1(b) is more like a mostly negative-going spike, broadened out, with a small (in ratio) positive dimple on either side. This is what a *good* recording looks like; a *bad* one is downhill from that! Somehow, the TRS-80 will accept that waveform and load the data it contains into RAM, if the recorder/playback head azimuth is quite close and the playback level is just right!

This is where the circuit of Fig. 2 comes into action. The root of the problem lies in the TRS-80's resident software. After the computer recognizes a sync pulse, it waits a short time and then looks at the input once again. If there is a pulse present, the computer interprets it as a 1 and goes through the cycle all over again. If there is no pulse present, the computer assumes this to be a 0 and repeats the cycle.

This sequence occurs until all of the data has been loaded from the tape, at which time the READY prompt reappears. The problem in all of this, however, is in the *amount of time* that the TRS-80 waits after recognizing a pulse, before it looks for the next pulse, and *not* in the input level, as many believe!

Currently, a Level II TRS-80 waits only about 250 microseconds before testing for a pulse, and therein lies the problem. A *good* tape will produce a pulse that is much narrower than 250 microseconds—see Fig. 1(b)—but a *bad* tape, or one in which the head azimuth of the record machine differs from the playback machine, can easily produce pulse widths in excess of that magical 250 microsecond figure! When that happens, the computer interprets the tail end of the initial pulse as a new pulse, and there goes your CLOAD!

The E-Z Loader corrects this by waiting for a sync pulse, triggering and producing an output pulse 150 microseconds wide and then locking-out for 750 microseconds (2/3 of the time between a sync and data pulse), triggering again if a data pulse (logic 1) is present, and outputting it as a 150-microsecond-wide pulse. Thus, no matter how wide your input pulses are, they can produce only 150-microsecond-wide output pulses.

In a nutshell, the E-Z Loader circuitry takes the rather poorly defined spike of Fig. 1(b) and regenerates it back into a nice square, narrow pulse again. Your computer will really love that narrow pulse and will

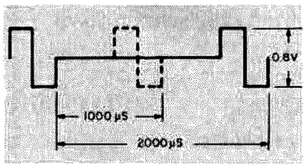


Fig. 1(a). Output directly from the cassette port of the computer. Sync pulses are solid lines; data pulses are dotted lines.

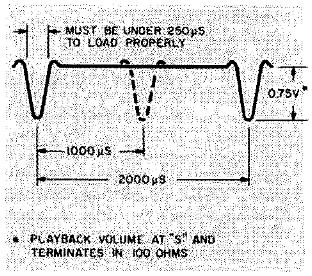


Fig. 1(b). The output from a good cassette tape after being recorded by the CTR-41 recorder. Sync pulses, solid; data pulses, dotted.

continue to reward you for your effort.

How the Circuit Works

Following the schematic diagram (Fig. 2) from the cassette player output (which is the input to the E-Z Loader), you'll notice that we transformer-couple in order to make the bridge rectifier behave properly and to eliminate the ground loop condition that exists in the Radio Shack CTR-41 recorder (in case you haven't eliminated it already by other means).

The input signal to the transformer first passes through a high-pass filter (C5 and R10) and is stepped up by a factor of at least 10. It is then applied to the bridge rectifier whose output consists of only positive-going pulses. These positive pulses are sent to the base of transistor Q1, but with a slight twist.

Locate R7 and C4 on the schematic and notice that Q1's base current must pass through C4. As pulses are rectified by the bridge, C4 charges to a voltage equal to the output of the bridge (less 0.6 V) and at the same time supplies a current spike to Q1's base, triggering the transistor. By the next time a pulse arrives, C4 has discharged slightly through R7, and again supplies a triggering current spike to Q1's base.

The net effect of all of this is that Q1, C4, and R7 form a passive level detector and trigger the rest of the circuitry only on pulse peaks, regardless of the level arriving from the recorder. The amplified and peak-detected pulses are fed to the first inverting input of the 74LS123 IC, which is a dual low-power Schottky retriggerable monostable multivibrator chip (say that three times!).

The two multivibrators in this package are connected in such a way that the output is taken from the Q output of section one, which also feeds the non-inverting input of section two. The $\overline{Q}$ output of section two is fed back to the non-inverting input of section one, which has the effect of disabling the output of section one for a 750-microsecond duration.

The total effect of all of this can be observed on an oscilloscope at pin 13 (or pin 10) of the IC: a positive-going square pulse, 150-microseconds wide, for every sync and data pulse leaving the tape, regardless of the width of the pulse on the tape. No hum, no noise, no miscellaneous crud to fool the TRS-80 into loading erroneous data . . . just nice, clean pulses. The buffer amplifier is an emitter-follower with a voltage gain somewhat less than unity, but it does a nice job of isolating and matching the 100-Ohm input impedance of the TRS-80 computer.

TRS-80 performance won't be affected by positive, negative or square waves (both transitions), so we chose positive pulses to keep the circuit parts count down. The pulses output to the computer are between 1 and 2 volts peak-to-peak (viewed on a scope with a 100-Ohm termination), regardless of where the CTR-41 recorder volume control is set, as long as there is at least enough volume to detect the pulses and trigger the E-Z Loader's circuitry. If the playback volume is too low, there simply will be no output (or possibly, sporadic output).

The point of minimum output for each cassette is easy to determine, however, and as long as you stay above that point, you'll get a good load. On a decent tape, this minimum can be 2 or 3 on the CTR-41's graduated volume control knob, and there

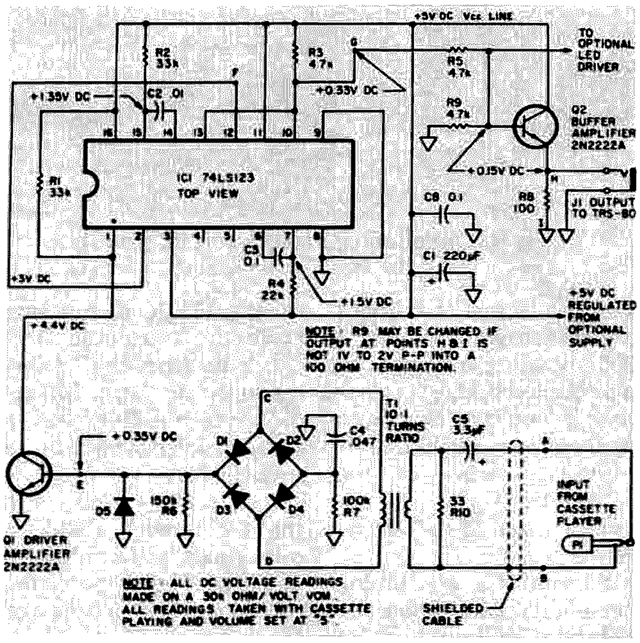


Fig. 2. TRS-80 E-Z Loader schematic diagram.

usually is *no maximum level*.

Precautions

One potential pitfall to properly loading with the E-Z Loader in-line (other than tape dropouts and/or bad data on the tape) would be insufficient level into the E-Z Loader, thus the optional LED driver shown in Fig. 3. The LED visually shows the operator that point at which the E-Z Loader is not receiving enough level from the recorder on playback. As long as the LED is lit and slightly flickering, the recorder output level control (volume) is set above this threshold. It also adds a nice touch in impressing visiting dignitaries.

It's an option because it has no effect on the rest of the circuitry and is for operator convenience only. To prevent occasional drops in level on the tape from causing a bad CLOAD, keep the recorder's output at least two divisions above the point at which the LED extinguishes.

Requirements

OK, we've talked you into building the E-Z Loader, now you probably think that there will be some sort of catch such as specially selected parts, critical circuit layout, and/or fancy test equipment needed for alignment. No! All of the parts are available from Radio Shack with the possible exception of the input transformer, which is actually an output transformer with a turns ratio of approximately 10:1. You can probably scrounge one from that defunct $9.95 portable transistor radio you've been putting off fixing. That's called recycling and it's the "in" thing to do.

The transformer is hooked up backwards so that the low impedance (speaker) winding is accepting the audio out of the cassette recorder. Resistors are all 1/4 or 1/2

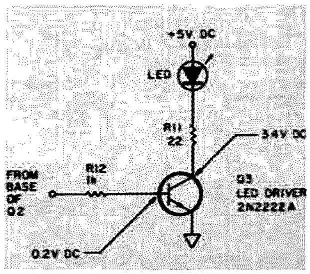


Fig. 3. Optional LED driver circuit.

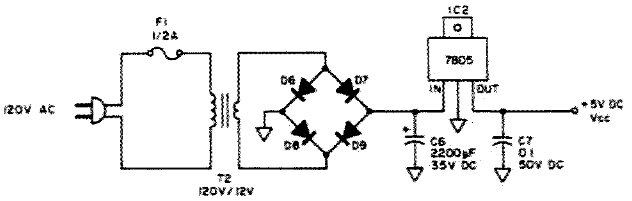


Fig. 4. Optional regulated 5-volt dc supply.

Watt units, and the diodes are silicon with at least a 200 piv rating. You can use a packaged bridge rectifier unit, or you may choose to wire up four individual rectifiers as shown on the schematic (Fig. 2). All capacitors are 35-to-50-V dc rating.

C2 and C3 are timing capacitors and should be polyester or tantalum for stability and accuracy of value. The 2N2222A transistors are medium-gain devices and also are not critical. Whether you use perfboard layout (as shown in the photo) or a printed circuit board, it would be advisable to consider using a socket for the 74LS123 IC (I just hate unsoldering 16 pins all at once).

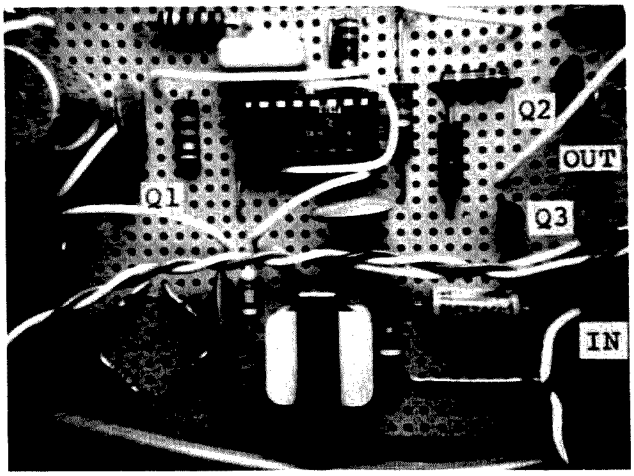
As you may have noticed, the E-Z Loader requires +5 V dc (at about 25 mA), and it should be quite close to that figure for the TTL IC to function correctly. You could steal +6 V dc from the CTR-41 through an appropriate dropping resistor, but a better choice would be to incorporate the supply shown in Fig. 4, along with the E-Z Loader board, in one neat self-contained package. The parts for the optional power supply and the optional LED driver are also available from Radio Shack. Now you don't have any excuse for putting off building the gadget!

Putting E-Z Loader to Use

There is no alignment or parts selection required. Voltage readings and oscilloscope waveforms at various points are shown to assist in verifying that the unit is functioning properly. Simply hook up the E-Z Loader between your CTR-41 recorder's "ear" output and the TRS-80's audio input and you're all set. Incorporating a 1/8-inch phone jack on its output and a 1/8-inch phone plug on its input will permit you to remove the E-Z Loader at any time and normalize your setup. But we honestly don't think that you'll be inclined to do that very often, not once you've seen how easy it is to CLOAD with the E-Z Loader in-line (except, perhaps, to demonstrate the difference to skeptical friends).

One other use for the E-Z Loader would be to clean up poor quality tapes. Using a second recorder, play the bad tape through the E-Z Loader and plug the E-Z Loader's output into the second recorder's aux input. The recording on the second machine will then be first quality, and should load on anyone's unmodified computer with ease.

Exceptionally high hum level on the tape being played back and wow (frequency instability) in the record or playback machines are other potential sources of CLOADing errors. The E-Z Loader helps in all cases, but obviously there are limits beyond



The perfboard layout used in one of the units that has been constructed.

Parts List

C1—220-uF electrolytic, R.S. #272-1029
C2—.01-uF printed circuit capacitor, R.S. #272-1065
C3—.1-uF tantalum capacitor, R.S. #272-1401
C4—.047-uF printed circuit capacitor, R.S. #272-1068
C5—3.3-uF tantalum capacitor, R.S. #272-1408
C6—2200-uF electrolytic, R.S. #272-1020
C7, C8—.1-uF ceramic disc, R.S. #272-135
D1 to D9—200-volt silicon rectifiers, R.S. #276-1102
F1—1/2-Amp, 1/4 x 1-1/4 inch fuse, R.S. #270-1271 mounted in R.S. #270-364 holder
IC1—74LS123 integrated circuit, R.S. #276-1926
IC2—7805 integrated circuit, R.S. #276-1770
J1—1/8-inch phone jack, R.S. #274-251
P1—1/8-inch phone plug, R.S. #274-286
Q1 to Q3—2N2222A transistor, R.S. #276-1617
R1, R2—33k, 1/2-W, 10 percent resistor, R.S. #271-040
R3, R5, R9—4.7k, 1/2-W, 10 percent resistor, R.S. #271-030
R4—22k, 1/2-W, 10 percent resistor, R.S. #271-038
R6—150k, 1/2-W, 10 percent resistor, R.S. #271-047
R7—100k, 1/2-W, 10 percent resistor, R.S. #271-045
R8—100-Ohm, 1/2-W, 10 percent resistor, R.S. #271-012
R10—33-Ohm, 1/2-W, 10% resistor, R.S. #271-007
R11—22-Ohm, 1/2-W, 10% resistor, R.S. #271-005
R12—1k, 1/2-W, 10% resistor, R.S. #271-023
T1—audio output transformer, 10:1 ratio or greater, such as Calectro #D1-729 (200-Ohm c-t to 8 Ohm)
T2—120 V ac to 12 V ac @ 300-mA transformer, R.S. #273-1385

Miscellaneous

Socket for IC1—16-pin DIP, R.S. #276-1998
LED—light emitting diode, R.S. #276-1622
Solder, hook-up wire, shielded cable, perfboard and cabinet
Note: C2 and C3 are timing capacitors and as such must be of good quality such as those listed above. Do not use disc types for this purpose.
A circuit board for the E-Z Loader and power supply is available from the authors. Send $6 and an SASE to Paul Goelz, 2228 Madison Pl., Evanston IL 60202.

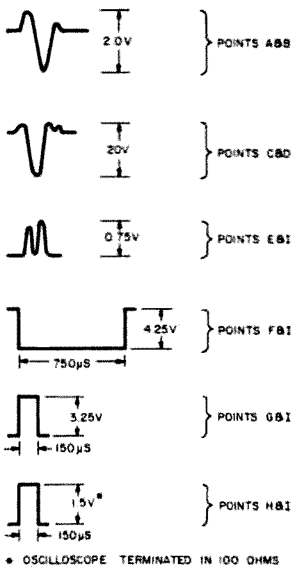


Fig. 5. Peak-to-peak oscilloscope measurement within the E-Z Loader's circuitry.

which very little can be done.

Keeping your recorder's head, pinch roller, capstan and tape guides clean will go a long way toward helping the E-Z Loader do its job. Using fairly decent cassettes without wrinkles on the tape, fixing sticking reels and poorly placed pressure pads, and watching out for nonuniform oxide coating are also your responsibilities toward good loading. As stated in the beginning of the article, as long as the data is on the tape, the E-Z Loader will go a long way toward digging it out and loading it into your TRS-80, but you will have to give it a fair shake at least!

It has been our intent to make public a circuit that is genuinely needed within the TRS-80 community. We intend no infringement on the rights of others, and reproduction of the circuit is granted on a not-for-profit basis only. I will answer all inquiries if the writers would be kind enough to enclose an SASE. ■

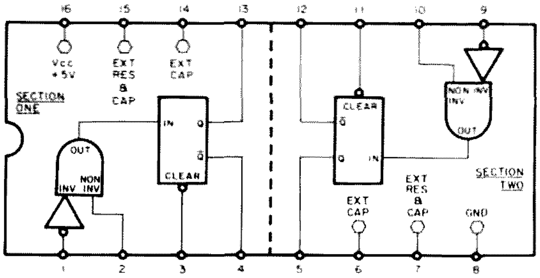
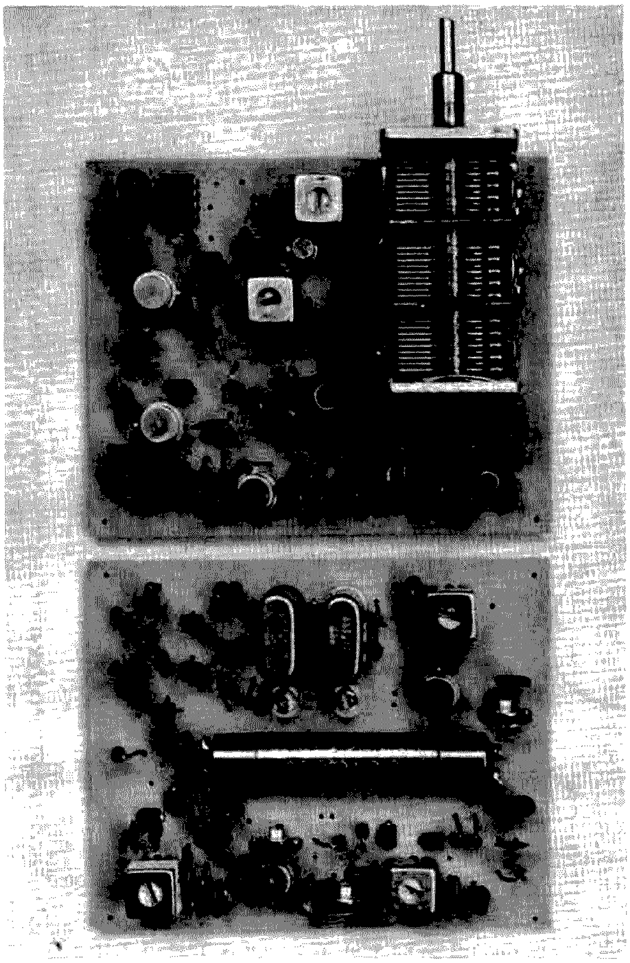


Fig. 6. Internal logic for the 74LS123 chip.

The Incredible Shrinking Transceiver

—build it on two tiny PC boards


Both boards fully assembled.

Ray Megirian K4DHC
606 SE 6 Avenue
Deerfield Beach FL 33441

Over the years, a ham's junk box can sport a pretty wild assortment of goodies, and mine is no exception. Many of the items are treasured for their sentimental value, some because they are of the often-needed variety, and the remainder simply because they cost a bunch. In this last category, I had stored away several Collins mechanical filters which by now had been with me so long that I couldn't remember how I had acquired them in the first place. On several occasions I had tried to sell or swap them, but no takers had appeared, so I decided I might just as well put them to use.

A Miniature Transceiver

If you are familiar with my Minicom series of receivers, you know I have a passion for miniaturization and it would seem logical that the filters be used in something small. The final choice was an SSB generator and receiver combination which would ultimately form the major portion of a transceiver. The entire project occupies 2 PC boards of identical size. Both boards are 3.7" x 3" and can be stacked if desired. The receiver portion is a simplified version of the Minicom MK V and covers 3.5 to 4.0 MHz. The transmitting exciter section output is also 3.5 to 4.0 MHz. By adding a suitable amplifier, the rig could be used as is on 75 meters. For use on other bands, additional mixers and a crystal oscillator would be used to heterodyne up to the desired frequencies.

Circuit Description

The Collins filters from my junk box are all housed

in the Y-style case which is cylindrical and for which the PC layout is designed. Of the 2 filters from the collection which were suitable for this application, one had a bandwidth of 2 kHz and the other 3.1 kHz. Both worked well in this circuit.

A complement of 6 integrated circuits and 8 transistors provide all the needed functions. One i-f stage, the vfo, and the bfo are common to both receive and transmit modes. The input to the mechanical filter and the output from the common i-f stage are transferred from receive to transmit by means of diode switches. The upper- and lower-sideband crystals in the bfo are also switched by diodes.

All the frills such as VOX, noise blanker, CW filter, S-meter, and other goodies were left out in the interest of miniaturization. When assembled sandwich fashion, the whole rig fits in the palm of your hand.

Speech Amplifier and Balanced Mixer

A CA3020 integrated circuit performs as both speech amplifier and balanced mixer, thus contributing substantially to our miniaturization efforts. This device, though designed for class B audio amplifier service, has a bandwidth of 8 MHz and lends itself to rf applications such as this. The chip houses an emitter-follower input stage, a differential amplifier, 2 emitter-follower drivers, and 2 output transistors. The output transistors have uncommitted collectors and emitters, which makes the device suitable for use in our circuit.

The mike feeds into pin 10 which is the base of the input emitter-follower. Input impedance is over 50k Ohms. R2 is a preset trimmer used to adjust the audio gain for the mike being used and, once set, can be left alone. The 455-kHz carrier is introduced across the emitters of the output transistors and a 50-Ohm preset pot is used to balance the signal. In some cases, cancellation of the carrier from the output may not be complete and capacitive balancing may be necessary. The PC board has provision for a small capacitor on either side of the balance pot to ground.

A modified transistor i-f transformer is used to couple the collectors of the output transistors to the mechanical filter. The winding data for this and other transformers will be covered later.

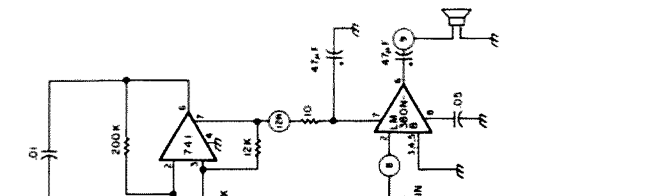
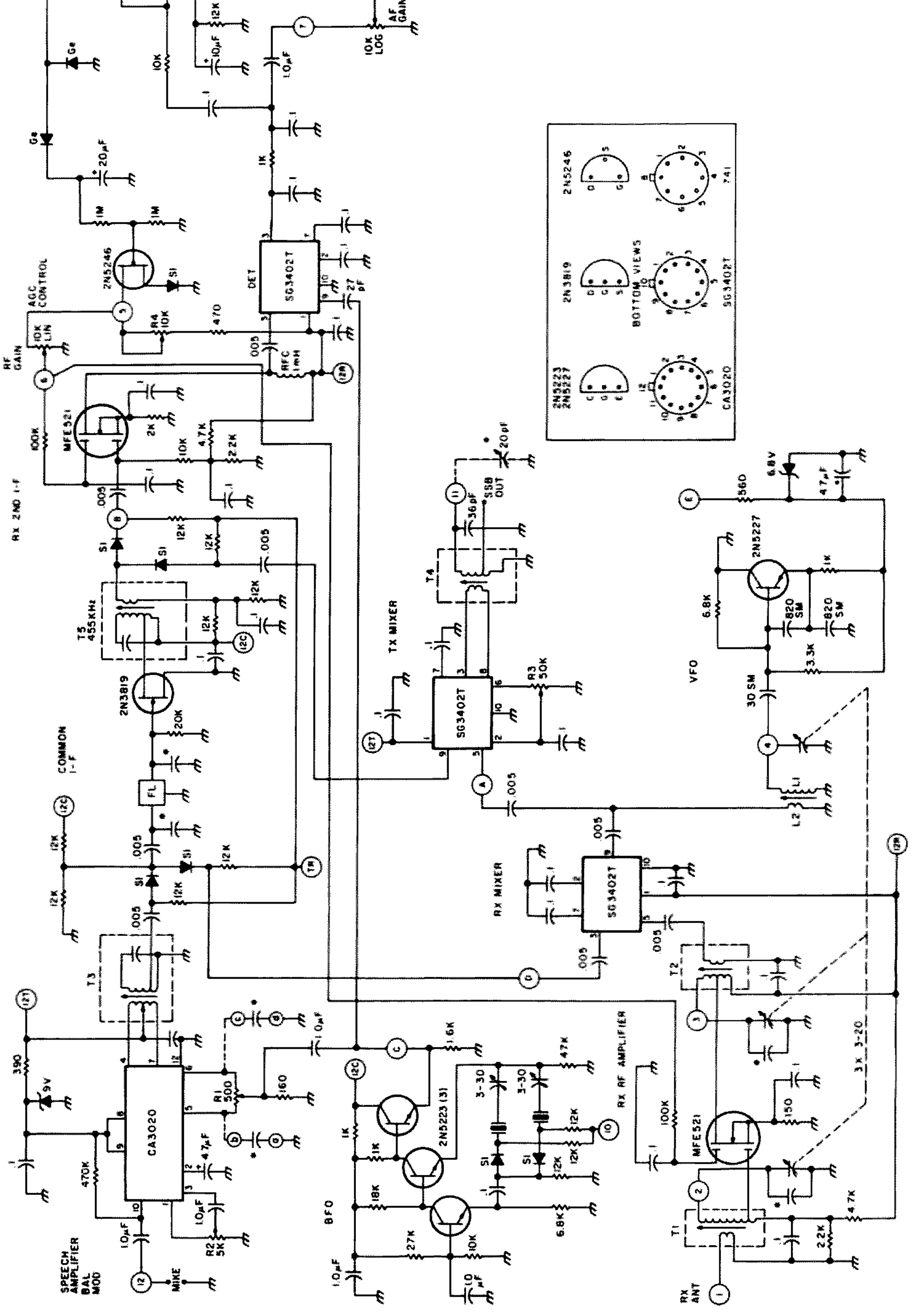



*Fig. 1. Complete schematic for the transceiver. Circled letters and numbers refer to pads on the PC boards. *See text. Si = silicon diode. Ge = germanium diode.*

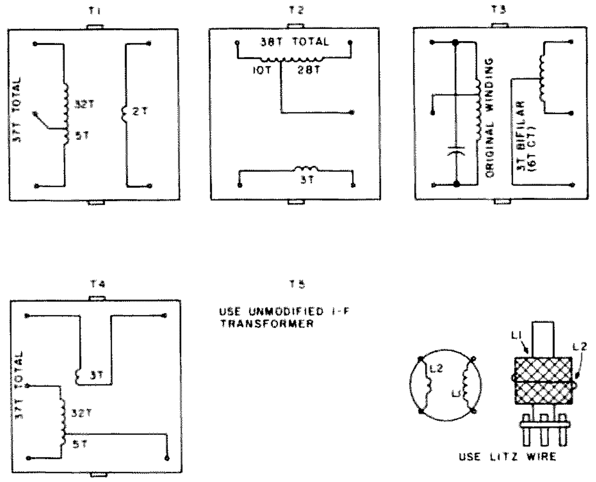


Fig. 2. Coil winding table. All bottom views.

I-f Amplifier

The SPDT diode switch at the input to the Collins filter connects it either to the transmitter mixer or to the receiver mixer output. Following the filter is a JFET amplifier that stays in the circuit for both transmitting and receiving. Then comes a second SPDT diode switch that routes the output to a second i-f stage for receiving or to a mixer for transmitting. The second i-f stage uses a dual gate FET with agc applied to gate 2.

Bfo, Vfo, and Transmitting Mixer

The bfo is crystal controlled and operates continuously since it is common to both receive and transmit modes. An SPDT diode switch selects the desired crystal for either upper- or lower-sideband operation.

The vfo tunes from 3.045 to 3.545 MHz. It is also a common circuit and operates continuously. It is actually a part of the receiver section and is the same circuit that has been used in the Minicom. The common vfo and bfo ensure that both transmitter and receiver will be on the same frequency. Since very little energy is required by the mixers, no buffers are used after the vfo. Output is taken from a 1-turn link wound over the tank coil.

The 455-kHz signal and the output from the vfo are mixed in an SG3402T IC balanced mixer. A 3.5-to-4.0-MHz output is produced and the vfo signal is nulled by means of the 50k preset trimmer, R3. The output transformer, T4, is fabricated from a standard transistor i-f transformer. A PC pad is provided for connecting a small variable capacitor of 20 to 30 pF across the coil for front-panel peaking at any frequency. A tiny solid dielectric type from a transistor FM radio is ideal for this purpose.

Receiver

All the circuits used in the receiver section are the same as the Minicom MK V. For those not familiar with the DMOS transistors, such as the Motorola MFE521 used in the rf and i-f stages, they require a fixed bias of around 4 volts on gate 1. This is provided by the 2.2k and 4.7k resistors which form a divider across the 12-volt supply. Gate 2 is controlled by agc voltage but, unlike the regular MOSFETs, need not go negative to attenuate the signal. The DMOS transistor works with all positive bias which simplifies the agc. R4 is adjusted so that the no-signal level on the agc line is 6 volts. The transistors will be working at close to maximum gain at this value of bias and a strong signal will drive this voltage down to 3.5 to 4 volts. A manual rf gain control is provided and would normally be mounted on the front panel.

The mixer is an SG3402T IC which provides substantial gain and, as mentioned before, places a very light load on the vfo. Output from the mixer is routed to the filter via the diode switch.

A third SG3402T is used as a product detector and feeds the LM380N-8 audio IC directly. Some of the audio output from the detector is fed to a 741 op amp where it is amplified and rectified to provide a positive dc voltage which charges the 20-uF tantalum capacitor across its output. Part of this charge is bled off by means of the two 1-meg resistors and applied to the gate of the 2N5246 agc control transistor. As the dc level increases due to strong signals, the transistor conducts more heavily and causes the voltage at the drain to drop. Since the drain is connected directly to the agc line, receiver gain is decreased and the purpose accomplished.

Filling in the Details

There are some numbered pads on the boards and some with letter designations. These notations also appear on the schematic and should aid in keeping the external wiring straight. The pads marked capital A, B, C, D, and E on both boards have to be connected together in pairs, that is, A to A, B to B, etc. Mating pads are directly above one another with the boards properly oriented and component side up. This allows stacking if desired. Pad A is vfo output. B is output from the common i-f, and C is bfo output. Pad D is input to the filter, while E connects 12 volts to the vfo from the other board's constant 12-volt supply connected to pads marked 12C.

Pads to accommodate a balancing capacitor if it should be needed as mentioned earlier are marked with small letters. One pair is a and b, the other c and d.

Pads marked 12R are for 12 volts applied during receive mode, and 12T designates a connection for 12 volts applied during transmit. Only one pad is needed; others are spares. There is a separate pad (12C) for the bfo, however, and it should be connected to a constant source of 12 volts along with one of the other 12C pads.

The pad marked TR is used to control the diode switches in the i-f strip. A 12-volt level is used for transmit and a ground level for receive. A TR relay would normally control this line as well as the 12R and 12T connections. The bfo crystals are similarly controlled by application of either 12 volts or ground to pad 10.

Of the other numbered pads, none needs individual explanation since the schematic clearly indicates their locations and the function becomes obvious.

Coils and Transformers

All the transformers are fabricated from regular 10-mm 455-kHz transistor i-f transformers. T1, T2, and T4 require the bare parts only, which means removing the tuning capacitor and all wire from the bobbin. Carefully salvage all the wire as it will be used to wind the new transformers.

The large winding goes on first and the link is then wound over the top. T1, T2, and T4 should be wound as per the table, making sure

the pinout is correct. Views are looking at the pin end or bottom of the assembly.

For T3, carefully break off the secondary leads where they enter the bobbin. This is the side with 2 pins. Unsolder the remaining wire from the pins and clean off excess solder. Since the new winding is center-tapped, you'll have to steal a pin from a spare assembly and push it into the existing hole in the base. The new link is bifilar wound over the top of the existing winding and connected as per the table. Identify the winding in some way so you won't have trouble orienting the transformer when mounting it on the board. The new winding goes to the CA3020 output.

The vfo tank coil, L1, is pie-wound on a slug-tuned PC coil form. I used a Gowanda series 7 Velvetork form which is .209" in diameter by .625" long. A carbonyl E (red) core was used for the slug. Impregnate the winding with hot coil wax and put a single turn link over the top of the pie for L2.

Construction

I doubt that there will be any mad rush to duplicate this rig exactly as it stands, but parts of it may be of interest to some readers. I even debated the need to supply PC layouts, but decided they might prove helpful in some way. Just in case you do wish to copy the layout as much as possible, the following information may be useful.

All resistors, diodes, and rf chokes were mounted hairpin fashion to conserve space. Miniature low-voltage ceramic capacitors were used for coupling and bypass applications. Polarized capacitors are dipped tantalum and resistors are ¼ Watt.

Before mounting the SG3402T used as the receiver mixer, cut off pin 6. Likewise cut off pin 4 of the product detector. The same goes for pin 11 on the CA3020.

The 2 trimmer capacitors in series with the bfo crystals are subminiature (5-mm) units in case you were wondering how they squeezed into the space allotted to them. Incidentally, the exact operating frequency for the crystals will depend on the particular filter used, but this circuit will pull quite a bit and allow appreciable leeway in crystal accuracy.

Note that there are 2 silver mica capacitors across the ends of the mechanical filter whose purpose it is to tune the two transducer coils. Values will depend on the type of filter used. For the F455 Q2 that I used, I had to install a 91-pF capacitor at one end and a 110-pF capacitor at the other end.

The 3-gang tuning capacitor is the same one used in the Minicom receivers and has a range of approximately 3 to 20 pF per section. An additional padding capacitor is required across each of the first 2 gangs. Use 20- to 22-pF silver micas and solder directly to the frame before installation. When mounting this item, use #4-40 screws ¼" long. Put a toothed washer under the head to allow good contact with the copper. Place 2 flat washers over each screw on the component side before mounting the capacitor. This will leave enough space to clear the rivets that hold the compression trimmers for the first 2 gangs.

I used MPN3401 (Motorola) diodes to do the switching since they were in my junk box and are made especially for this use. Regular silicon diodes should work okay, so don't panic. No other remarks come to mind regarding components, so I'll get on with the checkout.

Tune-Up and Checkout

A DPDT toggle switch can be used for TR switching by using one section to apply 0 or 12 volts to the

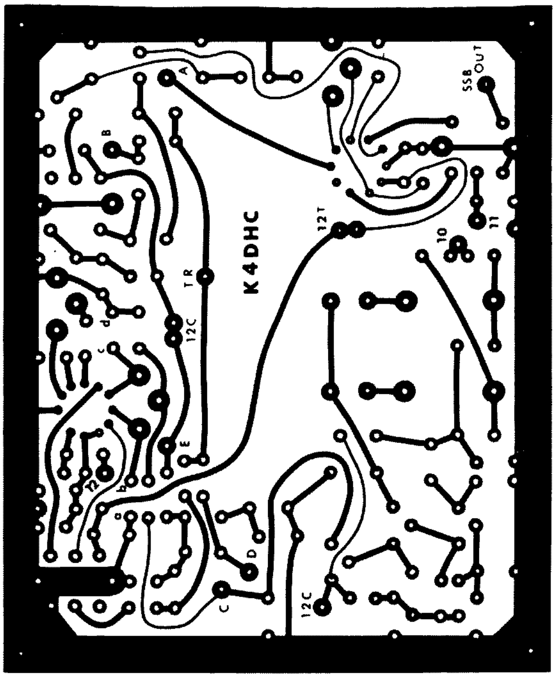


Fig. 3. PC board for transmitter.

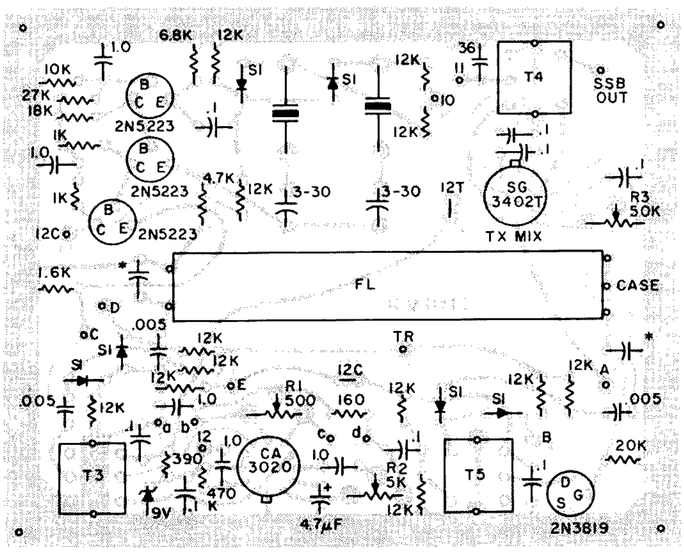


Fig. 4. Component layout for transmitter board.

TR line and the other half to transfer 12 volts between the receive and transmit circuits. An SPDT toggle can be used to switch the bfo crystals. A 10k audio gain control with log taper and a 10k rf gain control with linear taper are the only other items needed at this time. With the boards lying on the bench, make the jumpers between boards long enough so that each board can be handled freely while making adjustments. The copper border around each PC is ground and should be made common with all other grounds and power-supply return.

Connect an 8-Ohm speaker and 12-volt power supply to the rig. Set all trimmers to midpoint. Run the screws on the 2 compression trimmers on the 3-gang capacitor up snug but not tight. Turn the variable to full mesh. Connect a dc scope or high-impedance voltmeter between the top of the rf gain control pot and ground. Switch to receive and apply power. Current drain should be between 55 and 65 mils. Turn the rf gain control all the way down and adjust R4 for a reading of 6 volts. Disconnect the meter and turn the rf gain to maximum. Turn up the audio gain and feed in some signal at 3.5 MHz. Adjust the slug in the vfo tank coil until the signal is picked up. Adjust the cores in T1 and T2 for maximum output. Run the variable capacitor up to the high end and feed in signal at 4.0 MHz. Peak the response by means of the 2 compression trimmers on gangs 1 and 2. Repeat these 2 procedures as many times as needed to achieve good tracking. T5 can be peaked on the noise present. If the band is active, you can connect an antenna and listen on the air to verify proper operation of the receiver. Also make sure both bfo crystals are working. This concludes receiver checkout.

An audio generator should be connected to the mike input during tune-up of the transmitter. Turn R2 to minimum and switch to transmit mode. Current drain should be 40 to 50 mils. Connect a scope to the output side of T3. A piece of discarded pigtail can be temporarily soldered to the pad if necessary to make the scope connections. With no audio input, adjust R1 to null out the carrier. If there is still some trace of rf, tack a mica trimmer across pads a and b and then c and d to see where improvement can be made. Measure the value of the trimmer at the best setting and substitute a silver mica fixed capacitor.

Once the carrier has been nulled, turn up R2 and feed in some audio signal at around 1500 Hz. Adjust the level to a point just below where distortion occurs as observed on the scope. Transfer the scope to the output side of T5. Determine the values for the capacitors that tune the filter and install them at this time. Turn the tuning capacitor up to the high end of the band just below 4.0 MHz and transfer the scope to the transmitter output at T4. Shut off the signal generator and null the vfo signal by adjusting R3. Turn on the generator and adjust the core in T4 for maximum output. Later on, a tuning capacitor can be mounted on the front panel to allow peaking of the output as frequency is changed. That concludes tune-up of the transmitter.

I've listened to the signal from this little rig on some of my Minicoms and can report that it sounds excellent.

If you write, please remember to enclose an SASE if you expect an answer. ■

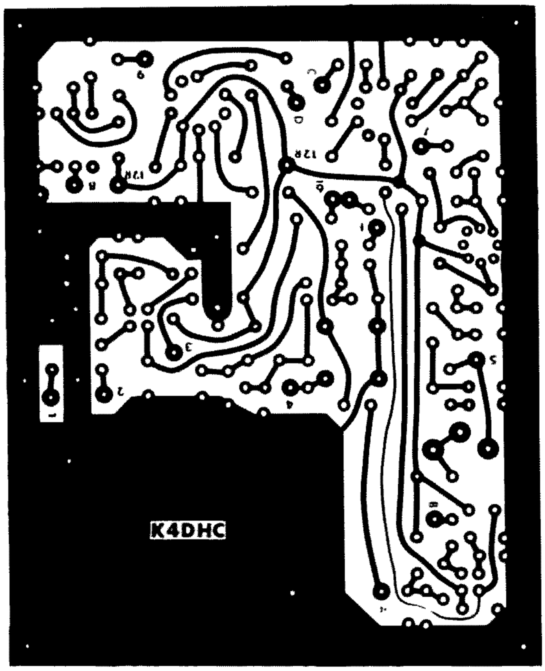


Fig. 5. PC board for receiver.

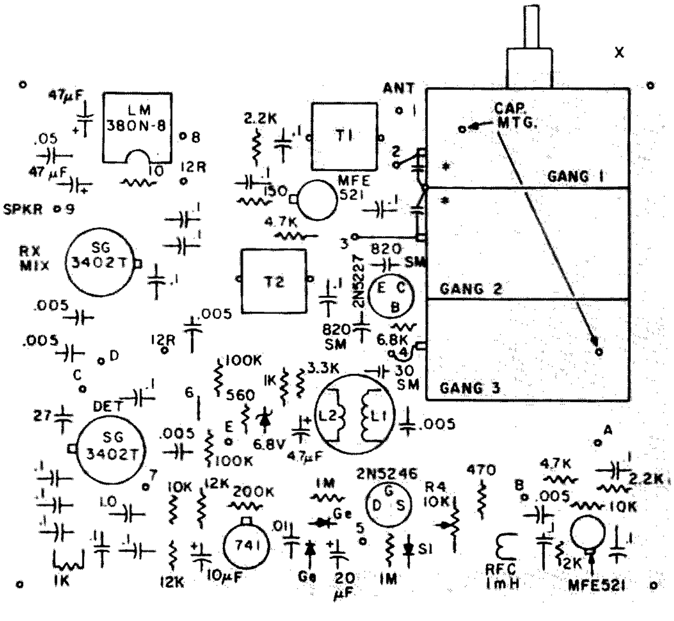


Fig. 6. Component layout for receiver board.

Glenn Jacobs WB7CMZ
Rathole 857
Poverty Flat AZ 85925

In Quest of Perfect Break-In

—well . . . almost perfect

PROLOGUE: About twenty years ago—no, more—it was the year the Russians blew our minds and our national ego by putting up their *Sputnik 1*—I found an article in an encyclopedia in the library at my high school.[1] The essence of the piece was that just anybody could have his own private radio station and communicate with other anybodies who had *their* own private radio stations. It gave detailed instructions for building a one-tube receiver. It hinted at a simple transmitter and even let on that one should get a license before transmitting.

I sent off for a hundred-pound grab-box of electronic goodies. I used only one thing: a filament transformer to heat the single filament of that single tube in my first home-brew receiver. I wound one of the coils a few turns too much (using a cardboard core from a roll of paper towels), and, behold! The local broadcast stations could be tuned in. A veritable miracle on a masonite frame.

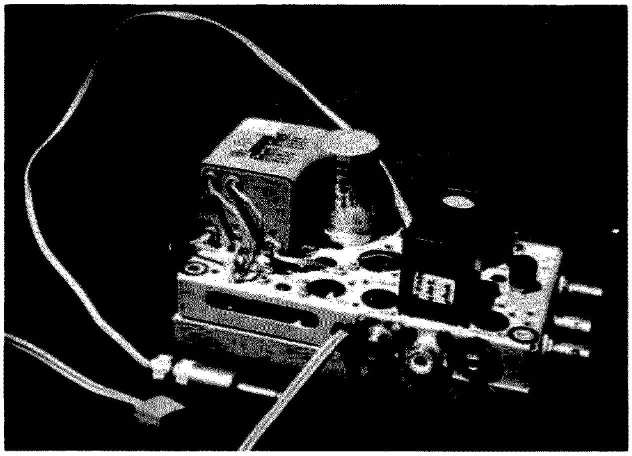
Next, from another article, I built a simple transmitter. No, I didn't get the license, and I didn't even learn the code. But I didn't break the law, either, although I intended to. This little widow-maker, I later learned, was high-voltage keyed. When I fired it up, it knocked me across the room as soon as I touched the key. I took it apart and let my yen for a personal radio communications station cool for fifteen or twenty years.

After I got out of the Army,[2] the yen returned. My wife drilled me in the code without ever learning it herself. I bought the first commercially-manufactured amateur transmitter I had ever seen or heard of: an Eico Model 720, for $25.

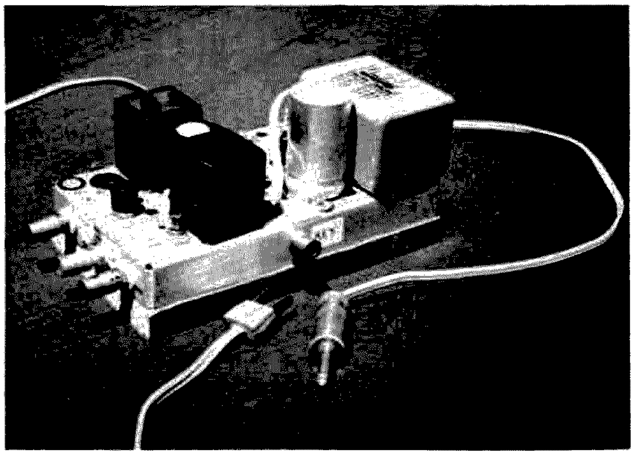
"What will they think of next?" I asked myself. "Somebody is saving us new amateurs a lot of trouble by building our transmitters for us."

That little jewel didn't work and it didn't have a manual or a schematic, and I didn't have a license yet, but I went right out and bought a nice brass key and a pair of coax connectors. A few days later I laid out thirty-five dollars for an Army surplus BC-348-Q receiver at a local swap meet. (Not a hamfest. I hadn't even heard of such a thing.)

WA7UKB was my "Elmer," my encourager,



This is the finished QSK unit, showing antenna jacks, ugly holes, and wooden base.



The finished QSK unit from its good side, showing mute adjustment, mute-defeat switch (the push-button), and mute and sidetone binding posts.

my teacher. I became WN7CMZ. I was legal. I could transmit. At last. And with such modern, up-to-date, ready-made equipment as I could not have imagined to exist a short time before.

Look out, world! WN7CMZ is about to transmit! Plug in the crystal. Fill out the logbook headings. Warm up the tubes. Transfabulate the franistan. Borrow W7KWJ's swr meter. Prune the dipole to the last half inch. Pull up a chair. Throw the knife switch to "receive." Listen. Throw the knife switch back to "transmit." 4 . . . 3 . . . 2 . . . 1 . . . TRANSMIT!!

YEEOOUUP YIP YAARRK YIP—WOOOP YEAAAP YIP WAAAZHP . . .

"Mercy sakes, good buddy! My nice new receiver has gone to the happy hunting ground." It hadn't. When I threw the antenna switch back to "receive," the WWII surplus receiver made those beautiful sea-double-you sounds again.

I asked a lot of questions and listened to a lot of answers and bought a book about amateur radio and studied it. I built an electronic transmit-receive switch right inside the transmitter and thought I was the only ham in the world smart enough to do this, seeing that my cookbook-type instruction sheet showed it on a separate chassis with a separate power supply.

I bought another receiver. It was bigger and prettier than the BC-348, but it had no markings at all, so I could never tell anyone just what I had. Anyway, with this handy combination I could transmit by pushing the key down and listen by letting it up again. The receiver overloaded very nicely and merely woofed and grunted when I transmitted, and I actually made a few contacts—some of them out-of-state.

The next summer I found out about hamfests, and I went to the one at Flagstaff. I bought a Johnson Viking Ranger because it had a built-in vfo. This transmitter didn't work, either, but it had a manual and schematic. In fact, it had two manuals—both for the Ranger II. I took out the modulator and built in a T-R switch just like the other T-R switch. It didn't work quite like the other. In fact, it didn't work at all. I built two or three different kinds, following magazine articles and friendly advice. They didn't work either.

Back to the old knife switch. Back to turning the receiver gain way down to transmit and turning it back up again to receive. Back to lost QSOs.

Back to reading about ham instead of doing ham. I bought a big pile of *73*s and other amateur magazines second-hand and spent a lot of time reading them.[3] There are a lot of articles in the back issues that are worth reading. Some of them tell how to change from transmit to receive without having to throw half a dozen switches. Some of them tell how to do it without using noisy, old-fashioned relays. I laid out about a day's wages for PNP transistors in blister packs and proceeded to gather the other components. The day before the transistors came in the mail, I finally found what I was looking for all along: How to do it *with* those noisy, old-fashioned relays.

Now, I had never lost the love of surprises ever since that hundred-pound grab-box twenty years before, and sometime along then I started buying two-ton grab-piles from Department of Defense Surplus Sales.[4] Therefore, I had a very respectable junk box. It's about four feet deep in not-so-neat rows all across my back yard. There are lots and lots of noisy, old-fashioned relays in MY junk box.

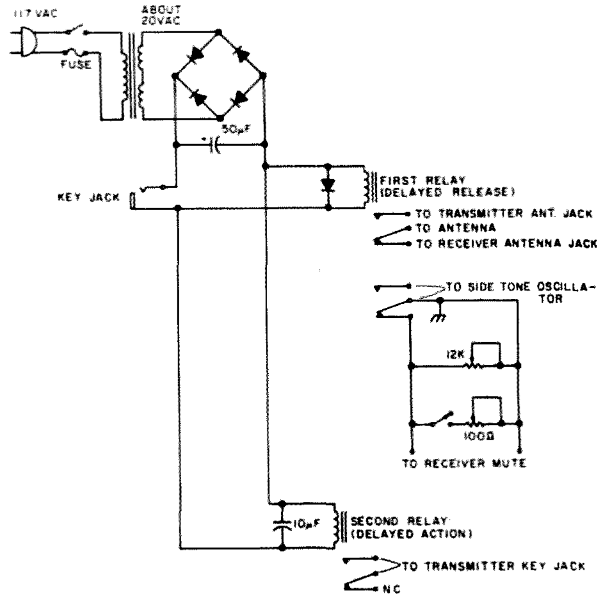


Fig. 1. Schematic diagram of break-in unit. The diode across the first relay delays its release; the capacitor across the second relay delays its action. Parts values are not critical. Contacts are shown with relays not energized.

It seems the problem with relays is that the contacts cannot handle nearly as much current when they are opening and closing as when they are already closed. Sparks fly. Metal melts, or even vaporizes. The contacts get rough, pitted, oxidized, non-conductive. They may even weld themselves together. But if the current does not flow except while the contacts stay closed, those nasty things don't happen. (Unless, of course, you have a *lot* of current flowing.)

If you key the energizing coil of a DPDT relay and have one set of contacts key the transmitter and the other set change the antenna over from the receiver to the transmitter, pretty soon you fry the antenna change-over contacts because the finals are still putting out when the antenna connection opens at the end of each dit or dah. Sparks fly, etc.

You really need two relays set to operate a very small fraction of a second apart. When you close the key, the first relay should change the antenna from receive to transmit and *then* the second relay should key the transmitter. When you open the key, the second relay should unkey the transmitter and *then* the first relay should change the antenna from transmit to receive. This way, there is no rf flowing in the relay contacts while they are opening and closing.

Here is the precious secret the Guru up on the high mountain peak in Northern India imparted to me, and now I disclose it to the world. (Actually, it has been disclosed to the world many times before, in amateur radio magazines, engineering texts, electronics magazines, the *Toymakers Journal*, handbooks, letters to the editor, over the air, and under the counter.)

You can *delay the opening* of a relay by putting a diode across the coil so that the inductive 'kick' when the current is shut off has a place to go; it goes

through the diode and back around the coil, and around and around it goes until it gets tired of going around and just lies down and quits due to the resistance of the circuit. This holds the relay closed a long time—maybe a thousandth of a second. When it finally, at long last, opens, a millisecond or so later, one hopes that there is no current left at the contacts to burn them up and weld them together. If your relay opens too slowly to suit your purpose, put in a few Ohms of resistance.

You can *delay the closing* of a relay by putting a capacitor across the energizing coil. When the current comes to close the relay, it has to charge the capacitor to a certain extent before it can close the relay. The delay is controlled by the capacity. This delay lets the other relay close and change the antenna over to "transmit" before the transmitter is even keyed. (See Fig. 1.)

This is not a secret, not a new breakthrough. But it was new to me. And very interesting. I went looking through my rows of surplus electronic scrap.

There was an aluminum chassis, about the right size, and it took me only half an evening to get the goverment parts off it so that I could put my parts on it. There were the relays, of course, and a filament transformer with enough winding to put in series to get enough volts. There was a solid-state rectifier bridge, a diode, and lotsa connectors. No two parts came off any one chassis in my junkyard; oops, pardon me. I mean junk box. Never bought a thing for this project.

Well, yes, it looks kinda funny, and there are holes in the chassis with no parts in them and circuit labels for circuits that aren't there any more. The labels that count are just stick-ons, and there's that big capacitor that's merely taped onto the side of a relay. There's no panel, and wires stick out of every side except the bottom. But it works. And I did it my way. No one else ever had a QSK unit just like this one.

You're smart. You're careful. You can make a better, prettier one.

About those noisy, old-fashioned relays: They clack, clack, clack. Transistors don't. When my super-stable antique transmitter vfo drifts so far that I cannot hear my own sending on my super-stable antique receiver, I can still hear my sending, after a limited fashion, in the clacking of the relays.

These good government relays have extra sets of contacts and they are useful, too. Hook up one set as a mute and sidetone control. (See Fig. 1.) This thing worked the first time around. (That should prove there is nothing critical about it.) The receiver was silent when the transmitter was keyed, and it came back to life instantly when the key was raised. I actually made a contact or two that way before I tore into it to make improvements.

In order to hear the signal on the receiver, it cannot be altogether muted. (That's because I never got around to building that sidetone oscillator.) The diagram shows a variable resistor across the receiver-mute contacts of the first relay.[5] It is there to adjust the loudness of the transmitter as heard in the receiver. Now I could hear myself send, but could not zero-beat the transmitter to the incoming signal without sending out a full-strength signal. It is a "no-no" to twiddle the vfo dial around with the finals turned on. It aggravates a lot of people to hear that horrid WAH-YOOP sound when they are copying code, especially when they're copying the DX ham's callsign. The last thing I've done (so far) to this thingie is to add the "spot" switch and a second variable resistor across the receiver-mute contacts of the first relay.[5] By closing that switch, I can hear the transmitter vfo and zero-beat the guy who's calling CQ before turning on the finals. By opening it, I can hear myself send without ripping my speaker cone and my eardrums. And the relays take care of changing the antenna from the transmitter to the receiver and back and turning the gain up and down as fast as I can key.

No. I haven't achieved Nirvana. Pardon me, I mean perfect break-in. But I have had many relaxed, satisfactory communications since I built this thing. Now that I write this, it occurs to me that it is too complicated, too ugly . . . maybe a single relay would do—an open frame relay where I could get at the contacts and just bend them a little so that one contact makes before another. Let's see, a triple-pole, double-throw relay . . . and build it right into the transmitter . . . quiet it with sponge rubber, maybe . . . hmmm . . .

I can see now that this is not the final chapter of "Quest." In fact, it is *all* prologue. ■

Footnotes

1. *Book of Knowledge*, 1957, Vol. 14, p. 5183.
2. The United States Army, Department of Defense, Washington, D.C.
3. Lockheed Amateur Radio Club, 2814 Empire Ave., Burbank CA 91504.
4. DoD Surplus Sales, Box 1370, Battle Creek MI 49016.
5. These values were found by experiment, and are good only for my particular combination of vintage equipment.

✓ Reader Service—see page 195

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The Amazing Audio Elixir

—this limiting amp is a cure-all

Back in the days of the Old West, there were groups of traveling salesmen who sold snake oil and other cure-alls. The claims made by these people and their medicine shows were that if you bought this wonder elixir, it would cure anything that ailed you. Here is a modern-day electronic circuit which will "cure all that ails you." The circuit presented here is a general-purpose amplifier which can be used to solve many problems and increase the performance of many audio circuits. The unique feature of this amplifier is that it will take an input of 100 mV to 10 V while the output level stays the same. The output is adjustable from no output up to about 8 volts peak-to-peak. You are, no doubt, asking what it is used for. Let me describe a few uses which will get your mind working and then you can take it from there.

In a repeater system, a tone decoder is used for control. The tone decoder works best with some precise input level, and the users are always tweaking the pad levels to make their pads work the system reliably. Drop an audio limiting amplifier between the receiver and the tone decoder and the problem is gone. Another use is in an autopatch system. Put one of these little units between the phone line and the transmitter and you will always be able to hear the person on the phone at the normal level.

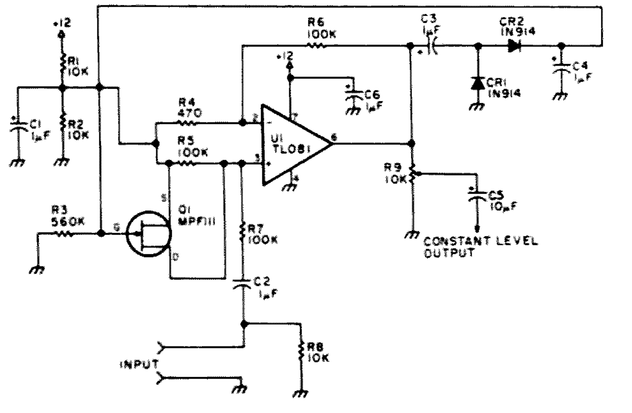

Fig. 1. Audio-limiting amplifier diagram. (This diagram is supplied with printed circuit boards.)

For you computer buffs, take this unit and put it between the output of the tape recorder and the tone input to your interface unit and get constant levels even as the tapes age. My 2-meter SSB rig does not have agc in it. When I have the volume high enough to hear a DX station and a local comes on, the level change inverts my speaker cone and my chair (with me in it). I lifted the wire from the top of the volume control and placed one of these units between it and the volume control. Now all the stations come out at the same level, at whatever level the volume control is set, and there is no more ear damage for me.

I know of one person who set up a room microphone and used this unit to record anyone talking in the room without moving the microphone or having to ride the tape recorder's input control. With touchtone™-type signals, place a group splitting filter in front of two of these units and independently level each tone group to remove any twist or imbalance in the tones. How about a speech processor? Use this unit in a fast-agc mode and drive the input to your SSB rig at full level all the time. Another use might be as a "linear clipper" in a modulator. Drive the unit below the point where the output limits, and if the signal through it gets too high, the limiter cuts back and won't allow excess audio to pass. The advantage of this unit over normal clipping methods Is that this unit does not clip, and thus it does not add clipping distortion. Enough of these ideas. Let's go on to see how it works.

How It Works

See Fig. 1. U1 is an op amp and is simply a gain block. The gain of U1 is set by the values of R4 and R6. As shown, the amplifier is set for a gain of about 200. The output is sampled by C3, CR1, CR2, and C4. This network produces a dc voltage directly related to the ac (audio) output of the amplifier. This dc level is fed to the gate of FET Q1, which is an inexpensive Motorola MPF111. This FET is not critical and any

equivalent FET will do. R1 and R2 form a voltage divider which is used to bias the FET source and the op amp inputs at a point exactly one-half way between the power supply voltage and ground. C1 ensures that the bias point is at ac ground. With no detected voltage from C4 to the gate of Q1, the gate of Q1 is at ground, which is negative to the source, and the FET is in a "pinched-off," or nonconducting, condition.

The incoming signal comes in through R7 and is amplified by U1. The output is detected and the dc voltage is fed back, which lifts the gate of Q1 from ground and Q1 starts to conduct. As Q1 conducts more and more, it shunts the input signal away from the op amp input. R7 and R5 act as a voltage divider and, with the FET, R5 acts as a variable resistor. The combination acts as an electronically-operated pot, with the "wiper" connected to the input of the amplifier. Once the detected output reaches a certain level, it will cut back the input signal and not allow the output to go any higher.

The purpose of C2 is to block the bias voltage from going out the input. R8 is used only to terminate the input and should be a value that the driving circuit wants to see. It can be any value because it has no effect on the operation of the circuit. Since U1 is a closed-loop amplifier with a fixed gain, the output will drive anything as long as the output capabilities of the op amp are not exceeded. Even though there is some circuit loading, I have even driven small speakers with this unit and obtained output volume which was usable for testing purposes. The amplifier is protected so you do not need to worry about damage.

This unit is designed for 12-volt operation, which is near its lower operating voltage limits. The voltage is not critical, and as long as the voltage limits of the capacitors are not exceeded, it will work over a wide range of voltage. The lower limit is 12 volts and the upper limit is greater than 30 volts. If different agc release times are desired, the value of R3 may be changed. The larger the value of R3, the longer, or slower, the recovery time of the amplifier. When used as an agc, it has a fast attack time and a fast decay with the values shown.

In conclusion, this article was meant to be mostly an idea article and describes a building block which I have found to be very useful. Circuit boards may be obtained from the author for $3.50 each and are top-quality glass-filled, drilled boards with silk-screened parts layouts on the surface. ■

Parts List

Designation	Description	Qty.
U1	TL081 BiFET op amp	1
Q1	MPF111 FET	1
CR1, CR2	1N914 signal diode	2
R4	470-Ohm, ¼-Watt, 5% resistor	1
R1, R2, R8	10k, ¼-Watt, 5% resistor	3
R5, R6, R7	100k, ¼-Watt, 5% resistor	3
R3	560k, ¼-Watt, 5% resistor	1
R9	10k pot, multi-turn variable resistor	1
C2	.1-uF mylar™ capacitor	1
C1, C3, C4, C6	1-uF electrolytic capacitor	4
C5	10-uF electrolytic capacitor	1
	PCB	1

No More Rotary Switches!

—gadget freaks will love these solid-state replacements

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Are your bored with rotary switches in your projects? Even if by some slim chance you are not, here are a few simple remedies for replacing those tiresome rotaries with a sequentially-stepping counter that lights one of a string of LEDs each time a pushbutton momentary switch is pushed.

The cost of such a system is about as much as you would pay for a new rotary switch, but the main attraction is that it makes that "electronic wombat finder" of yours a real eye-catcher that is fun to use.

The devices described here are primarily CMOS, because I am a devoted CMOS fanatic. With proper attention to the pertinent peculiarities, however, any other logic family will work well.

A two-position, two-deck rotary switch eliminator is shown in Fig. 1. The switch portion of the circuit is a set-reset flip-flop that gives clean, bounceless low-to-high transitions to clock the counter. The counter is a 4013 D-type flip-flop wired as a toggle. It divides the incoming clock frequency by two and transfers data from the D input to the Q output on the positive edge of the clock pulse. Each push of the button puts a low to high signal at the clock input. With CMOS, these levels are essentially ground and the supply voltage. We will call these low and high levels "0" and "1" for clarity.

The characteristics of a D-type flip-flop wired as a toggle, with the $\overline{Q}_1$ output fed back into the D input, is that for every 0 to 1 transition on the clock input, the Q output changes, and then remains at that value until the next positive going clock pulse comes along. This means that it has two stable conditions. If the Q output was at a 1 level, then a single push of the button would change it to a 0. The next push would send it back to a 1. The $\overline{Q}$ output does the same, but, of course, is of the opposite polarity.

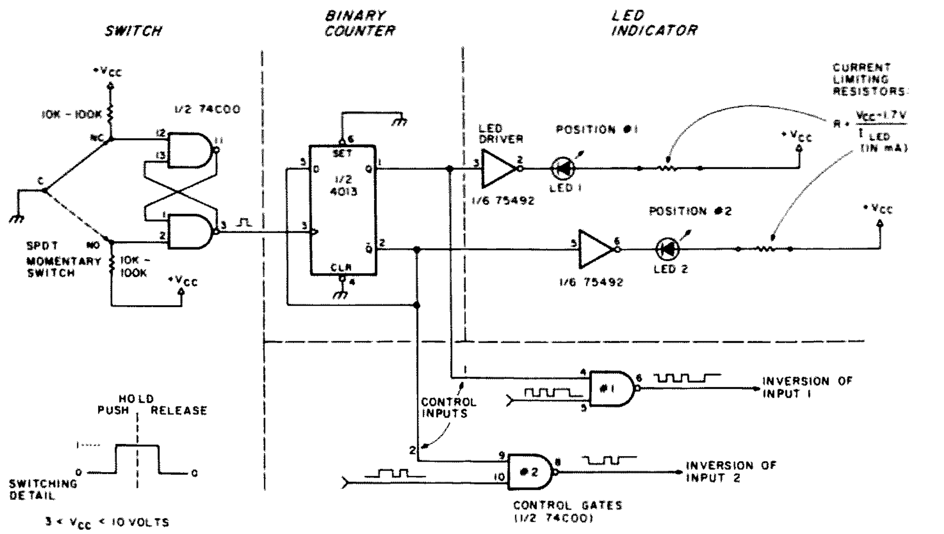

Fig. 1. Two-position rotary switch eliminator.

As each of these outputs assumes a 1 level, it will turn on its LED driver, the 75492. The 75492, which has six drivers per package, is a power amplifier to supply the current requirements of the LED. The LEDs current is limited by a resistor whose value will be determined by the supply voltage and the desired current. A reasonable formula for such calculations is given in Fig. 1.

Speaking of power, CMOS works fine on 3-15 volts, but the 75492, a bipolar device with CMOS compatible inputs, is limited to 10 volts. Anyway, whichever one of the outputs, Q or $\overline{Q}$, is at a 1 level will cause the 75492 driver

to go low, which will forward bias the LED, turning it on.

So much for the indicator, but what will it indicate? We need our switch to control something. This is accomplished by the remaining 74C00 2-input NAND gates labeled Control Gates. This section of the circuit is the second "deck" of our two-deck switch eliminator.

A 1 from either the Q or $\overline{Q}$ flip-flop at one input of the 74C00 will allow an inverted replica of a signal at the other input to pass through the device. A 0 at the control input will keep the output at a 1 level regardless of the condition at the other input. As the button is pushed again, the control is shifted to Control Gate 2 and Control Gate 1 is disabled, remaining at a 1 level.

Because of the binary nature of toggle flip-flops, any number of switch positions that is a power of two can be readily made by cascading these binary dividers until the desired number of stages is reached.[1]

A four-position rotary switch eliminator is shown in Fig. 2. With these two flip-flops come a possible four combinations of the Q outputs, Q_A and Q_B. They are 0,0; 1,0; 0,1; 1,1. The next sequences are only repetitions of the first. The sequence is as follows: Assume both Q_A and Q_B are at a 0 level. After the button is pushed once, Q_A goes to a 1, but Q_B is still at a 0 level. So far the count sequence is 0,0; 1,0. The next push gives a 0 at Q_A, but now Q_B goes to a 1. The sequence is now 0,0; 1,0; 0,1. The third push of the button flips Q_A to a 1, but because Q_B changes only half as often, it remains a 1. The sequence is now complete: 0,0; 1,0; 0,1; 1,1. The next push would cause Q_A and Q_B to become 0,1.

Now we have to decode

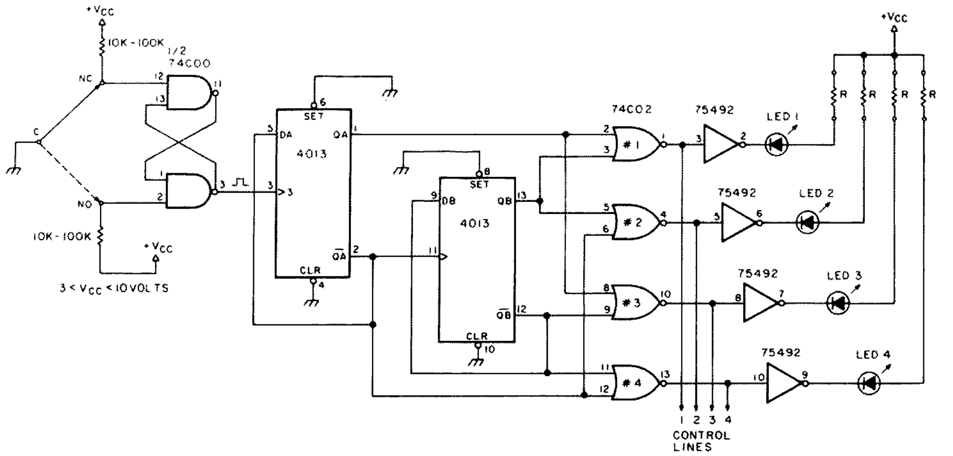

Fig. 2. Four-position rotary switch eliminator.

each of these pairs of outputs to light four LEDs in sequence, one at a time. The 74C02 quad 2-input NOR gates do this trick neatly.

The NOR gate is a great "zero detector" because it will give a 1 output only when all of its inputs are at a 0 level. The NOR gate fed directly with Q_A and Q_B would output a 1 level only when the count of 0,0 was reached, turning on the 75492 LED driver, illuminating LED 1. The next state in the count sequence is 1,0. This will extinguish LED 1 because the 74C02 no longer has the conditions required to turn on LED 1.

For LED 2 to turn on, we can use Q_B directly because it is a 0 level. Instead of Q_A, though, we'll use $\overline{Q}_A$, which is a 0 when Q_A is a 1. Now 74C02 #2 has the proper zeros on the inputs to give a 1 output to turn on LED #2. The next state of the counter results in a Q_A of 0 and a Q_B equal to a 1 level. 74C02 #3 will be activated by using Q_A and $\overline{Q}_B$, the exact opposite from the requirements for 74C02 #2.

The final push gives a 1,1 condition, which needs both $\overline{Q}_A$ and $\overline{Q}_B$ to be used as 0 inputs to 74C02 #4 to turn on LED #4.

So much for a four-position switch, but how about an odd number like three? What we'll do is to start with a four-position switch and use the fourth state of 1,1 to reset the circuit back to 0,0. The counter will think it is still a four-position counter, and only we will know the difference.

The three-position rotary switch eliminator is shown in Fig. 3. The significant difference between it and the four-position counter in Fig. 2 is that the 74C02 #4, which detects and decodes the 1,1 condition, is used to reset both halves of the 4013 to zero, giving a count sequence of 0,0; 1,0; 0,1, and back to 0,0.

The point of this decoding business is to ensure that each and every combination of counter outputs results in only one LED on at a time. Otherwise, we will have the equivalent of a rotary switch with shorted contacts.

If you are interested in readable, useful information on counters, try one or more of Don Lancaster's *Cookbooks*. The "reci-

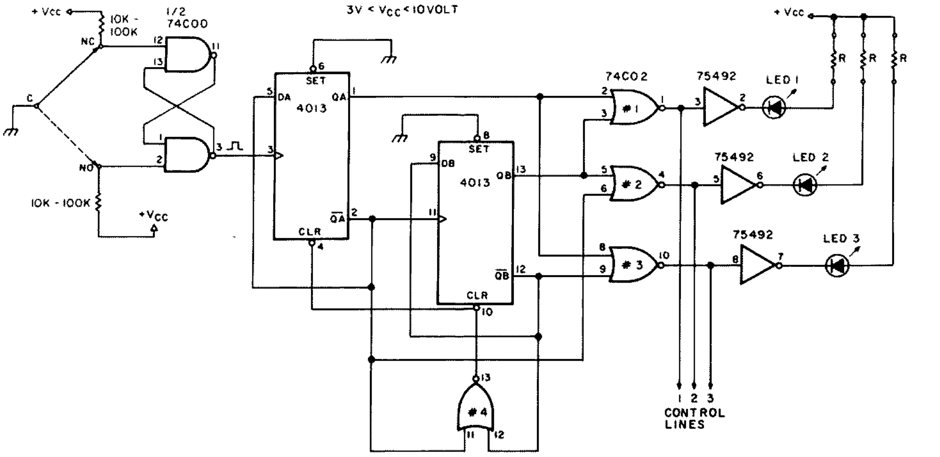

Fig. 3. Three-position rotary switch eliminator.

pes" satisfy most digital appetites without overstuffing.[2]

Simulating any number of switch positions is possible by remembering two basic guides. One is to be certain of the *sequence of the outputs of the flip-flops* as you push the button. This knowledge will allow you to properly decode the outputs to control the LED lighting and whatever else you have in mind. Equally important is to be sure that *all the output combinations are accounted for*, either for proper decoding, or for resetting the counters, as shown in the three-position counter. Any combination you miss will at best give the effect of a dead switch position, or, as previously mentioned, a shorted switch.[3]

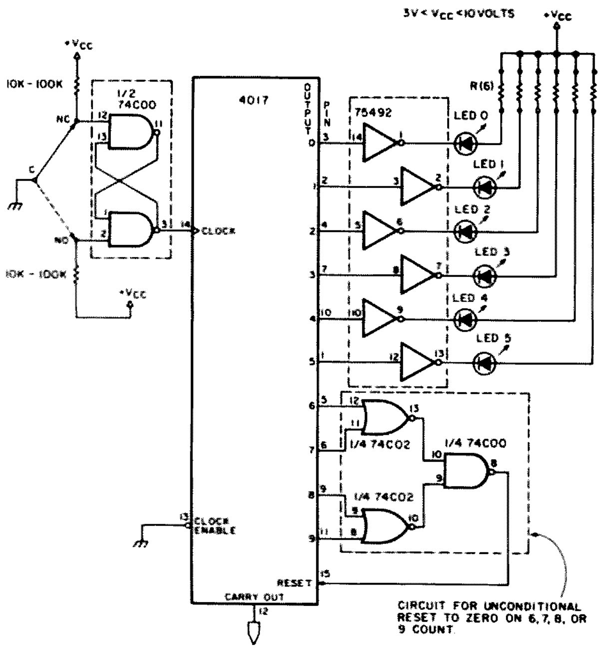

Fig. 4. Six-position rotary switch eliminator using a 4017 decade counter.

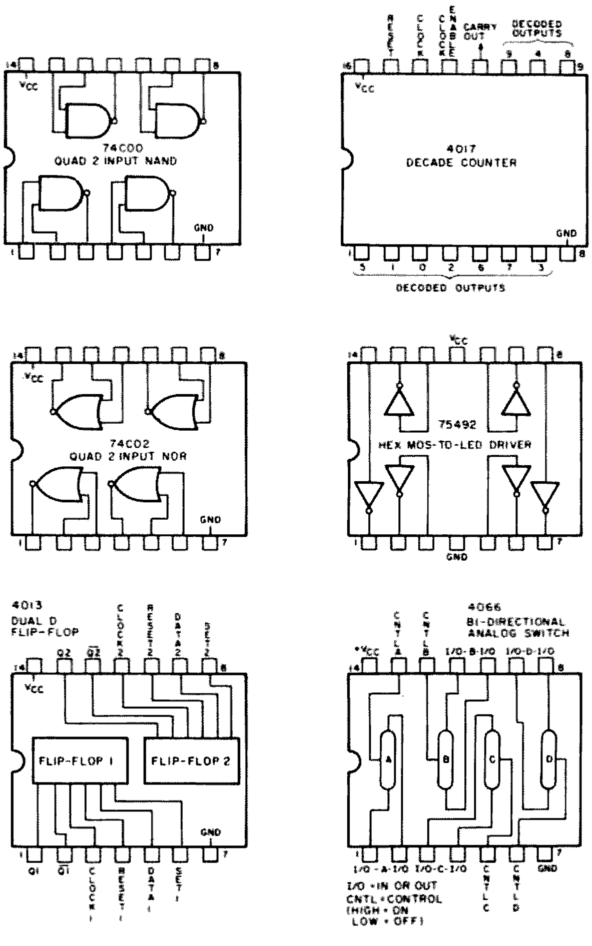

Fig. 5. Pinouts of the ICs used (top view).

An easy way to avoid concerning yourself with much of the above trouble is to use a resettable counter like a 4017. Any number of switch postions from 1 to 10 can directly be implemented. The 4017 is a five-stage divide-by-ten Johnson counter with ten unique decoded outputs. Johnson must have been clairvoyant, because this sixteen-pin package is just what we need.

The example in Fig. 4 is a six-position rotary switch eliminator. This circuit will count from 0 to 5, then start over again with successive pushes of the button. The two 74C02 gates and the 74C00 gates eliminate any hazard of unwanted outputs, in this case, a 6, 7, 8, or 9 count. You'll recall that the NOR gate gives a 1 output if all inputs are 0. Well, any active 6, 7, 8, or 9 output will give a 0 at the output of the one of the NORs, and this 0 will drive the 74C00 NAND's output to a 1 level, which will just happen to reset the counter to 0. Now at any count from 0 to 5 the 6, 7, 8, and 9 outputs are all 0. Following these through the NOR and NAND logic gives a 0 on the reset line, which is just what we want, that is, no reset until a 6, 7, 8, or 9 appears. The 0 through 5 outputs control the lighting of their respective LEDs through the six gates of 75492 package. These lines can also be used to control other functions, as in Fig. 1. Easy enough. The 4017 also has a carry out, which allows cascading 4017s together for long count sequences. More components, a little imagination and a calloused index finger are the only requirements.

So far, only digital controls have been discussed. By using 4066 bi-directional analog transmission gates, low level analog (or digital) signals up to 40 MHz can be faithfully controlled with minute distortion. Just substitute 4066s for the 74C00 Control Gates as in Fig. 1. Pinouts for all the devices mentioned are shown for reference in Fig. 5.[4,5]

As an extra attraction, these circuits also have built-in service aids. The LED indicators can act as diagnostic pointers by "illuminating" your logic and/or wiring errors. With all this in mind, "switch" to these rotary eliminators for your current and future projects. If you have the capacity, I'm sure you'll get a charge from designing and building them. You, too, can be the envy of friends and rivals alike! If I have etched them into your memory, then they will certainly be difficult to resist. ■

References

1. *TTL Cookbook*, Don Lancaster, pp. 207, 218; Howard W. Sams & Co. Inc., NY, 1976.
2. *Op. Oit.*, preface.
3. *Design of Digital Computers*, H. W. Gschwind and E. J. McCluskey, pp. 171-172; Sprinter-Verlag, NY, 1975.
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Confessions of a Teenage HFer

—the world between channel 40 and 28 MHz

"Breaker, lawbreaker!"

Hans Peter
c/o 73 Magazine

In August of 1975, while I was a long-term patient in the hospital, I received an AM mobile transceiver. This was before the FCC changed the Part 95 regulations to allow idle chitchat one month later. I did not receive my FCC call letters until October, two months later, but of course I transmitted before then.

Roll Your Own

On all crystal-synthesized 23-channel CB rigs, there was a blank spot between channels 22 and 23. It was normally an inoperable channel that, I thought at the time, was the position to use when using the PA function. After meeting a few other CBers and discussing equipment, I learned that on a few rigs, by setting the dial between the blank spot and channel 23, it was possible to "roll in" a non-CB channel, commonly called 22A. There was also another channel called 22B, but this channel could only be installed by adding at least one crystal to the rig. No one really knew what these channels were for, but supposedly they were business channels.

I could not roll this channel in on my particular rig, so I wired in 2 switches to connect where the rotary switch was not making contact. It worked, and I was very excited to discover this modification. It seemed that most people thought that if you could not roll it in, then it was not possible to get this channel. At that time it was a quiet channel and at first only a few "elite CBers" had it.

I did read in an advertisement for an 11 meter vfo that 22A and B were for business traffic, but I never did hear any, and I could not find anything about this in FCC rules and regulations.

I also started modifying other CBers' radios to get this channel. It could be done by cutting a ground wire, or adding a jumper wire, or installing a toggle switch if the manufacturer had gone to great lengths to internally defeat this channel. I charged five dollars to do this modification, although I knew of someone else with a First Class license who charged twenty dollars.

When people would get on frequency, they generally would say "break A" or "break 22A." Now this frequency has become channel 24. If you hear someone on the air saying "break A," they probably are using a 23-channel transceiver.

I met another fellow on 22A who was also interested in the electronic aspect of CB, and we became good friends. We both learned as much as we could about radio modification. We also did radio work for other CBers.

Moving Up

I eventually moved on to bigger and better things, namely getting into the HF aspect of 11 meters.

I studied my crystal synthesizer and eventually figured out that by changing two master crystals I would get 23 channels just above the class D channels. At first I had no idea where to get these crystals made. Finally, in a CB catalogue, I saw I could order crystal certificates and have the crystals made. I thought perhaps the company I sent the certificates to would not grind the crystals for me because they would result in out-of-band operations, but this did not happen.

After about 3 months of waiting, the crystals arrived. I thought that by just unplugging the original master crystals and plugging in the new ones, I would be all set. However, only the transmitter would work. The receiver was dead. I eventually found out I had to retune the synthesizer cans for each set of master crystals. But it did work and I got HF capabilities. Later, I tuned the receiver for a happy medium so both sets of crystals worked, but the receiver performance suffered and I got all kinds of receiver images.

CB shops eventually

started selling HF synthesizer crystals. These would give 4 or 5 new channels per crystal. They were hot items and sold out quickly. Very few CBers even knew how to wire in these crystals, and here I was of service. The crystals sold for five dollars. I would install a 2-pole toggle switch with one empty socket and an HF crystal for twenty dollars.

Gadgets

CBers are almost helpless when it comes to doing even simple modifications or repairs. Even when a microphone cord needs to be resoldered or a CBer buys a preamplified mike, he has to pay someone to fix or install it. This lack of technical knowledge leaves CBers open to many rip-off artists. I have seen standing-wave meters advertised as 40-channel standing-wave meters, as if the ones manufactured during the days of the 23-channel sets were inferior.

I have seen an item called a crystal vfo. What is it? It's a little box with a twelve-position rotary switch connected to twelve crystal sockets with a trimmer cap for each socket. Theoretically, one of these could give a crystal-synthesized transceiver 60 new channels. All this for only $100, less the crystals.

Other items in demand are tweety birds and pingers. The pinger produces a short feedback-like squeal of short duration when the microphone is keyed. The Browning Golden Eagle had this built in. Because of pressure from the FCC, the new 40-channel Brownings do not have this feature. It can easily be added because the pinger is still in the radio but is not connected when the set comes from the factory. Pingers are now sold as add-on units by an independent firm for about $18. These can be attached to any radio.

The tweety bird produces a chirping sound. They are often used to attract attention, but can cause severe bleed-over on adjacent channels. Prices for tweety birds are around $15 to $20. There are full page ads for both of these noisemakers in CB magazines, even though they are prohibited by Part 95 of the FCC rules and regulations.

Regular tunable 11 meter vfos are made which plug into one of the crystal sockets in the transceiver's synthesizer. There are two very popular models.

One, made by Siltronix, has a simple two-transistor LC circuit and is inclined to drift unless the unit is left on continuously. Few CBers know that these can be adapted to any transceiver by adding or subtracting some capacitance to or from the LC circuit. The other popular model is made by PAL. These are rather complex and use a crystal-controlled reference oscillator.

I have seen used units at hamfests going for $175 to $200, which is the same as the retail price. The funny part about eleven meter vfos is that in advertisements it specifically states that it is illegal to transmit with vfos, as if that will stop anyone. I charged $20 to install a vfo. I arranged it so the vfo could be disconnected from the transceiver, for obvious reasons.

The clarifier on a single sideband set could be modified into a quasi-vfo by changing some components or readjusting trimmer resistors. This increased the sliding range from ±500 Hz to about plus 2 kHz and minus about 13 or 14 kHz. Now the clarifier could slide into RC channels which are between class D channels.

In the world of CB, if something is illegal, it is even more desirable to have, and the CB consumer will pay an arm and a leg to have it.

Having a transmitter "peaked up" is another service in demand. Rarely can more than 1 extra Watt be squeezed out of an average CB transceiver and still have just a touch of upward modulation. Overdesign is not common. But a CBer usually thinks, "It may help me get out an extra mile." I usually charged $5 to peak the transmitter, but a licensed repairman could get $20 to $25. Of course, he had to do this under the counter. The big money in CB is in modification, not repair.

HF Lingo

How do HFers refer to illegal channels? They think of the frequency in megahertz and use the first three digits after the decimal point. So 27.415 would be just 415. This is the first channel above channel 40. From channel 26 through 40, the frequency can be determined by just adding a 5 to the end of these digits. Channel 40 is actually 27.405, channel 34 is 27.345. By extrapolation then, 27.505 would be channel 50. Many AM HFers use this method of nomenclature, and you will hear "Break channel 43" on 27.435.

Eleven meter single sideband is a rather new and very different development. Almost all CB sideband is on the lower side. Upper-side users are looked down upon and sometimes even harassed when on the air.

Sideband conversations are formalized. They are very similar to ham QSOs, which they are intended to mimic. No ten codes are used as on AM—only Q codes are used. There are no AM handles either; everyone uses first names. If you are an AMer new to sideband and have picked up the habit of saying 10-4, you will often be politely asked to try not to say it. "Roger" replaces 10-4 on sideband. There is very little of the stereotyped channel 19 lingo on sideband. But when skip starts, it is funny to hear sidebanders call out "CQ DX" over and over.

To replace handles, sideband operators have club call letters. The first CB sideband clubs formed used the number designating their state's place in the order of all states' admittance to the Union, followed by a W, which stands for World. For example, California would be a 31W state because it was the thirty-first state to be admitted to the Union. Newer clubs are using an N prefix, for National, so Georgia would be a 5N state. Other abbreviations include A for America and X for X-ray. It seems like the whole alphabet is being used.

An AM operator will generally get mad when someone else uses the same handle. Sidebanders will also get disturbed when someone else has the same club call letters. How can this happen? Well, 36A3536 could be the 36 Alpha or the 36 America club (Nevada) when written down on paper.

Many sidebanders get a number from every club in the area so they can use call letters to match the person on the other end of the QSO. The use of club letters makes a neater and more efficient operation on the crowded Citizens Band.

When the DX is in, it is easy to figure out what states other operators are in. Club call letters replace FCC call letters on the HF band. During local QSOs on class D frequencies, both FCC and club call letters are generally used.

An AMer might say, "This is the Hill Billy, KABC 1234, going 10-7 for the night."

A sidebander might say, "This is 36-National-1234, KXYZ 9876, QRT and QSY to bed."

Using Ham Gear

Most HF gear is modified CB gear with possibly a linear amplifier, but converted amateur gear is most popular among sidebanders. It may not be apparent, but amateur equipment has distinct advantages and actually makes sense. An amateur transceiver has a dynamite receiver. Its sensitivity and selectivity will beat any piece of CB equipment hands down.

Citizens Band is far more crowded than any ham band. In the evening, signals abound as people turn on their radios to have a conversation. Adjacent channel interference is unbelievable. Look around an average suburban area sometime, and see how many CB base station antennas are on the rooftops. Citizens Band has truly become radio communications for the people.

Before CB expanded to 40 channels, FCC type acceptance rules were very lax. Very inexpensive 23-channel transceivers were junk. Not only were they severe generators of TVI, but when a preamplified microphone was added, the transmitted signal was 15 or 20 kHz wide.

And think about this: The Cadillac of CB radios is the Browning Golden Eagle. This 40-channel set now retails for about $1000. A Drake or Yaesu has a transmitter that can be tuned and has complete range over the 11 meter band after relatively simple modification. The price is also several hundred dollars less. The cost of a moderately priced CB transceiver, external vfo, and linear amplifier is about the same as that of a piece of amateur gear.

Amateur transceivers put out a clean signal. There is very little spurious radiation and harmonic content. If everyone ran ham equipment on eleven meters, there would be virtually no TVI and far less adjacent channel interference.

There seems to be little interference to licensed users of the HF band, mainly because the business band is FM and usually 5 kHz off from most HF traffic. Business-band licenses are not being renewed because of expansion to 40 channels, and their signals are getting fewer all the time. There are a few business-band stations between the newly allocated CB channels, but few CBers realize what the buzz from the FM signal is. As far as government use of the HF band goes, it probably exists, but I have never heard any government transmissions.

Practically no one worries about being caught by the FCC. There may be a scare now and then that the FCC is in town, but I have yet to hear of someone I know being apprehended. With so many people into CB, it just cannot be controlled easily.

HFers are generally the CBers who go for ham tickets. After obtaining a ham ticket, they generally stop HFing or curtail their activity greatly. Getting a ham license fills their DX appetite and their HFing is done less and less after that. But most never leave CB for good because they still have too many friends there.

There are some CBers operating amateur gear who will not use a non-class D frequency. Most of these people are sidebanders. When CB had only 23 channels, only one of those channels came to be known as a sideband frequency. This was channel 16. As the popularity of CB began to rise, so did the crowding. Occasionally, AMers strayed onto this frequency. Because of the hassle, many people held their conversations about 60 kHz or more above 23. After 40-channel expansion took place, the top 60 kHz of the present class D frequencies, channels 35 through 40, became unofficial sideband-only frequencies, mainly because they were beforehand. Because these frequencies were legalized, some sideband operators, including those running ham gear, quit operating out of band because they felt they now had a place and did not want to lose the new frequencies to AMers.

As a rough estimate, about ⅓ to ½ of the total CB population has probably at one time operated on illegal frequencies. Most of these operators do so when DX is in. When conditions are quiet, there is little non-Class D activity. In fact, there is more illegal AM activity when conditions are quiet. The sidebanders seem to stay put.

Special Activities

There are a few unusual activities that take place in sideband HFing. Slow scan television is around 27.985, just 15 kHz below 10 meters. I have personally never viewed an SSTV signal when the DX is running.

Round table conversations happen frequently. Three or more stations from different parts of North America link up and talk for an hour or more. Virtually all of these HFers use amateur gear and beam antennas.

Phone patches are popular. If an HFer QSOs with another whose location is near his relatives, he will dial up a phone patch without a second thought.

Perhaps one of the most unusual HF clubs is the Eleven M Club. To join, you must own and operate your own business and run all Collins equipment. The club's standby frequency is 27.765, and they only want their members to use this frequency. They generally appear only when DX is running. And the Eleven M is not what you think. The club was supposedly started by eleven millionaires. A rumor circulating about them is that most of these guys are hams who want something a little different to do.

There is also illegal activity below channel 1. For some unexplainable reason, it is all AM activity. When skip starts, this spectrum of frequencies gets filled with traffic. It extends about 300 kHz or more below channel 1. The frequency 26.800 is a popular one because it is exactly 455 kHz below channel 23. A receive crystal for channel 23 put in the transmit crystal socket is a common way to get this frequency.

CB's Popularity

Because CB became so popular in a short period of time, the FCC had to legalize idle chitchat. I really do not think it affected CB's growth. Psychiatrists have come up with many reasons why CB has become so popular so quickly, but I do not agree with any of these.

I think there is a little bit of a ham in everyone. Most CBers do not know how their radio works, but why is that so bad? A lot of people, including some hams, do not understand how a Polaroid camera works or understand every part of a car, but this does not prevent them from using these items and getting good results.

What attracts people to CB is the fact that they can push a button on a microphone and talk to someone

else across town or further away. All this can be done without interconnecting wires. This is what attracted me to radio and this is what initially attracts every ham to amateur radio.

CB has proven there is strength in numbers. As more license applications came in, the FCC relaxed the rules. They allowed higher antenna placement, permitted idle conversation, changed the rules so that only the sender needed to use his call letters, and expanded the number of channels. Most of these changes happened in a relatively short period of time. No one really worked together as a group to achieve these ends, although I will admit that the EIA lobbies wield quite a bit of force.

Yet 350,000 hams, who generally know radio well and work in unison for the most part, cannot persuade the FCC to allow phone operations in a large segment of the 20 meter band now allocated to CW.

Many CBers would like even more expansion on 27 MHz, but the FCC will not expand any further because of intermodulated products resulting from 455 kHz i-fs. Now that 220 MHz is not available, CB will probably end up around 800 or 900 MHz if there is any further expansion. Antennas with huge amounts of gain would be possible, and so would moonbounce. It would be an ideal hobby band. Skip would be all but totally eliminated, and so would interference to other devices. Skip on 11 meters is the main reason HFing exists. HF activity just is not there unless skip is present. ■

Reader Service—see page 195

70-Watt Shoes for the IC-502

—put some punch in that 6m signal

George Hovorka WA1PDY
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674 Brush Hill Rd.
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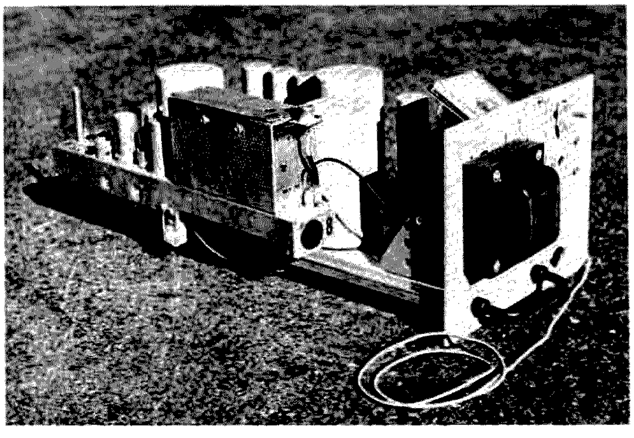
The IC-502 is an excellent 6 meter transceiver for the money, but sometimes a little more power is very useful, especially during skip openings. Here is a linear amplifier that you can build at little or no cost, which runs about seventy Watts input. The heart of this amplifier is a surplus tube-type low-band Motorola FM transmitter strip. I bought mine for $1.00 at a local hamfest. Only the final amplifier of the transmitter strip is actually used, so the condition of the strip is unimportant. The advantage of my scheme is that the critical VHF wiring, neutralizing, and shielding, as well as the procurement of rf components is all taken care of for you. Essentially, this project consists of modifying the transmitter strip, building a power supply, and creating the relay switching for the amplifier.

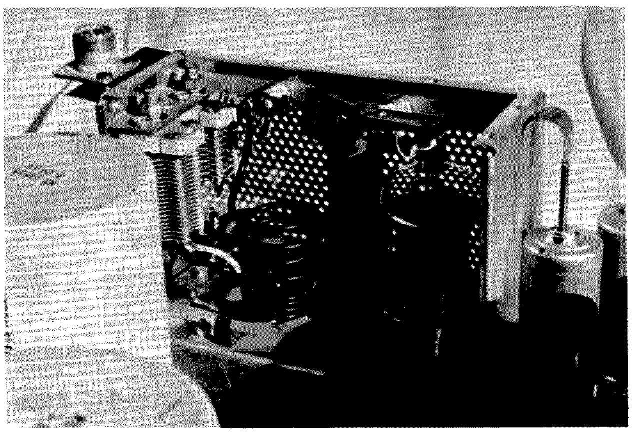
This amplifier will also work well with low-power AM transceivers, such as the Heathkit Sixer and the Lafayette HA-650.

Selecting a Transmitter Strip

This conversion is based on a Motorola TA104 series low-band transmitter strip. These can be easily recognized by their long, thin appearance, and a large multi-turn tank coil. This transmitter series covers the 25-to-54-MHz range in 5-MHz segments. To find the



Completed amplifier. The power transformer is in the foreground, and C1 can be seen attached below the transmitter strip.



Power amplifier coil. Note cut-down tank coil.

frequency range of a particular transmitter, first locate its identification numbers which are stamped in black ink, usually around the final amplifier compartment. These numbers should either be TU113 or TU113-C2. After the identification number, there is a one- or two-letter suffix. This denotes the frequency range of the transmitter. Before you go out shopping for your transmitter strip, make a copy of the suffix frequency code shown in Fig. 1's caption and keep it handy.

The unit covered by this article is an MM-type (35-40 MHz). This type often shows up at low prices because it requires a major conversion job to move it up to 6 meters or down to 10 meters. This poses no problem for its use in this project, since only the final amplifier is employed and only two coils need to be modified.

One final note: If your transmitter strip is other than the HH (50-54) type, be sure to remove the T-section harmonic filter. This filter is located next to the antenna relay which is directly underneath the final amplifier compartment. It consists of two air-wound coils and three capacitors mounted on a tie lug strip. Remove this filter and run a wire directly from the output coupling coil, L2, to the antenna relay.

Construction

A heavy chassis should be used for the base. In my prototype, I used an old dc power supply as a starting point. The main power transformer is not critical. One from an old TV set will work fine. The bias transformer is a six-volt filament transformer connected in backwards. The high-voltage diodes are from Poly Paks and cost $1.00 for five. Be sure to use diode-protection resistor-capacitor networks across each diode. Also, be sure to use bleeder resistors across the filter capacitors. The plate milliamp meter is noncritical, but be sure that it is well insulated above ground.

To convert the transmitter final amplifier, it is necessary to use a grid-dip meter. If you don't own one, check with your local repeater group. You will probably find a ham who will loan you one.

To modify the transmitter strip, first cut the tank coil down four turns. Check for resonance at 50 megahertz by rotating the plate tune control. The resonance dip should occur with the plate tune capacitor half meshed. Next, remove T3, and take off seven turns from the top winding. With T3's top slug halfway in, connect capacitor C1 in parallel with the top winding of T3, and check for resonance at 50 megahertz. I used a variable capacitor for C1 because T3's slug is hard to tune without a special tuning tool. Now replace T3, and complete the wiring. I mounted C1 on a piece of scrap plastic, but any suitable insulation will do.

Since there are no external relay contacts provided with the IC-502, I used a simple hand switch arrangement to key the amplifier. I connected a microswitch to a ten-foot cord which runs to the amplifier. When I am using the amplifier, I hold the push-to-talk mike in one hand, and the microswitch in the other. Alternatively, a foot switch could be used for this function. During standby periods, the bottom of the bias pot is lifted above ground by opening a pair of contacts on relay RLY1. This biases the grid of the 6146 into the cutoff region, which results in cooler operation of the final tube. Relay RLY1 is a twelve-volt DPDT type,

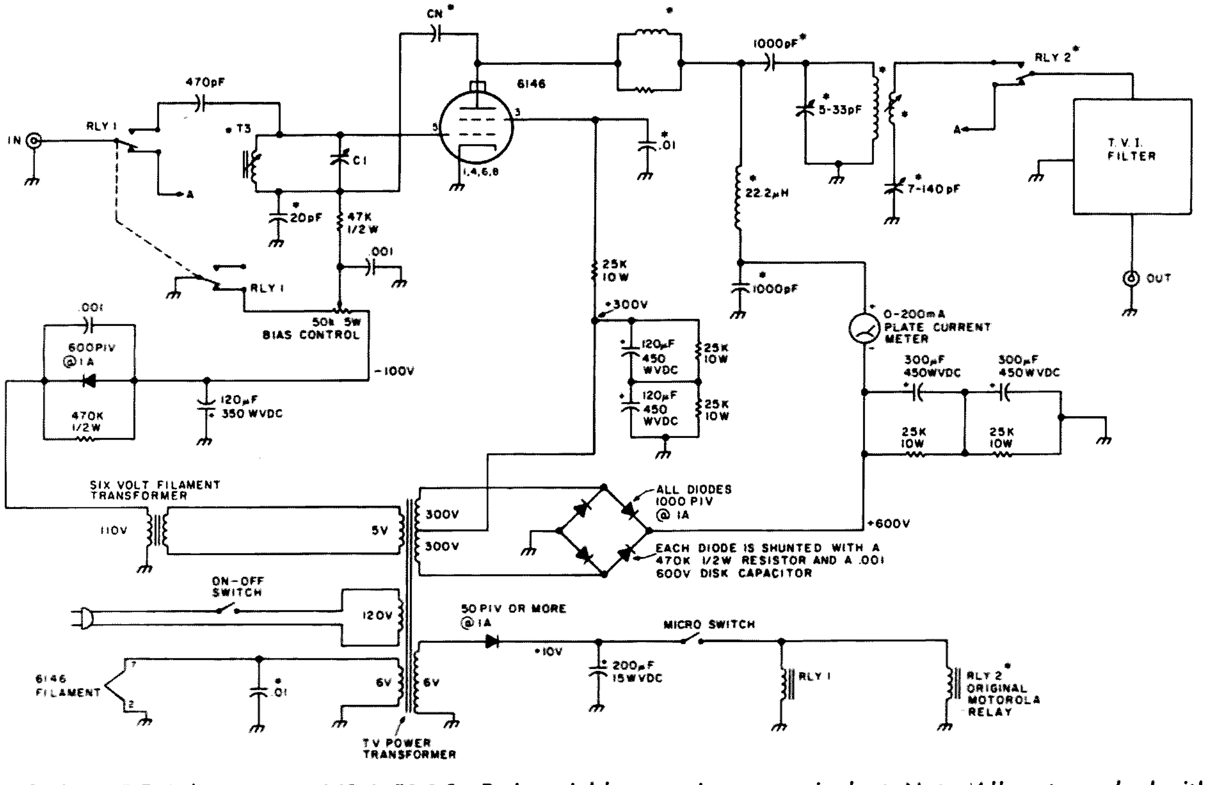


Fig. 1. C1 is an E.F. Johnson-type 148-4, 50-3.2-pF air-variable capacitor or equivalent. Note: All parts marked with an asterisk are from the Motorola transmitter strip which is a TA234 series. The relays are shown in the receive position. L—25-30 MHz; ML—30-35 MHz; MM—35-40 MHz; HL,—40-45 MHz; HM—45-50 MHz; HH—50-54 MHz.

and RLY2 is the original antenna changeover relay in the transmitter strip. All of the rf wiring should be done with RG-58/U coaxial cable. Except for insulating the high-voltage filter capacitors, the rest of the wiring is noncritical.

Some sort of 6 meter TVI filter should be placed on the output side of the amplifier to ensure that it meets FCC harmonic suppression requirements.

Tune-Up

Without any rf drive applied to the amplifier, adjust the grid bias control so that the plate idle current is about twenty milliamps. Next, connect an swr bridge between the amplifier and the exciter. Adjust the exciter to the frequency you most commonly use (such as 50.11 MHz), and place it in the tune position. In the case of the IC-502, place the transceiver in the CW position, and put the key down. Then with the amplifier off, adjust C1 for the lowest swr. With the amplifier peaked for 50.11 MHz, I am able to QSY up to 50.4 MHz without any substantial drop in power.

Over the past few months, the on-the-air reports which I have gotten while using the amplifier have been gratifying. Stations that I have contacted on a regular basis report about a 4 S-unit improvement when the amplifier is turned on. Often, over long tropospheric bending paths of 400 miles or more, the amplifier has made the difference between whether I was able to make a contact or not. If you construct one of these 6 meter amplifiers, I am sure you will find it a valuable asset to your station. ■

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The Big Bopper

As an interested amateur, you probably have heard many on-the-air and off-the-air conversations discussing phased antennas. If you have never operated a phased array, you may have wondered—with honest skepticism—whether they really perform well. In particular, are they generally equivalent to other good arrays and do they have any unique advantages? The answer to both questions is yes. Obviously, there are some qualifications. No single approach to an antenna system can ever be the universal solution to every ham's radiation problem. But if what you need is an effective radiation system on multiple bands with a low physical profile and you want it to be relatively inexpensive as well as easy to construct and maintain, then you may want to consider a vertical array.

The two-tower vertical array described here has directional radiation (and reception) characteristics which are easily rotatable. The system is sturdy, attractive, and readily usable on five bands, with no outdoor adjustments required while operating. Standing-wave ratios are

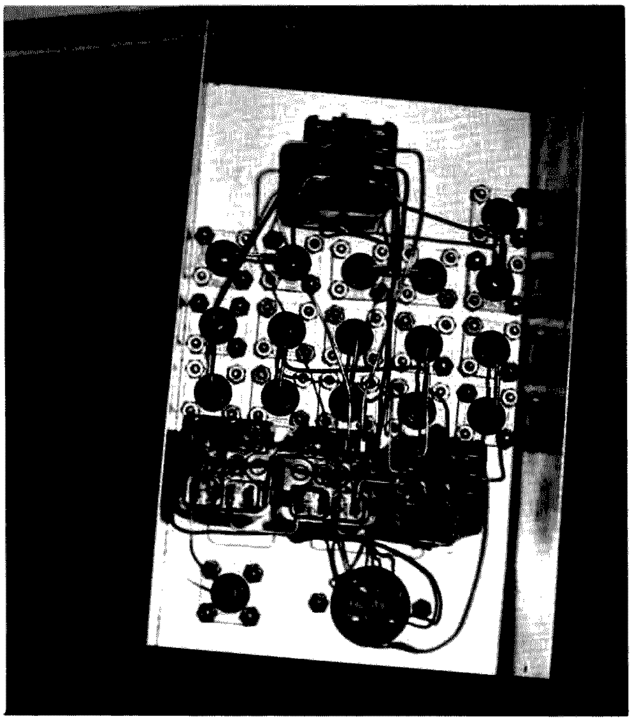

Photo A. Wiring side of the relay switch box.

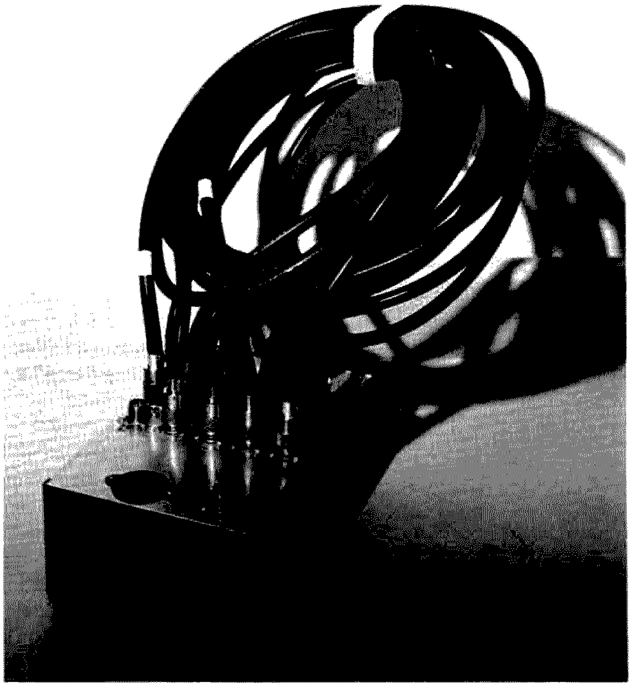

Photo B. Relay switch box "buttoned up" with seven "internal" lines attached.

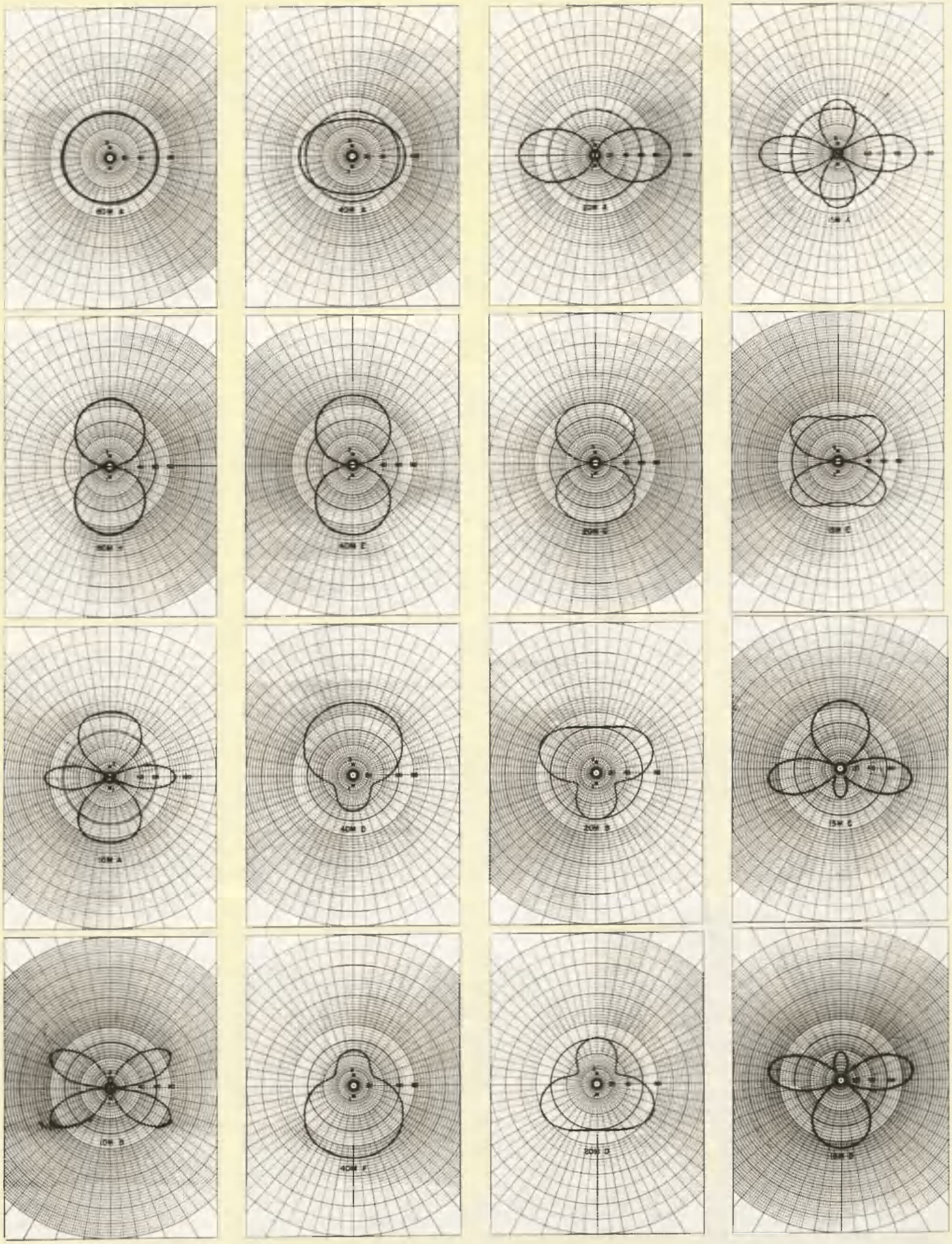

Fig. 1. Idealized radiation patterns. All patterns represent field intensity from 100 radiated Watts. Dots 1 and 2 represent towers 1 and 2. Capital letters represent switch positions. Circles = 61.8 millivolts/meter at one mile. This is the field intensity from a single tower with the same 100 Watts radiated.

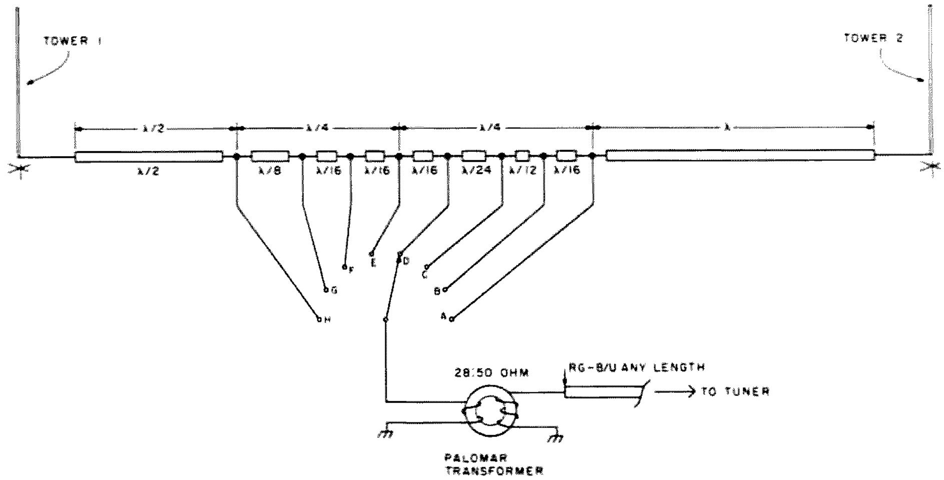

Fig. 2. Block diagram. All notation refers to 40 meters only. All cable and delay lines are RG-8/U or a 50-Ohm equivalent. The transformer is a Palomar Engineers or equivalent (see text). Towers and trapped units on each band are Hustler 4-BTV or equivalent.

moderate under all conditions of operation. The transmission line can be any convenient length. An antenna tuner or matching network is recommended between the transmitter and the antenna system.

The effects of mutual impedance on the array operation have been determined. The radiation patterns have been calculated for typical amateur-level field intensities. Importantly, the patterns recognize the effects of any unbalanced tower currents which sometimes result. The construction of the array, and its operation, is completely straightforward and uncomplicated. It does not require great resources, either real estate or budget. It may be especially attractive if you have been denied a more conventional beam because of zoning restrictions, house construction limitations, or general appearance considerations.

Since the tower separation is fixed, the array cannot be equally directional on all five bands. Offsetting this quality is the ability of the system to operate on five bands with the turn of an indoor switch. It is emphasized that this ability to operate on all major bands with variable directional enhancement on each band is a capability that is not a commonplace feature of typical antenna systems. Also, as will be seen, once the system is tuned to a pattern, it is very tolerant of frequency shifts within a band and can be characterized as having quite a flat load response.

There is no special design requirement for the individual trapped towers. For symmetry, it is recommended that they be nearly the same. Commercial units are readily available and are competitively priced. If your machine shop facilities are limited, buying the verticals may be the quickest and least expensive approach. On the other hand, if you are more venturesome, or able, various means of trapping are described in the amateur handbooks and periodicals which most of us have in our ham libraries. Actually, you may have one vertical antenna already. In this situation, the array discussed may offer you an easy extension in operating capability, with only incremental cost or effort.

This array effectively uses all of the basic lobe patterns that are intrinsic to a two-tower system with a common feedline. Intentionally omitted are some familiar two-tower patterns—perfect cardioids, for instance—that can be generated only with an elaborate feed system so as to maintain balanced tower currents.

The Design Approach

Vertical antennas—towers—used as the basis of the design approach have a number of appealing qualities. They are unobtrusive in residential neighborhoods. Vertical towers with tuned traps allow easy band changing and multiband operation.

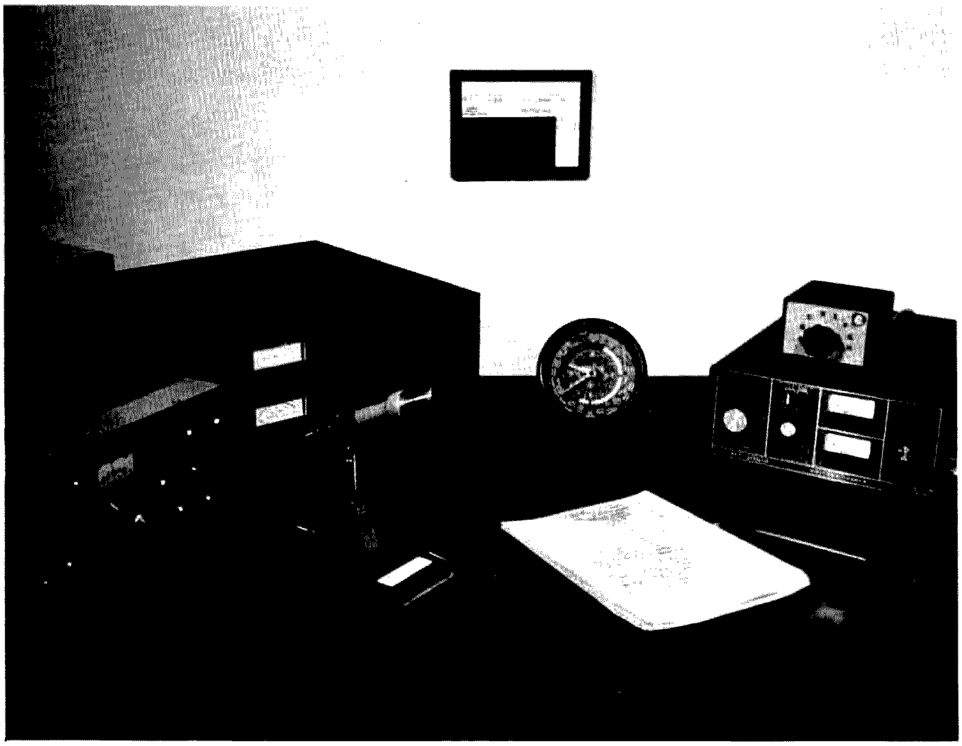

Photo C. The desk control unit in place.

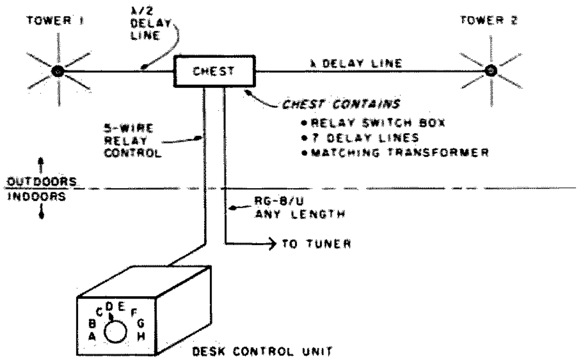

Fig. 3. Bird's-eye view showing the simplicity of the system.

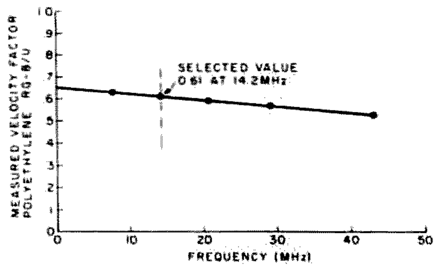

Fig. 4. Velocity factor versus frequency for polyethylene RG-8/U.

The low-angle radiation patterns from verticals enhance DX probabilities for a given transmitter power. The absence of high-angle vertical lobes usually equates to effective use of radiated power. Properly constucted, ground-mounted verticals can have low losses and are structurally sound in almost all weather.

For 40 meter and 80 meter operation, a two-tower vertical system is one of the few practical options that can be used to enhance directivity. This is especially true if rotation of the pattern is desired. Typically, at these frequencies, the beam element lengths in conventional arrays become too ponderous for most hams to cope with.

Finally, in the two-tower system, no mechanism or external rotators are required. The quick switching of the lobe patterns is especially handy for reception when operating in a net or group. Often the compass bearing between received stations is quite wide. Quick optimization of the received signal is a real operating advantage. Sometimes, too, it is helpful to be able to partially null an interfering signal.

How This Antenna System Operates

The two towers are physically separated by λ/4 on 40 meters (34′5″). This is a separation distance that will comfortably fit on many home lots. There is an eight-position switch at the operator's position that selects between the lobe patterns (Fig. 1). For example, switch position D on the 40 meter band selects a paddle-shaped pattern directed off the top end of the axis. Switch position F on the 40 meter band is an identical paddle-shaped pattern, but directed off the bottom end of the axis. The absolute geographic direction is determined by the tower axis orientation.

It is worth noting again that the division of current between the towers affects the pattern generated. Yet the current division between towers, with a common feedline, is a function of the tower self-impedances—including mutual impedance—as transformed through the delay lines to the feed-in point. The individual tower impedances, in turn, for a given current phasing, are a function of the current division between them.[1] Sound circular? For example, it is possible with some patterns and phasings to initiate a multivibrator-type action. As a tower current goes down, the tower impedance goes up, which causes the current to go down further . . . etc. The resulting radiation pattern degenerates toward a single tower pattern or a circle. It can be speculated that such action has discouraged unsuspecting experimenters in the past when actual performance compared poorly with anticipated pattern enhancement.

These degenerative conditions have been avoided in this array. But to avoid them, some two-tower patterns, as shown in a *Radio Engineering Handbook* or similar source, are not available in practice. Uncritical referencing to tables of these patterns is a common error. Such handbook displays are normally predicated on towers which are λ/4 high and which have equal currents in each tower. Maintaining equal currents under all conditions of operation and switching is not an easy trick. Instead, the lobe patterns in Fig. 1 are based on the unequal currents which occur normally. The patterns give good emphasis and direction selection on each band. By orientating the tower axis with care, good world coverage can be obtained.

All patterns as shown in Fig. 1 are "idealized," meaning that they are computed, not measured, and are assumed to be generated over perfectly conducting earth. For most ham installation planning jobs, these assumptions are quite acceptable. The

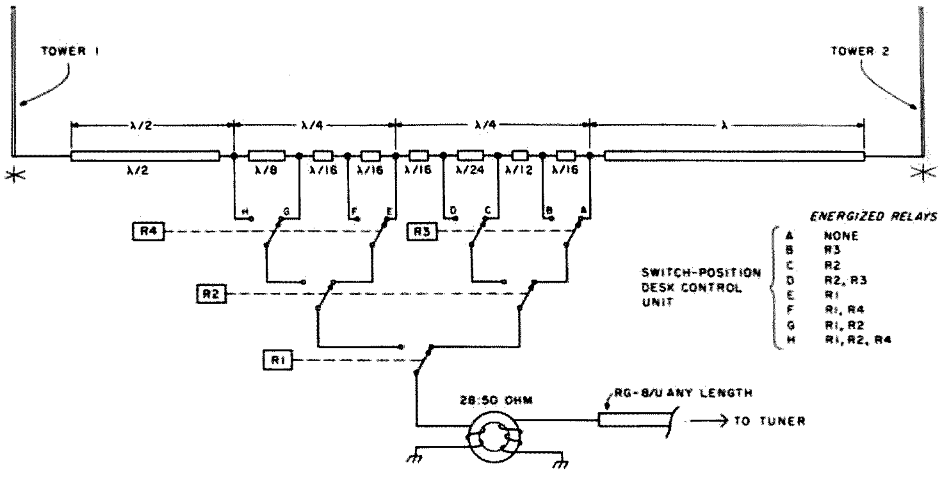

Fig. 5. Relay circuit. All relays are shown at rest. All wavelengths refer to 40 meters only.

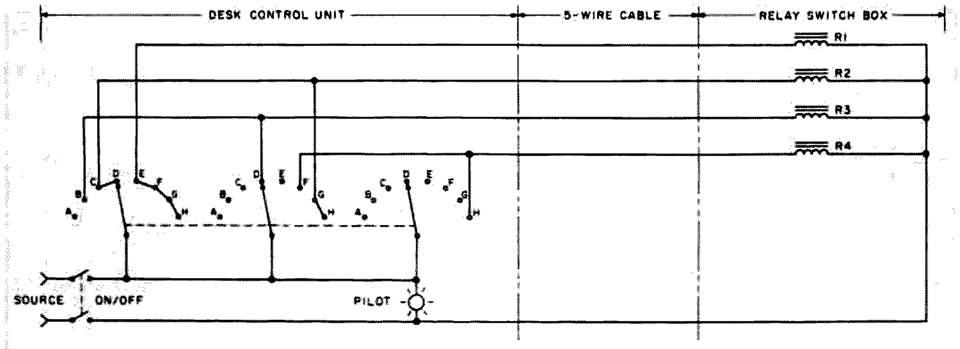

Fig. 6. Relay coil-control circuit.

charts are calibrated in millivolts/meter for a radius of one mile with a total rf radiated power of 100 Watts. To estimate the field strength for a different radiated power, P_2, it is only necessary to multiply the chart reading in the chosen direction by $\sqrt{P_2/P_1}$. In our case, P_1 is 100 Watts. The circles in the charts represent 61.8 millivolts/meter at one mile, which is the field intensity that theoretically would be obtained if the 100 reference Watts were to be radiated from a single vertical tower.

The Block Diagram

The antenna system is shown in block diagram form in Fig. 2. For consistency, all notations in Fig. 2 and throughout this article relating to wavelength or delay degrees will refer to 40 meter operation. Conversion to other bands is then straightforward.

Although the towers are physically λ/4 apart (90°), they are separated electrically by two wavelengths of delay line in nine unequal sections. The electrical centerpoint is at A. The feed-in point of the transmission line is determined by an eight-position switch.

In the D position, as shown, there is a 13/16λ delay to tower 1 and a 19/16λ delay to tower 2. In other words, the current in tower 2 lags the current in tower 1 by the difference in delays, or: 19/16λ − 13/16λ = 6/16λ = 3/8λ = 135°. At the same switch position, consider 20 meter operation. All electrical dimensions are now doubled. The towers are physically separated by 180 electrical degrees. Tower 2 current now lags tower 1 current by twice the amount at 40 meters, or 270°.

The eight-position switch function could be done manually as is illustrated. Such manual switching would be quite awkward in most operating situations, since the switch would necessarily be outdoors. Instead, the equivalent function is done remotely with four relays. The relay circuit and the matching transformer will be discussed in a later section.

The specification of trapped antennas for the towers is important. For predictable radiation pattern generation, it is desirable that each tower be an electrical quarter wavelength high for each operating band (at least no higher than 5/8 λ). Trapping achieves this condition. It may be tempting to try to use untrapped 40 or 80 meter quarter-wavelength towers for all bands. Such untrapped tower heights, when used on high frequency bands such as 10 or 15 meters, can cause confusion and difficulty. In effect, each tower can become a resonant "longwire" with the associated intricate radiation pattern. Lossy high-angle lobes can result. The interaction of these complex patterns in a switchable two-tower array is apt to result in unpredictable and disappointing results without careful analysis.

Electrical wavelength	Physical length (vel. fac. = 0.61)
λ	84'8"*
λ/2	42'4"*
λ/8	10'7"
λ/12	7'.5"
λ/16	5'3.5"
λ/24	3'6.25"

*Table 1. Physical lengths of delay line sections. *Initially cut long and trimmed to final length with a dip meter (see text).*

Construction Features

One real advantage of this array is its easy and straightforward adaptation to construction. For instance, the full λ length of delay line to tower 2 and the λ/2 length of delay line to tower 1 permit the physical grouping of a switch box plus seven of the delay lines conveniently away from both towers. This statement allows for the physical shortening of the delay lines to accommodate transmission line velocity factors. This arrangement flexibility is often useful for appearance or screening considerations (Fig. 3).

While on the subject of velocity factors, it may be helpful to review my own experience. Perhaps I should have known better, but I was unprepared for calibrated dip-meter measurement results, which indicate that the velocity factor in polyethylene RG-8/U varies with frequency (Fig. 4). A review of the technical literature that I have, plus manufacturer's data on hand, discloses no mention of this quality. A single standard "nominal" value for the velocity factor is usually given. Other experimenters may also have this gap in their information. Obviously, knowledge of this variable is significant if the same cable is to be used for generating specific delays, but at different frequencies—as in this array. I selected a velocity factor of 0.61 obtained at 14.2 MHz. This is a compromise value. Errors introduced on other bands are within reasonable limits with this value. Table 1 lists the physical lengths I have used.

It is suggested that the λ length of delay line, and also the λ/2 length of delay line, be cut a little long. Then, with all of the delay lines attached to the switch box but not connected at the towers, balance and trim the lines from midpoint A outward with a dip meter. This balancing will minimize any discontinuity effects in the switched leg due to relay points or coax hardware.

The Relay Switching Circuit

The functional switch in Fig. 2 is replaced by the relay circuit in Fig. 5. The switching relays are conventional medium-power units and need not be the expensive coax type. They should have two sets of SPDT contact points. A compact physical design is suggested. It is important that they have sufficiently heavy-duty contact points

to be able to handle the currents involved. A contact current rating of 10 Amps or better will be adequate in most applications. Obviously, the relays should have good insulation and a low inductance switch path. Contact resistance should not be a problem since full rf current flows through any contacts that are used.

The relay coil-control cable is a five-wire cable. Since the cable runs from the shack to the switch box outside, it is likely to either be buried or at least to touch the earth. As a result, conventional safety precautions require that the relay coils should either be of the low-voltage type or else should be isolated with a suitable transformer arrangement.

In my installation, the relays are housed in an aluminum box, 3½ x 6 x 10 inches (Photos A and B). This box also serves as a mount for the SO-239 panel receptacles which make the connections to the transmission line and delay lines. This arrangement affords good shielding, short connections, and easy assembly and disassembly. Another plus is the ability to make easy substitutions of delay line lengths for experimentation. The layout is not critical and your own design should work well if attention is given to short lead lengths.

Selection of the relays is controlled from a desk control unit which basically consists of a 3-pole, 8-position rotary switch housed in a decorator metal box (Photo C). A pilot light and an on/off switch can be convenient additions. The relay coil-control circuit is detailed in Fig. 6.

Radials and the Ground System

All too frequently, hams underestimate the need for a proper ground system with vertical towers and attempt to skimp by. This is false economy and wastes effort and power. An adequate radial system is a fundamental and necessary component of the total radiation array and should not be neglected. A working rule of thumb is to have a minimum of six radials per band with a minimum length per band of 0.125λ (Photo D).

The Transmission Line, Delay Lines, and Matching Considerations

Although simple in physical appearance, operation, and construction, there are some deceptively involved aspects to the electrical analysis of the array:

- There are two towers with mutual coupling which affects the individual tower impedance.
- Pattern switching affects the load impedance at each tower.
- The towers are not always operated at resonance with the corresponding introduction of reactance of varying magnitude and sign.
- The impedance of the system, viewed from the radial switch, is a resultant of two parallel paths—one to each tower. The length of these paths, their individual impedances, and the current division between them change with switching.

It should be clear that the system—considered as a load—varies under normal operating conditions. For the most part, these operating conditions, while tedious to analyze, are quite solvable with the charts and equations of G. H. Brown, the liberal use of Smith charts, plus the determined application of patience and time with a programmable hand calculator. Fortunately, in practice, the system analysis complexity can largely be ignored while achieving excellent operating results. Anyway, the analysis is mostly needed for determining the pattern shapes when the tower currents are unbalanced. Still, it is realized that most users will want an insight into the operation without the tedium. The following discussion is intended for that purpose.

The range of impedances at the radial switch is such that a broadband transformer can offer very suitable compromise matches to the transmission line. In short, it splits some differences. Two simplified examples will illustrate in principle the general mode of the transformer plus some system features.

Assume that the two towers are physically identical and are operating at resonance in the 20 meter band. Assume further that the resonant resistance of each antenna is a typical 40 Ohms. Assume also for simplicity that there is no mutual impedance! Now let the feed-in point of the transmission line be switch position A, or the midpoint

Band	Tower 1	Tower 2
10	1.30	1.25
15	1.45	1.50
20	1.25	1.15
40	1.20	1.20
80	1.00	1.05

Table 2. Swrs measured at tower base and at tower resonant frequency.

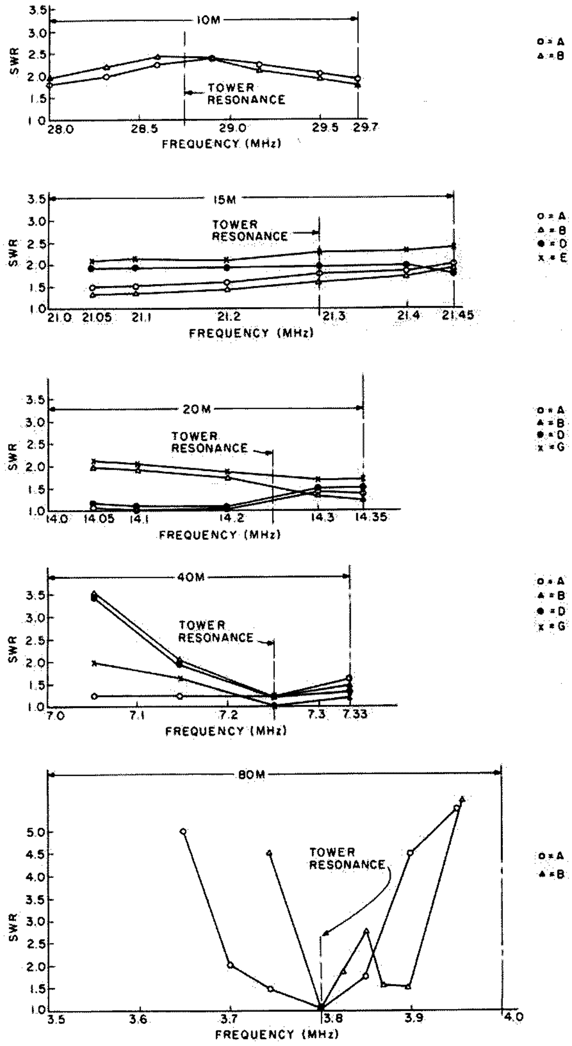

Fig. 7. Swrs versus frequency.

of the delay line. From switch position A, with 20 meter operation, there are two wavelengths of delay line to each tower. Since a half wavelength of transmission line repeats its input at its output, then the resonant resistance of each tower—40 Ohms—will be repeated at A. The two legs are in parallel so that there is a net resistance at A of 20 Ohms. Without a transformer, the 20 Ohms as a load would develop an swr, with the 50-Ohm transmission line of 50/20 = 2.5. However, 20 Ohms through the 1.0:1.8 ratio transformer will appear as 36 Ohms, which will develop an swr of only 1.4—a significant improvement!

For the second example, let the switch tap move to D and keep all other assumptions constant. It may clarify the situation to note that, at 20 meters, there is a half wavelength of line between points E and A. Remembering again that a half wavelength of line repeats its input at its output, the tower 1 resistance is repeated at point H and again at point E. Similarly, tower 2 resistance is repeated at A. The electrical distance from E to D is 1/8λ. The electrical distance from A to D is 3/8λ. The question now becomes what happens at D? Whipping out our handy Smith chart, we find that the resistance of tower 1 will be seen at D as 49 Ohms resistance plus 12.5 Ohms of *inductive* reactance. Likewise, the resistance of tower 2 will be seen at D as 49 Ohms of resistance plus 12.5 Ohms of *capacitive* reactance. Since the reactances are equal and opposite, they will cancel. (This action is true at any tap. Its value will be discussed later.) As in example 1, this leaves us with two resistive legs in parallel. The net parallel resistance is 24.5 Ohms. This resistance, seen through the transformer, will appear as 44.1 Ohms, which, in turn, will generate an swr of only 1.13.

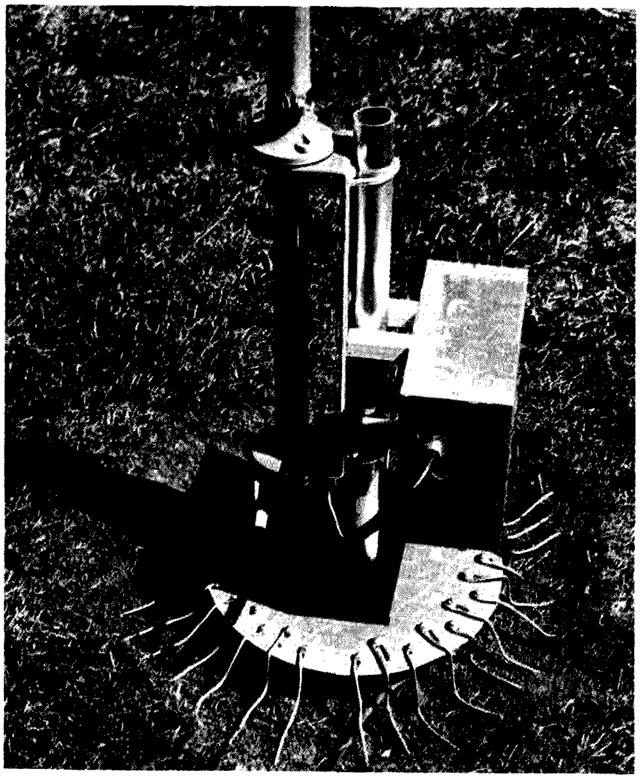

Photo D. The radial system. The aluminum box is handy, but not necessary. It is used to weather protect a PL-239, which was used for cable length experimentation.

Unfortunately, when mutual impedance is reintroduced into our assumptions, the reactive components do not always cancel at all times. Also, the self-resistance of the towers may become different, which would mean that the currents will no longer be the same in each tower. Nevertheless, the function of the transformer can be understood as an impedance leveler and, in fact, practical experimentation is easy.

The transformer itself is a ferrite core unit. I use the Palomar transformer at the nominal ratio of 28:50 Ohms. Roll-your-own transformer winders should have little difficulty achieving the 1.0:1.8 ratio or close to it.[2,3] The turns ratio is not excessively critical, and some experimentation with ratios may be rewarding. It has been my experience that swrs for a favored band can be improved, but usually at some expense to another band.

Adjustments/Tuning

The first operation in adjustment is to tune the towers individually to the same frequency on each band. Other things being equal, a midband resonant frequency will probably give better overall results than a frequency near band edge. Assuming the absence of an rf bridge, probably the most direct alignment technique is to measure the swr at the base of each tower and adjust for minimum. To avoid mutual coupling effects, the other tower should be removed from its standard and placed out of the immediate area.

It will be remembered that an ideal vertical λ/4 tower has a resonant resistance of about 36 Ohms. Thus, with a 50-Ohm transmission line, the swr for an ideal tower would be 50/36 = 1.4. Some hams are confused about this point—probably by advertising claims—and expect an swr of 1.0 or close to it.

The swrs that I measure on the transmission-line side of the matching transformer are shown in Fig. 7. These moderate swrs represent no threat to RG-8/U, even at full legal power. Coax losses at these ratios are insignificant. Most antenna tuners can easily cope with these ratios and will present a perfect load to the transceiver or linear amplifier.

Table 2 lists the swrs I measure at the base of each tower. Superficially, it would appear that I have the best adjustment on 80 meters where the swrs are the lowest. The contrary is the case. My towers are telling me that I have an inadequate radial system on 80 meters. In effect, I have a dissipative ground resistance in series with the radiation resistance, and, therefore, the total resistance is raised. The net resistance at 80 meters nearly matches the transmission line characteristic impedance. Although this raised overall resistance gives a nice low swr, it also indicates that I am wasting some valuable rf power heating the ground!

Perhaps of more interest is the shape of the swr curves in Fig. 7. For the most part, 80 meters excepted, they do not have the familiar lopsided, saucer-shaped, resonant curves. Instead, they tend to be gently curved and be level, or have a slight tilt. That is, *the swr does not change appreciably* with change in operating frequency! This is a feature of the system. Stated another way, once an antenna tuner is adjusted for a par-

ticular lobe pattern, at a particular frequency, it is usually unnecessary to readjust it much while operating across a significant band segment. For emphasis, it should be noted that the chart for the 10 meter band has a 5:1 compression in its frequency scale when compared to the other bands. Its flatness is thus even more impressive.

For an explanation of these unusual swr curve shapes, recall that, in our second example, there was a cancelling of reactance at each switch tap, *providing that there is an integral number of half wavelengths of delay line between towers.* If the operating frequency is moved away from the resonant frequency of the towers, an identical reactive component will be introduced at each tower. These reactive components will tend to cancel at the taps, leaving only resistance. It is like having a built-in compensating tuner!

In addition to matching the antenna system to the output pi network of your transceiver or linear amplifier, an antenna tuner gives added protection against spurious radiation. This antenna system is an excellent radiator on all bands at all times! It will not filter nor inhibit any undesired harmonics. An antenna tuner is an investment in tranquillity. ■

References

1. G. H. Brown, "Directional Antennas," *Proceedings of the Institute of Radio Engineers*, January, 1937. See equations 37, 38, 39, and 40 on page 92.
2. John J. Nagle K4KJ, "Wideband rf Autotransformers," *Ham Radio Magazine*, November, 1976.
3. Jerry Sevick, "Broadband Matching Transformers Can Handle Many Kilowatts," *Electronics*, November 25, 1976.

Contests

from page 30

RS(T) and 3-digit serial number starting with 001.

SCORING:

European stations count 1 point per QSO on any band; non-European stations score 1 point per QSO on 20 through 10 meters, and 3 points per 80/40 meter QSO. Count every call area in the above-mentioned countries on every band as a multiplier, e.g., LA1 = LB1 = LJ1 and SM3 = SK3 = SL3. A portable station in Norway or Denmark counts as the 10th call area, e.g., W2XXX/OZ counts for OZ0. Some countries have no geographical call areas, but count this contest as if they had. The sum of all complete QSO points from all bands multiplied by the sum of multipliers from all bands is the final score.

AWARDS:

Certificates awarded to the highest-scoring station in each participating country and US call area in each operating class separately on CW and phone. A special SAC-plaque will be given to the continental winners on both CW and phone. A reasonable score is requested for both certificates and plaques. Depending on the number of contestants in each country, the contest committee will consider more certificates.

ENTRIES:

Write separate logs for CW and phone. The logs are to be filled in in the following order: date and time in GMT, station worked, sent and received message, multiplier, and points. Separate logs for each band are recommended. On the summary sheet the contestant will write his/her callsign, name and address, the final result, the operating class, and a signature that he/she fully agrees to the rules. The logs must be mailed no later than October 15 and sent to: SRAL, SAC Contest Committee, PO Box 306, SF-00101 Helsinki 10, Finland. The decisions of the contest committee are final and definite and they reserve the right to change the rules. Usual disqualification rules.

DELTA QSO PARTY

Starts: 1800 GMT September 29
Ends: 2400 GMT September 30

All amateurs are invited to participate in the 10th annual party which is sponsored by the Delta Division of the ARRL. Amateurs outside of the Delta Division (Arkansas, Louisiana, Mississippi, Tennessee) will attempt to contact as many stations inside of the Delta Division. Delta Division stations will attempt to contact as many stations both inside and outside of the division. Stations may be worked on each band/mode; portables and mobiles may be reworked on the same band/mode if they change counties.

FREQUENCIES:

CW—3550, 7050, 14050, 21050, 28050.

SSB—3990, 7290, 14290, 21390, 28590.

Novice—3725, 7125, 21125, 28125.

EXCHANGE:

QSO number, RST, and QTH (ARRL section for non-Delta Division; county and state for Delta Division).

SCORING:

Delta Division stations score number of QSOs times the number of ARRL sections (75 maximum); outside Delta Division score number of QSOs times the number of counties worked (316 maximum). DX stations may be worked by Delta Division stations but do not count as multipliers.

ENTRIES AND AWARDS:

Logs must include date/time, station worked, exchange, band, emission, and multiplier. Logs must be postmarked no later than October 21 to be eligible for award consideration. Logs will be returned if requested. Send logs to Malcolm P. Keown W5XX, 213 Moonmist, Vicksburg MS 39180. All amateurs contacting 5 different stations in each of the 4 states comprising the Delta Division will receive a certificate. Section awards to the 3 highest-scoring stations in each Delta Division state, 4th and 5th place if warranted; section awards to high-scoring stations in each ARRL section and country outside Delta Division, 2nd and 3rd if warranted. Plaques to high-scoring stations both inside and outside of the division and to high-scoring portable and mobile stations in the division. Another plaque to the high-scoring Delta Division club station (no limit to number of operators or transmitters, but all QSOs must be made from same QTH).

COLLEGE RADIO SCRIMMAGE

Starts: 1900 GMT September 30
Ends: 0100 GMT September 31

Entry classes: 1) alumni and 2) club station. Open to all amateurs; alumni may work other alumni and club stations. Entry may have one or more operators but must have only one transmitter (no distinction between single- and multi-operator).

EXCHANGE:

Name of college, junior college, or university you last attended and the last two digits of the year you graduated, will graduate, or last attended. Club stations substitute the words "Amateur Radio Club" for number. Non-collegians substitute the words "High School" for college name, but are not eligible for awards and may not be counted as a multiplier.

SCORING:

Stations may be worked once per band. Multiply total QSOs by number of different colleges worked (college counts once regardless of band).

FREQUENCIES:

1815, 3895, 7230, 14280, 21355, 28560.

AWARDS AND ENTRIES:

Trophy for top scorer in each entry class. Certificates as well. Logs must be received by November 1 to be eligible. Send an SASE for results to: Penn State Amateur Radio Club, K3CR, 202 Engr. Unit E, University Park PA 16802.

FALL CLASSIC RADIO EXCHANGE

Starts: 2000 GMT Sunday, September 30
Ends: 0300 GMT Monday, October 1

This contest is sponsored by the Southeast Amateur Radio Club, K8EMY, of Cleveland, Ohio, and is open to all. The object is to restore, operate, and enjoy older equipment with like-minded hams. A classic radio is any equipment built since 1945 but at least ten years old (an advantage, but *not required* in the Exchange). The same station may be worked with different equipment combinations and on each mode on each band. General call is "CQ CX" and non-contestants may be worked for credit.

EXCHANGE:

Your name, RST, state/province/country, receiver and transmitter type (home brew send PA tube type, e.g., "6L6").

FREQUENCIES:

CW—up 60 kHz from low band edges.

Phone—3910, 7280, 14280, 21380, 28580.

Novice/Tech—3720, 7120, 21120, 28120.

SCORING:

Multiply total QSOs by number of different receivers, transmitters, states, provinces, and DX countries worked on each band and mode. Multiply that total by your classic multiplier: total years old of all receivers and transmitters used, three QSOs minimum per unit. If equipment is a transceiver, multiply age by two.

ENTRIES AND AWARDS:

Certificates and other appropriate memorabilia are awarded periodically for highest scores, longest DX, best excuse, and other "unusual achievements." Send logs, comments, anecdotes, etc., to Stu Stephens K8SJ, 2386 Queenston Rd., Cleveland Heights OH 44118. Include an **SASE** for a copy of the *Classic Radio Newsletter*.

Ham Help

I would like to correspond with any ham using a Heath HW-18-3 160-meter single sideband transceiver on CW as well as SSB.

William Toben W7JGL
1244 W. Schafer Drive
Tucson AZ 85705

I have been taking *73 Magazine* now for three years. I want my Novice license very much. I am 70 years old and blind—my wife reads the magazine to me. I have *73*'s code tape and know the code very well. However, I can't receive too well, as I don't know Braille and can't read back anything after writing it down.

I believe I could pass my theory test. I need to know just what is required for the blind to pass the test and if there is anything else I could get that might help me. I have radios that I listen to all the time, but I would be happy to talk to someone.

Can anyone give me any help or advice?

Raymond L. White
3341 James Avenue
Fort Worth TX 76110

I am looking for meter rewinding information and/or specifications for a replacement meter for a Johnson Viking Challenger transmitter. Thank you.

George L. Smyth N8AMZ
1316 Eastern Ave.
Morgantown WV 26505

I need any information I can get for a Keithley Milliohmmeter Model 502.

Will buy, copy, or pay to have copied information on batteries, operation, calibration, and schematics.

Dave Hammer K0PCL
610 E. South
King City MO 64463

I would like to form an exchange of solar, alternative energy, and anti-nuclear information with thinking hams.

James G. Coote WB6AAM
906 Dexter Street
Los Angeles CA 90042

W2NSD/1 NEVER SAY DIE
editorial by Wayne Green

from page 6

... not just for our own egos, but in order to keep newcomers entering our hobby and thus keeping it alive.

Without the support of a national organization, what can we as individuals or even as clubs do to help the situation? Well, getting publicity is not difficult once you recognize how the system works ... ask your terrorist or other politically active group. No, I'm not suggesting that hams start fire bombing police cars; I'm just pointing out that a realization of how television and newspapers select what they think is news will give us some ideas which can allow us to take advantage of a seriously unbalanced situation.

Take a large parade ... maybe thousands of people and floats. That's not news. But if you add six yelling and screaming agitators in a small group jostling the parade, that's what you'll see on the news that evening ... and not the ten thousand people in the parade. No, we don't want to break up parades either ... we just want to understand what *is* news and what is *not* news.

Our getting publicity should take advantage of amateur radio's possibilities. For instance, suppose we set up a national net to check food prices and report the inequities. Then amateurs could set up cars or vans in front of grocery stores with a big report poster showing the comparison between the prices in that store and other stores around the country ... where large price differences are found.

There are plenty of these price inequities to be found, and the project would make television all over the country. Heck, right here in Peterborough you can find 10% to 20% differences in the prices of identical products just between the Grand Union and A&P stores! As long as stores end prices in a 9, we know that these prices are not honest ones ... at least the chances are 90% against their being honest. We know for darned sure that a price ending in 9 is 90% of the time picked because it seems lower than one which is one cent more. If products were honestly priced, the prices would end in a random selection of numbers ... which should reflect the cost of manufacture and distribution. We also know darned well that if the honest price of a product comes out to be, say, 80¢, it will turn up on the store shelf at 89¢, not at 79¢.

There are fewer and fewer products which are not being priced in 10¢ steps, all ending in a 9. The carpet people go in dollar steps, always managing to end in 99. Bless 'em.

Ham communications could do the job, using two meters for price reports in the immediate area and perhaps 20m for long-range comparisons. And if you don't think something like that wouldn't make every television news broadcast in the country, you have another think coming. Hams working to beat down the artificially high prices on food ... hams working to bring honesty to pricing and show up the price gougers.

The gas shortage may not last very long, but we could take advantage of the tremendous interest in this situation by setting up a ham reporting network on two meters in each area which could let motorists know where gas was to be found, where the gas lines were the shortest, and gas prices ... particularly on weekends. Temporary signboards along the major routes, manned by hams (with coordination by a local ham club), would make the news broadcasts. The gas stations could be checked by telephone for the latest news of their situation or checked out by mobile units. It would be a fun project and would provide a real service. Now that the idea is out, if you don't do it, the CBers will, and you'll have to see them on television and in the newspapers. Your choice.

Those are just a couple of ideas. I'm sure you'll be able to come up with more and possibly better ones. Those came to me while I was taking a shower this morning. Take a shower. Let's get amateur radio known and appreciated.

CQ ... DE LEAVENWORTH

The chap in the middle, between the two police officers, has some serious problems. The photo was taken from a video monitor shortly after the arrest of the unhappy chap in the center for shoplifting.

This fellow had previously been into the store, one of the largest ham stores in the country, and had been suspected of gaining a good deal of weight during his earlier visit. This time they were waiting for him, complete with video monitoring and recording. The police were called and arrived to watch him stuffing his coat with books and parts via the TV monitor.

You see him in the Polaroid above, just after having been read his rights and as he was being carted off to the police station for booking.

The monitoring system has worked well, providing the staff with some rather clear pictures of shoplifters for use during later visits, complete with police in the audience. The tape recorder allows a moment by moment replay of the surveillance at any later time ... which helps in the case of any later claims of innocence.

THE ARRL LINE

Every time I tune from 14,200 on up past 14,275 to where the channels are packed solid with nets and QRM, I tend to think of the dividing line at 14,275 kHz as being the ARRL line. This dividing line is there because the League forced the FCC to take away General frequencies. Before the advent of "incentive licensing," there was no such line and General Class licensees had the use of the entire band. Now they're jammed up into half the phone band, away from 99% of the attractive DX ... certainly away from the relatively open frequencies in the lower part of the band ... and from SSTV experimenting.

This all started in 1963 when the League, being run at the time by some old-timers who wanted the ham bands to be back the way they were before the War, pushed through a disastrous piece of legislation. Amateur reaction to the proposals was so furious that it almost stopped the League, despite their inside help via Herb Hoover, Jr. The amateur reaction brought the sale of amateur equipment almost to a halt and stopped the growth of the hobby for over ten years. Talk about disaster!

This was the time when most of the famous names in ham manufacturing disappeared ... Hallicrafters, National, Hammarlund, Johnson, Harvey Wells, B&W, etc. Tuning past 14,275 brings back these memories of the havoc wrought by the League in the 1960s. *73* was too small then to be more than a cry in the wind, but I think that without the cry the League proposal to remove Generals entirely from the major DX bands would have gone through. The retaining of half of the bands by Generals was better than nothing.

The result of all this? Proof that forcing amateurs to upgrade would not work. Many of us held that the FCC should offer rewards such as better call letters rather than taking away frequencies and then giving them back if you upgraded. If you are locked above 14,275, it's something to think about.

SAROC ZOMBIE

That's what they call the dead brought back to life ... or at least some semblance of life ... and it seems apropos for the SAROC hamfest. This is a strictly commercial venture run for profit by a chap in Nevada and it died a couple years ago of extreme neglect. I see a report that this exploitation of amateur

radio has been announced again for next year in Las Vegas.

The main purpose of SAROC is to provide a legal excuse for a few of the ham manufacturers to go to Las Vegas for a vacation in January. The actual business done is a farce. For instance, one major supplier brought in a truckload of ham gear for his exhibit at the last show and over the three days of the show sold $1,500 worth of gear. That's less than one tenth of the minimum acceptable business for him just to break even.

Now, if the show was that lousy when there was still plenty of gas for the California hams to drive over the desert to come, who will be there when gas is in short supply and a lot more expensive? Ten years ago, when FM and repeaters were firing everyone's imagination, the local Vegas FM club ran a hospitality suite. Art Householder of Spectronics also had a hospitality suite where he made everyone crazy with desire for recycled Motorola HT-220s which he pulled from his pockets and sold in a kind of under-the-table atmosphere. It was heady stuff and FMers were king of the roost.

No more. The last show, two years ago, was held together mainly by itinerant hams in town for the concurrent winter Consumer Electronics Show and who came over to the hamfest for a few minutes to see what their poor relatives were doing. Next year, CES will be January 5-8th. The hamfest will be the 10-12th and the Fifth Annual Ham Industry meeting will be in Aspen, Colorado, on January 12-19th. I'll probably hop out on the 7th for a couple of quick days at CES, visit the Wilson factory on the 9th in Vegas, see who was wealthy enough in the industry to "exhibit" at the hamfest, and then poop on up to Aspen for the yearly industry conference and workshops.

SAROC, being run strictly for a profit, has a tremendous charge for attending . . . I think I paid $17 last time . . . and for that I got to wander around a handful of booths. It took me maybe half an hour to see everything. There was no recognizable program. ARMA held a meeting, but many of the manufacturers were unable to find the meeting room, which was very well hidden.

Now, why is Wayne Green so down on SAROC? Is it that I'm getting even because I haven't been asked to speak? No . . . as a matter of fact, I've been asked to speak and have refused. It's a long story and there is a lot of background. It comes down to a question of supporting what I feel are unsavory elements. I sure wish someone would take the time to write an exposé of the people behind this hamfest.

Anyway, between the gas problem and the CES show ending two days before the hamfest, it seems unlikely that the next SAROC will be any improvement over the last one . . . which had CES to help and no gas problems . . . and still was a disaster. Perhaps this commercial show should be put to rest and remembered for its heyday ten years ago instead of its more recent disappointments.

DXERS AND LISTS

A lot of true-blue DXers are very uptight over list operations. For those of you who have not enjoyed the spice of working serious DX, a list of calls is taken by some intermediary and passed along to the rare DX station, who then works the list and only the list. This can be very upsetting for some operator who comes along after the list has been drawn and finds that while he can hear the DX station easily, he can't work him. Oh, bitter anguish!

The operators of rare DX stations have several choices open to them when they get on the air. First, they know that a normal contact is out of the question because every time they stand by there will be dozens, then hundreds, of stations all calling them simultaneously. The din soon gets so great that it is impossible to hear any call distinctly and the tendency then is to wait out the caterwauling until there is just one station left to come back to him.

The encouraging of "tail-ending" quickly screws up everything. The waiting hordes quickly detect what is happening and there soon develops a two or three operator contest to see who can be the last one to call. None of them can even hear the DX station and none will quit the bedlam, so the calling can go on for several minutes. One W5 I know got steamed up at a certain K6 and the two of them refused to budge or listen on the frequency for well over an hour. The poor DX station had gone to bed long before they stopped jamming each other.

Some DX ops like the system where a DX station operates from just outside the US band and tunes for calls. I like this, too, for it doesn't take long to find out where the chap is tuning and jump in the pileup on that frequency.

Having been on the other end of the pileups, I have some observations from the viewpoint of the rare DX station. Newcomers, I've DXed from the following rare and relatively rare spots: JY, OD, 5Z, YK, YA, VU, 9N, FK, VR2, 5W, KS6, FO8, KW6, KG6, KC4, HH, PJ, 4U, OH0, VP9, VP7, and probably some more that don't come right to mind. The main problem in working a lot of stations from a rare location is not in hearing them—it's in pulling the calls apart and getting the individual calls.

After trying every known system for working 'em as fast as possible, which included working by call districts on my own frequency, working from outside the US band and listening on one frequency in it, tuning a small band of frequencies, and working from lists, there was no question . . . the list could beat everything by far.

Well, let me amend that. The list situation works great if you manage to get hold of some sharp operators to gather the lists for you. I somehow always managed to get one or maybe two good ops and one thoroughgoing idiot. I really hate it when I think I have everything set up for some really fast operating. I've rounded up three chaps with good signals to move off my frequency and copy down call letters for me . . . maybe ten at a time. Then all they have to do is come on my channel and read off the list quickly so I can write the calls down and give each one in turn a report. I can run through ten in one minute if I have the calls. And getting the calls shouldn't take more than one minute at best, right?

So on comes my helper with his list: "Hello, Juliet Yankee Eight Alpha Alpha. Juliet Yankee Eight Alpha Alpha, this is Kilo Baker Zero Xray Quebec Quebec. This is Kilo Baker Zero Xray Quebec Quebec in Washington, Nebraska. That's doubleyou whiskey, aye America, ess Sweden, aich hotel, eye Indiana, enn Nancy, gee George, tee Toronto, oh Oregon, enn Nancy. The name here is Wilbur . . . that's doubleyou whiskey, eye Indiana, ell love, bee bravo, you Uruguay, are radio. You're certainly putting a good signal in here, Wayne, really poking the old S-meter around. I have your list for you. I sure hope everyone on the list is going to come up here and find us. Let me know if you're getting me all okay and I'll pass along the list. Juliet Yankee Eight Alpha Alpha, this is Kilo Bravo Zero Xray Queen Queen standing by."

I grunt out a terse "go ahead, quickly, please," stifling an oath. Good old Wilbur comes back, spelling out both of our calls again, apparently in the belief that I may have forgotten not only his call, but my own, too. Then he starts slowly spelling out each call, one at a time, spelling each one twice for me and standing by after each call has been sent, triumphantly. Wilbur is able to take a one-minute task and escalate it to nerve-shattering lengths for all concerned, stretching it out for maybe ten minutes or more. By this time, the other two chaps who have been scrounging calls for me are on channel wanting to give me their lists and I suddenly have thirty stations to work instead of just ten.

Ten works well. Thirty doesn't. Before I can work my way down through even twenty of the chaps, I have some breakers wanting to know who is on there, how can they get into the contact, where is the list being made . . . plus an Italian calling CQ DX with a 40 over 9 signal. When I ask him to stand by, he gives me my report, spells out his name twice, then the name of his town twice (why do most Italian towns have over twenty letters?), and refuses to get off the frequency until I give him my location and agree to QSL.

It is unfortunate that many lists are run in a much slower style. Hopefully, some of the DX operators will read this or hear about it and get moving faster. I heard YK1AA on the other evening and some OK station was running a list for him. It took maybe five minutes for each damned contact . . . and all Rasheed did was swap signal reports and call letters. But it went on with excruciating slowness and drove me and a few hundred others up the wall. I didn't particularly need a contact with Syria; I just wanted an opportunity to say hello to Rasheed since I had visited him and operated from his station a few years back.

Try the live list system with perhaps three good operators, all with good signals and in separate parts of the country, taking calls for the DX station. If you can't clearly read off ten calls, spelling them out as you go for the DX op to copy, in less than one minute, then you need some practice. Once the DX op has the calls, 95% of the work is over . . . he can then stand by for one, get the report, give a report, and get an okay . . . stand by for the next, etc. He doesn't have to spell any calls out or even give his own call more than once every few minutes.

The purpose of most DXpeditions is to work as many stations as possible in a given time . . . so why horse around with slow and frustrating systems?

MAY WINNER

"The W7GAQ Key Collection" collected an extra $100 for author Martin Krey K7NZA, since his article was voted the best in our May issue. Make sure your favorite article gets recognized by using your Reader Service card ballot.

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unique digit enable code, and then output these eight bits of information to the interface. For instance, the value 01010011 will cause a five to be displayed on the fourth digit from the right on the display. The digit enable code in this example is 0011, and the digit enable code for the right-hand display is 0000.

To display the number 3,163,908,332, register pair H is first loaded with the memory address where the two least-significant digits (LSDs, 32) are stored. In Fig. 4, this address is 004 120. Only five memory locations are required to store the 10-digit number, because the number is stored in a packed BCD format. The D register, which is used to store the digit enable code, is then set to zero. The content of register D, which will eventually be latched by the interface hardware, is used to turn on one and only one digit at a time. At DISPL1, the DIGIT subroutine is called, so that the content of memory addressed by register pair H is moved to the A register. Since the data values are stored in memory as packed BCD digits, this subroutine unpacks them. The digit in the four LSBs of the A register is rotated to the left four times, bit by bit. The first digit to be displayed is now in bits D7 through D4 of the A register when the OUTIT subroutine is called.

At OUTIT, the four LSBs of the A register are set to zero by the ANI instruction (the digit to be displayed is in bits D7 through D4). The digit enable code contained in the D register is then added to the BCD number in the A register and the result is output to the interface (OUT 125). When this word is output, the four LSBs determine which digit is enabled and the four MSBs represent the value to be displayed. The first time the OUTIT subroutine is executed, the A register will contain 00100000, because a two must be displayed on the right-hand digit.

At the end of the OUTIT subroutine, the content of the D register (the digit enable code) is incremented from zero to one, preparing it for the next digit enable code. To "intensify" the digit that has just been turned on, the computer executes a time delay at INTENS. Thus the digit is kept on for a period that allows it to be clearly seen. When the 8080 finishes the OUTIT subroutine, it returns to the MOVAM instruction just before the OUTIT subroutine. The A register is loaded with the content of the same memory location addressed by register pair H, only this time the BCD digit contained in bits D7 through D4 must be displayed. This is the second digit from the right in the number 3,163,908,332. The ANI instruction at OUTIT sets bits D4 through D0 to zero and the digit enable code (one) is added to

```
/THIS PROGRAM DRIVES A 10-DIGIT, MULTIPLEXED,
/LIGHT EMITTING DIODE (LED), SEVEN-SEGMENT DISPLAY
/IN ADDITION, INSTRUCTIONS HAVE BEEN ADDED SO THAT
/THE INTENSITY OF EACH DISPLAY IS EQUAL.

DISPLA, LXIH     /LOAD REGISTER PAIR H WITH THE MEMORY
        120      /ADDRESS WHERE THE BCD DIGITS ARE STORED.
        004      /004 120 = HEX 0450
        MVID     /LOAD D WITH THE FIRST DIGIT
        000      /THAT WILL BE ENABLED
DISPL1, CALL     /DISPLAY THE FIRST TWO PACKED
        DIGIT    /BCD DIGITS
        0
        INXH     /INCREMENT THE MEMORY ADDRESS
        MOVAD    /GET THE DIGIT ENABLE WORD INTO A
        CPI      /COMPARE IT TO THE
        012      /ELEVENTH DIGIT ENABLE COUNT
        JNZ      /HAVEN'T DISPLAYED ALL TEN
        DISPL1   /DIGITS YET, SO DO TWO MORE
        0
        JMP      /HAVE DISPLAYED ALL 10 DIGITS,
        DISPLA   /SO DISPLAY THEM ALL AGAIN
        0
DIGIT,  MOVAM    /GET THE PACKED BCD WORD INTO A
        RLC      /ROTATE THE FOUR LSB BITS INTO THE
        RLC      /FOUR MSB BITS
        RLC
        RLC
        CALL     /THEN DISPLAY THIS DIGIT
        OUTIT
        0
        MOVAM    /GET THE SAME WORD AGAIN
OUTIT,  ANI      /SAVE ONLY THE FOUR MSBS
        360      /(360 = HEX F0)
        ADDD     /ADD THE DIGIT ENABLE
        OUT      /OUTPUT THE EIGHT-BIT VALUE
        125
        INRD     /INCREMENT THE DIGIT ENABLE
INTENS, MVIE     /LOAD E WITH A NUMBER
        100      /100 = HEX 40
INTEN1, DCRE     /DECREMENT THE NUMBER
        JNZ      /IF IT IS NON-ZERO, EXECUTE THE
        INTEN1   /JNZ INSTRUCTION BACK TO INTEN1
        0
        RET      /WHEN E = 0, RETURN
```

Fig. 4. Displaying a 10-digit number on a multiplexed LED display.

```
/THIS PROGRAM DRIVES A 10-DIGIT, MULTIPLEXED, SEVEN-
/SEGMENT DISPLAY.  A LOOK-UP TABLE IS USED TO CONVERT
/BCD NUMBERS TO THE APPROPRIATE SEVEN-SEGMENT CODE.

DISPLA, LXIH     /LOAD REGISTER PAIR H WITH THE MEMORY
        120      /ADDRESS WHERE THE BCD DIGITS ARE STORED.
        004      /004 120 = HEX 0450
        MVID     /LOAD D WITH THE FIRST DIGIT
        000      /THAT WILL BE ENABLED
DISPL1, CALL     /DISPLAY THE FIRST TWO PACKED
        DIGIT    /BCD DIGITS
        0
        INXH     /INCREMENT THE MEMORY ADDRESS
        MOVAD    /GET THE DIGIT ENABLE WORD INTO A
        CPI      /COMPARE IT TO THE
        012      /ELEVENTH DIGIT ENABLE COUNT
        JNZ      /HAVEN'T DISPLAYED ALL TEN
        DISPL1   /DIGITS YET, SO DO TWO MORE
        0
        JMP      /HAVE DISPLAYED ALL 10 DIGITS,
        DISPLA   /SO DISPLAY THEM ALL AGAIN
        0
DIGIT,  MOVAM    /GET THE PACKED BCD WORD INTO A
        CALL     /THEN USE THE LOOK-UP TABLE TO
        OUTIT    /DETERMINE THE PROPER SEQUENCE
        0        /OF ONES AND ZEROES.
        MOVAM    /GET THE SAME WORD AGAIN
        RLC      /ROTATE THE FOUR MSB BITS INTO
        RLC      /THE FOUR LSB BITS.
        RLC
        RLC
OUTIT,  ANI      /SAVE ONLY THE FOUR LSBS
        017      /(017 = HEX 0F)
        PUSHH    /SAVE REGISTER PAIR H ON THE STACK
        LXIH     /LOAD REGISTER PAIR H WITH THE
        BINSS    /BASE ADDRESS OF THE LOOK-UP TABLE.
        0
        ADDL     /ADD THE LO ADDRESS TO THE NUMBER IN A
        MOVLA    /SAVE THE RESULT IN THE L REGISTER
        JNC      /THERE IS NO CARRY, SO LEAVE THE
        OKASIS   /CONTENT OF THE H REGISTER ALONE
        0
        INRH     /INCREMENT THE H REGISTER BY ONE
OKASIS, MVIA     /OUTPUT AN INVALID DIGIT ENABLE CODE
        377      /SO THAT THE DISPLAY IS BLANKED.
        OUT
        125
        MOVAM    /GET THE SEVEN-SEGMENT CODE INTO A.
        POPH     /POP REGISTER PAIR H OFF OF THE STACK
        OUT      /THEN OUTPUT THE VALUE TO THE
        126      /INTERFACE (7475 AND UDN2981).
        MOVAD    /GET THE DIGIT ENABLE CODE
        OUT      /AND OUTPUT IT TO THE INTERFACE
        125
        INRD     /INCREMENT THE DIGIT ENABLE
INTENS, MVIE     /LOAD E WITH A NUMBER
        200      /200 = HEX 80 = DECIMAL 128
INTEN1, DCRE     /DECREMENT THE NUMBER
        JNZ      /IF IT IS NON-ZERO, EXECUTE THE
        INTEN1   /JNZ INSTRUCTION BACK TO INTEN1
        0
        RET      /WHEN E = 0, RETURN

BINSS,  077      /SEVEN-SEGMENT CODE FOR 0
        006      /SEVEN-SEGMENT CODE FOR 1
        133      /SEVEN-SEGMENT CODE FOR 2
        117      /SEVEN-SEGMENT CODE FOR 3
        146      /SEVEN-SEGMENT CODE FOR 4
        155      /SEVEN-SEGMENT CODE FOR 5
        174      /SEVEN-SEGMENT CODE FOR 6
        007      /SEVEN-SEGMENT CODE FOR 7
        177      /SEVEN-SEGMENT CODE FOR 8
        147      /SEVEN-SEGMENT CODE FOR 9
        000      /SEVEN-SEGMENT CODE FOR 10
        000      /SEVEN-SEGMENT CODE FOR 11
        000      /SEVEN-SEGMENT CODE FOR 12
        000      /SEVEN-SEGMENT CODE FOR 13
        000      /SEVEN-SEGMENT CODE FOR 14
        000      /SEVEN-SEGMENT CODE FOR 15
```

Fig. 5. Using a look-up table with the multiplexed LED display.

the number and the result output. After incrementing the digit enable code to two, the 8080 again executes the INTENS delay loop, so that the three on the second digit from the right is displayed for a reasonable amount of time. When the RET instruction is executed, the 8080 returns to the INXH instruction just before DISPL1.

The 8080 increments the memory address in register pair H and then examines the digit enable code contained in the D register. If this code is less than 012 (decimal 10), the 8080 jumps back to DISPL1 so that the two BCD digits now addressed by register pair H are displayed. If the digit enable code is equal to 012, then all ten digits in the number have been displayed. If this is the case, the 8080 jumps back to DISPLA so that the memory address in register pair H and the digit enable code in the D register are re-initialized.

As you can see from this program, the 8080 is constantly updating (writing new information out to the interface) the display. New digit enable codes and data values are output to the display every millisecond.

Unfortunately, this "ties up" the microcomputer and it cannot perform any other tasks. Of course, the program listed in Fig. 4 could be converted to a subroutine. If it is called every 15 or 20 ms, the 10-digit number will still be displayed at a reasonably fast rate. However, it may be difficult to program the microcomputer so that the DISPLA subroutine is called this often.

One solution to this problem is to use an interrupt. This means that whenever the 8080 is interrupted, it outputs a numeric value to the next consecutive digit in the display. The microcomputer will have to be interrupted at least 400 times every second for the display not to "flicker." This means that our 10-digit number will be displayed 40 times every second. To interrupt the 8080 so that it "services" the display this frequently, a low frequency oscillator (400 Hz) can be wired to one of the interrupt interfaces previously discussed.[2,3]

The program that services the interrupt and outputs a new eight-bit value to the display interface is very similar to the software in Fig. 3. Because of its length, we have not included a listing of it. The only difference between the two programs is that the 8080 has to store the digit enable code and the address of the memory location that contains the next digit to be displayed. These values must be stored in memory, because register pair H and the D register may be used by the program that was interrupted. Therefore, each time the oscillator interrupts the microcomputer, it has to read from memory the address for the next digit to be displayed and its corresponding digit enable code. After the number is displayed, the digit enable code and the memory address have to be incremented and stored back in memory. To keep this software as simple as possible, it is easiest to store the 10-digit number in ten memory locations, one digit per memory location, rather than "packing" the BCD data.

One feature of our interface that we have not mentioned is the fact that we are limited by the DS8857 to display only the numbers 0 through 9. This device cannot be used if we wish to display the letters A through F, as is often the case if hexadecimal numbers or message codes need to be displayed. To display the hexadecimal characters 0-9 and A-F, the DS8857 must be replaced by a device that can be used to drive individual segments in any combination we desire. The UDN-2981A (Sprague Electric Company, Worcester MA) contains eight individual drivers that can be used in the display interface. This device has eight inputs and eight outputs—each input is interfaced to an individual data bus line by means of a latch circuit and each output is wired through a current-limiting resistor to one of the segment inputs of the display (A-G). If desired, the last driver in the integrated circuit can be used to drive the decimal point in the display. Since the UDN-2981A has eight inputs, an eight-bit output port (latch) will have to be used to interface it to the microcomputer. This means that one output port will be used to output the sequence of ones and zeroes that specifies a specific sequence of segments to be turned on or off. A four-bit output port is also required so that the digit enable code can be output and stored in the interface.

In Fig. 5, there is a look-up table used for converting BCD numbers to seven-segment codes.

The first difference between the programs listed in Figs. 4 and 5 can be seen at DIGIT. After the packed BCD word is moved from memory to the A register, the OUTIT subroutine is called. This means that the first BCD digit to be displayed is in bits D3 through D0 of the A register. At OUTIT, bits D7 through D4 of the A register are set to zero. The content of register pair H is then saved on the stack and register pair H is loaded with the base address of the look-up table. The BCD number in the A register is added to this address. The MVIA and OUT instructions at OKASIS cause the display to be blanked by writing an invalid digit enable code out to the display interface. While the display is blanked, the 8080 moves the bit pattern for the number to be displayed from memory to the A register (MOVAM). Register pair H is then popped off the stack and the seven-segment bit pattern is output to output port 126. The A register is then loaded with the digit enable code which is output to output port 125. When the OUT 125 instruction is executed, the specified digit in the display is turned on. The 8080 executes an intensifying time delay loop before returning to the MOVAM instruction just after DIGIT.

The MOVAM instruction loads the A register with the same packed BCD word that contained the previously displayed digit. However, the BCD digit in bits D7 through D4 must now be displayed. Therefore, bits D7 through D4 are rotated into bits D3 through D0 of the A register before the 8080 executes the instructions at OUTIT which cause the required bit pattern for the seven-segment display to be fetched from the look-up table. The bit pattern followed by a digit enable code is then output to the interface. The remaining instructions in Fig. 5 are the same as the instructions in Fig. 4.

One advantage of using seven or eight individual segment drivers is that you can display any combination of segments that you want. You are no longer limited to the numbers 0-9. If desired, you can display the letters A-F so that hexadecimal numbers can be displayed. For some special applications, some additional letters and words can be displayed, such as H, r, L, o, OIL, HELP, Error, etc.

There is one additional display method that we have not discussed—the use of an external display controller integrated circuit to control the multiplexed display. The Intel Corporation makes a number of these integrated circuits that are compatible with the 4004/4040, 8080, and 8085. These are the 4269, 8279, and 8279-5 integrated circuits. National Semiconductor Corporation also has two display controller integrated circuits that can be used with six-digit displays. One of the devices (MM74C912) can be used to display 0-9 and the other (MM74C917) can be used to display hexadecimal numbers. For additional hardware and software information about multiplexed LED displays, we refer you to reference 4.

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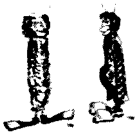

Ham Help

I need an operator's manual and schematic for a BC-1031 panoramic adapter. I will gladly pay for all copying and postage.

Chuck Holstein WD5CUG
4721 Lucy Dr.
El Paso TX 79924

I would like to copy or purchase the manual and/or schematic for the Multi-Elmac AF-67 transmitter and power supply. Can anyone help? Thanks.

Al Christman WD8CBJ
Box 44
Granville WV 26534

I have some older VHF equipment that utilizes electron tubes (remember those things?). Anyway, there doesn't appear to be a ready market for the tubes I need and I can't find a distributor who sells them.

If anyone has one or more tubes I list below, I would appreciate hearing from them, particularly those having the 6850. The tubes I need are: 5696, 5718, 5896, 5899, 5902, 5940, 6021, 6112, and 6850. Many thanks.

Bill Walston KB5GD
Drawer 1418
Rockport TX 78382

Does anyone have a Geiger counter in good working condition reasonably priced? Please send me the particulars.

Leroy Lawmaster W5HOM
Rt. 1 Oak Hill
Westville OK 74965

DX

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clerk.

Although the story seems to be changing daily, it now appears that the DXCC desk will not accept TH8JM cards for credit. If you need this one, you will probably have to work John again when he gets his true-blue TL8 license.

TR8AC and TR8GDC recently moved to Alexandria, Egypt, and should be heard signing SU any day.

Anyone needing confirmation for an ET3FMA/9E3FMA/9F3FMA contact from 1965 to 1968 can send an SASE to Don Murray W4WJ, 19700 NW 5 Ct., Miami FL 33169.

ON4UN recently worked CR9AJ on 75 meters to complete his 5BWAZ. Five more QSLs and it will be confirmed. 5BWAZ is easily the most difficult operating award to obtain in all of hamdom.

The correct route for ZS2MI QSLs is WA2IEN, 255 Route 17, Upper Saddle River NJ 07458.

C5ABK has reportedly received permission to operate in CR3 Guinea-Bissau for two weeks in December. He is presently assembling the necessary equipment to make the operation a success and plans to open up on December 1st. QSL to G3LQP.

If you worked HV3SJ on November 11/12 and had your QSL bounced by W6KNH, try again. Logs for that period disappeared for awhile, but now they are safely in the hands of W6KNH, all 45 pages.

As we mentioned last month, several of the deserving were surprised last June when they received a citation from the FCC for contacting HS stations in Thailand. The citation stated that Thailand was on the banned countries list. Those responding received a follow-up form letter from the FCC saying only that in view of the reply, the matter was being closed. Apparently, no form letter exists for apologizing and admitting an error.

The Panamanian government has confirmed to the ARRL that HP9 callsigns have never been issued for use on amateur bands. Communication of any type with stations signing HP9 is illegal.

VR6TC has recently acquired some SSTV gear and has been showing regularly on 14233 kHz from 0530Z. QSL to W6HS.

All KZ5 Canal Zone licenses expire September 30, 1979.

9M2FK reports needing Arkansas, Utah, North Dakota, and South Dakota for WAS and Zone 2 for WAZ. Look for him on 14020 kHz between 1000Z and 1300Z.

Those of you involved in the DX net and/or DX list business should keep in mind that it is possible to violate third-party traffic regulations when passing a list to a DX station. If you compile a list and pass it directly to a station in a non-third-party country, then you could be in violation. If you say "DX1DX call W5USA," then you are in violation. The correct way would be to say "W5USA call DX1DX." If you think this is just nit-picking, then be advised that some FCC monitoring types are on the prowl for just such violations.

Jim Smith P29JS finally received an answer from the Indian government concerning his application for permission to operate from Andaman. Unfortunately, the letter stated that new rules beginning in January, 1979, made it impossible to grant licenses for short stays.

Rumors floated hot and heavy that XZ2P was SP5AUC and that his was a true-blue operation. Unfortunately, the real SP5AUC denied the rumor and that sort of ended that.

While in Poland, we might mention that Polish amateurs are now allowed to work 160 meters between 1750 kHz and 1950 kHz. Maximum power is 10 Watts.

New officers of Murphy's Marauders include Al Meleg N1JW—President, Ron Grzelak K1BW—Vice President, Dan Street K1TO—Activities Manager, and Ron Nevers K1TVM—Secretary/Treasurer. Newsletter editor is Ed Kalin K1RT.

WA1SQB ran off better than 5000 contacts during his HC8 operation in March. He should be setting up in Montserrat this month where he will be signing either VP2MAY or VP2MI.

Last month we mentioned that sending currency through the mails to foreign hams could bring trouble to the recipient. If you are in doubt as to which countries can receive USA currency in the mails, ask your local post office to check through the Foreign Postal Manual for the country in question. Any illegal items are listed in this manual.

If you've worked everything else, then you might try for all the cities and districts in Japan. A full list can be obtained by sending 14 IRCs or $8.00 to Michio Koshimizu JR1BFT, 37-3, Nakano, 1-chome, Nakano-ku, Tokyo 164, Japan.

Tom Wong VE7BC recently returned from a business trip to China. While he was there, he inquired into the possibility of obtaining an operating permit for a future visit. Tom says that the current policy of the Central Government is that there will be no amateur radio operation. It seems that there will probably have to be some top-level changes made before any legitimate operation occurs. Tom feels, however, that this is entirely possible, and with the great interest in amateur radio, something might develop before the end of the year. The feeling still runs strong that when a legitimate operation does surface, it will be by the Chinese themselves and not a group of war-mongering, imperialist, running-dog lackeys, or whomever. Keep the faith.

That Soviet ski team that was signing U0CR successfully reached the North Pole last July.

ZS5DC is Diane Cardell, formerly VQ9DC, now living in Durban. Diane was in on the big Desroches effort by VQ9D, VQ9BP, and others back in 1974.

That HB9APN/BY operation a few months back did not have official approval and is not being accepted for DXCC credit.

Several "goodies" have been checking into the WA2JUQ Net on 14240 kHz. Heard recently were TA1MB, YI1BGD, FH8YL, and ZS2MI on Marion Island. The time to listen is around 0630Z.

Another net to watch is the DX-DX Net on 21280 kHz. Listen from 1600Z.

Vendaland is the third of the nine African homelands being established by South Africa, the first two being S8 Transkei and H5 Bophuthatswana. Independence day is set for September 13 and several ZS types plan to be there for the unveiling. ZS6AK and ZS6ABO will head a contingent of eight Durban DXers planning to make the 200-mile trip. DXCC status is expected to be the same as Transkei and Bophuthatswana, that is, no decision until after WARC 79 and then a favorable decision made retroactive back to the date of independence.

JF1IST/7J showed on schedule from Okino Torishima with a very good signal to most of the states. The one-man effort opened up on June 11th and ran through June 15th with WB8LDH the last station logged at 0653Z. Weather conditions cut short the expected ten-day stay, but some 5500 contacts were made on 6 through 40 meters. QSL to JA1RNH, Itaru Tomita, 1-2-9, Zaimokuza, Kamakura, 248 Japan.

This is the month (September) the ARRL begins accepting Desecheo QSLs for DXCC credit.

Reports have all 7Q7 stations being shut down and their equipment confiscated.

Slim showed from 3Y6CD in June and from 9A1VU earlier in the year.

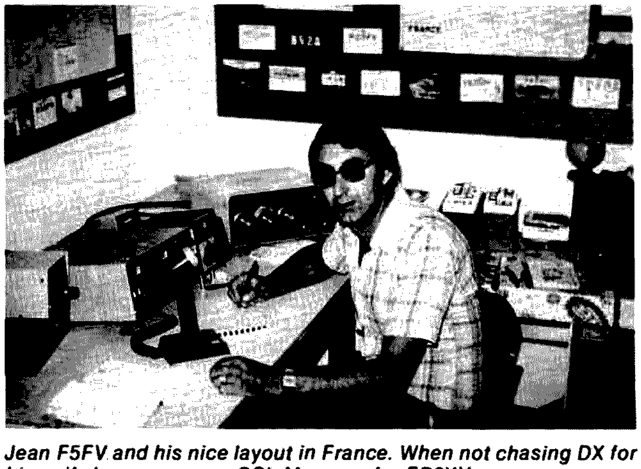
The correct route for all FH8OM/YL QSLs is to Box 86, Dzazoudi, 97600 Mayotte . . . via France.

The Guatemalan Radio Society indicates that TG7AA was Slim and the ARRL is returning the cards without allowing DXCC credit.

There is a multi-national effort being planned for a fifteen-day operation from 3V8 Tunisia this month. Amateurs from France, Italy, and the UK will man as many as ten different stations.

UHF marine-band applicants are being asked to make up their own callsigns until the overworked FCC can get their applications processed and the regular type licenses in the mail.

If you paid more than $20.00 to the FCC between August 1, 1970, and December 31, 1976, you are eligible for a refund. If you are eligible, then you



Jean F5FV and his nice layout in France. When not chasing DX for himself, Jean serves as QSL Manager for FB8XV.

should obtain a copy of the "Phase One Fee Refund Program" instruction and form manual from your nearest FCC field office or Federal Information Center. Check the June *QST* for more information.

Remember that EI8H/anything is always Slim and you will save time and money.

Bill KA2WG writes to remind us all that even though KA stations are not recognized as amateur stations by the Japanese government, they still count as Japan for everything except the All Asia Contest. Any US ham being transferred to Japan or Okinawa as US military or a civilian employee of the military is eligible to obtain a KA license. For more information, contact FEARL, c/o Sam Flemming, USAGH D/O, APO SF 96343.

That's about it for this month. I hope some of the information provided here will help you pick up a few new ones. If it does, let me know. In the meantime, don't forget we are always looking for DX info and pictures. Any pictures you send us can be returned if you wish. In the meantime, best DX and health.

Thanks as always to the *West Coast DX Bulletin*, LIDXA *Newsletter*, and *WorldRadio Magazine* for much of the preceding information.

Looking West

from page 10

USER RIGHTS

Question: What rights, if any, do repeater users have when being repeated through the station of another amateur? This is a question being fiercely debated in southern California and elsewhere. It recently surfaced here in Los Angeles when one of the control operators on the WA6KOS/R system turned the repeater off on a system user because of the "content of communications." The operator in question yelled "censorship" and the controversy ensued.

One group feels that the system owner, licensee, or control station does not have the right to turn off the repeater for any reason other than a technical malfunction, and that the repeater is akin to a public utility and therefore must be kept on the air regardless of what is repeated. This group feels that the total responsibility for "content of communications" rests with the individual system user, and the use of jamming, music, and even profanity is left to his discretion. To turn a repeater off under these circumstances is an act of censorship against the originating station.

The other side yells "wrong!" The FCC rules clearly state that an amateur station may not transmit profanity, unidentified signals, or music, and that a repeater does constitute an amateur station. Therefore, not only do the system licensee and control operators have a right to terminate system operation in such circumstances as outlined above, but under the terms of Parts 97.113, 97.115, 97.116, 97.119, 97.123, and 97.125 of the FCC Rules and Regulations, they are directly *obligated* to take such action. To do otherwise directly violates FCC rules. This group also feels that once an amateur decides to operate through a repeater, he is, in effect, operating through the station of another amateur. Therefore, when operating through a repeater, the user gives up any First Amendment rights and is totally subject to the will of the system owner/licensee. Whatever standards, guidelines, and regulations the *licensee* sets for user operation must be adhered to without question.

Where do we find the answers? Part 97? Have any of you read Part 97 lately? The FCC regulations, in relation to repeater operation, are too ambiguous. For that reason, I have written a letter to the FCC asking direct questions about repeater operation, regulatory enforcement, and other related matters. The letter was written on June 19, 1979, and was mailed to the FCC on June 23rd. It is presented below for your information. If received, the FCC's response will also be presented in this column.

Federal Communications Commission
M Street
Washington DC
Attn: Personal Communications Division

Gentlemen:

I wish to ask some specific questions in regard to Part 97 of the Amateur Rules and Regulations, concerning amateur repeater operation.

1) Who is responsible for "content of communications," the system licensee or the system user?

2) If a repeater system owner permits profanity and unidentified transmissions to be "repeated" via his repeater system (while his system is operational under fully automatic remote control), is he legally responsible for the content of such communications? Can he legally censor such communications? Should he?

3) Does the FCC hold any one person legally responsible for "content of communications" and all other aspects of amateur repeater operation?

4) What constitutes an operational amateur repeater—an established repeater, known to the community, or a repeater system that happens to be operating at any given moment?

5) If an established amateur repeater is resting between transmissions and another amateur decides to operate during that time, is the established amateur guilty of jamming when he operates once again, or is the new operator considered responsible for the subsequent jamming?

6) If the conduct of any amateur is considered by his peers to be obnoxious, although he may be technically operating within the regulations of Part 97, can the amateur community, through the Commission, take any legal action to stop said amateur?

7) Why is the Commission unwilling to heed the calls for help from amateurs who are suffering the outrage of willful and malicious interference on both high frequency SSB and VHF FM repeater operations?

8) Is the Commission willing to enforce the terms of Part 97 of the Amateur Rules and Regulations regarding profanity and unidentified transmissions (97.116, 97.119, and 97.123)? If not, why not?

9) Why hasn't the Commission acted to suspend or revoke the amateur license of one Scott Lookholder WB6LHB? He was convicted in federal court on a charge of using foul and abusive language on the two-meter amateur band. I have copies of letters sent to the Commission by southern California amateurs requesting such action. Does the Commission intend to act in this matter?

10) What action can we amateurs take to rid the community of the individuals who, licensed or unlicensed, willfully and maliciously jam, harass, and intimidate the law-abiding amateur's day-to-day operation? Would the Commission be willing to act if supplied documentation of such violations? Exactly what type of documentation does the Commission require before acting on such reported violations?

11) If I challenge the right of another amateur to hold an amateur's license because he operates his amateur station in violation of the regulations as set forth in Part 97, what possible Commission action can be taken? Must I file a formal challenge with your office?

12) Please define the following (using specific examples) as they relate to our subject:

A) willful and malicious interference

B) unidentified transmissions

C) profanity and indecency

I intend to publish this letter—and your response—in my "Looking West" column. Many amateur repeaters are suffering tremendous willful and malicious interference problems, and it is my hope to help guide them toward a solution. Your response to these questions will be appreciated.

Yours truly,
William M. Pasternak

I wish to credit WB2MIC for arousing my interest in this subject. In the June issue of *73*, a letter appeared from Jozef which relates directly to the situation out here. Jozef felt that he was treated unfairly by a repeater licensee who may have arbitrarily censored him. I must state my personal belief that, while I may not agree with arbitrary censorship by control operators and system licensees in certain situations, these people are clearly within their rights when they choose to censor. While you and I may not want to adhere to these standards, we are obligated to do so because we really have no alternative. I remember being told by one amateur that he felt he was a "god" by virtue of the fact that he owned and operated his own repeater. If he demanded that his users "paint their radios with red stripes and operate only while standing on their heads," they had better adhere to his dictates "or else." He had absolutely no compunction whatsoever about turning off his repeater if someone even "sneezed the wrong way." He was clearly "the boss."

It sounds absurd, but that's the way he felt. Having never operated through his system, I cannot tell you how tight a ship he really runs. Jozef and many others are unhappy with this unresolved situation. The problem is spreading. Only the FCC can make a final determination of this matter, and we await their answer.

HANDLING MALICIOUS INTERFERENCE DEPARTMENT

A few months ago, "Looking West" ran a series of articles on the problem of how to deal with malicious interference. While the amount of response to my questions has not been overwhelming, I have received a few letters. Over the next few months, I hope to bring you some of my respondents' views.

The following letter appeared in the June issue of the Mt. Lee (CA) Repeater Association *Newsletter* and is relevant to our discussion:

The jammers must be getting quite a laugh out of repeater users and owners these days, because a lot of us are so easy to bait.

A jammer with nothing better to do will figure out someone's weakness and rub that person the wrong way. Often this jamming is legal, because the one doing the jamming is a ham and uses proper prodecure. The jammer, by manipulating the right people with the right words, can tie up a repeater with hours of counter-jamming, shouting matches, and arguments. Former "good guy" hams, when baited and sufficiently angered, may resort to counter-jamming the original troublemaker. The jammer's gotten what he wants: People have taken his bait. A good example of this might be the licensed ham who uses CW on a repeater. He uses correct procedure, callsigns, and breaks properly, but may be trying to bait a response. CW, RTTY, and SSTV are legal on repeaters if mode and bandwidth rules are obeyed. Instead of reacting with hostility, come back with perfect *F1* 30-wpm telegraphy! What rubs *you* the wrong way? Do *you* fall for the bait?

Some of us feel that high power is

the solution to jamming. Boy, it feels good to talk right over the twerp with your 150 Watts and listen to the capture effect on your duplex! Secretly, you probably hope the jammer also has duplex so that he can hear his puny signal get stomped. Although this is satisfying, it creates problems. With 150 Watts versus the 2 Watts of the jammer, the DF committee will have a hard time hearing the jammer. Many jammers don't care if they are Q-5 into a repeater or not, because they get their jollies causing discomfort to other hams.

"Sorry OM ... no copy ... you're being jammed ... 73." You, the legitimate ham, have just succumbed to a psychological defeat from the jammer. The jammer is laughing at you. Try to sign off gracefully, if you're not succeeding. Don't give him his kicks by going QSY or QRT. Try to draw the jammer out the same way he baits us. Bait the jammer, legally ... don't talk *to* him, talk *about* him to another ham. Don't get into jamming him. Instead, go to low power and allow plenty of time for breaks. It's unpleasant to hear one of these clowns and you may want to "cover" him, but be sure to leave a space for the DF committee to listen in. While drawing out a jammer, it is important not to act as he does. It's easy to get mad and jam the jammer. Aren't we better than that?

Most of us have a local repeater ... a machine we like to hang out on, meet our friends, etc. It is hard to break away from a favorite machine and go somewhere else. We are loyal to the repeater or club to which we belong. When most of us get mad at a jammer, we want to make our stand on our own machine. When the jammer is forced off our repeater or decides to hassle another group, we tend to become temporarily apathetic about our common problem.

Jammers have knobs on *their* radios, although it seems some hams don't ... and these hams should be helping the ham community by following the jammer around the dial. All repeater users should get some sense of community and try to pool personnel and equipment to beat this thing. We must be able to continue the hunt even if the jammers have left "our" repeater and moved to another. The jammers seem secure in knowing that they can change frequencies without other repeater groups following.

DFers already know what to do, and the average user can also help. When the carriers or cursing start, listen to the input to the repeater. Normally, your radio is set so that you are transmitting on 147.84 MHz (the input) and receiving on 147.24 MHz (the output). Reverse this setup, or at least find a way to listen on 147.84. (Transmitting on 147.24 is not necessary.) Now, check your S-meter; is the needle 25% over from 0? 80%? 100%? Break with your call, QTH, cross-streets, time of day, and date, and tell the "woodwork" what % reading you have. See if any other breakers would like to give their reports. (We use % of signal instead of S-units because S-meters are not standard or accurate.)

Let's hope we can end apathy on the airwaves and pool our resources. After all, the jamming is only a by-product of our apathy. The problems on repeaters affect us all, and high-power amps, private systems, and 800-channel radios are not adequate solutions to our common problem.

73,
An Interested User

Review

TELEVISION HANDBOOK FOR THE AMATEUR

A large number of hams are professionals in the field of commercial television. Their daily involvement in the world of video gives them a headstart in understanding and operating a fast scan television station. The rest of the population shouldn't be discouraged, though. The book, *Television Handbook for the Amateur*, is a real help in bridging the gap between beginner and pro.

Television Handbook is published by Aptron Laboratories and a paperback edition costs $6.50. The author, Biagio Presti, is not a ham, but as president of Aptron, he is familiar with amateur television efforts. The first two-thirds of the book is devoted to theory, while the remaining 30 pages discuss construction projects and include tables dealing with radio transmission and television standards.

By minimizing the use of mathematics and including numerous illustrations, the author is able to make the theory chapters down to earth and very understandable. The circuits used to generate a video signal are thoroughly described. To get the most benefit from these chapters, the reader should have a good background in basic transistor circuit design. If you are studying for an Extra class license, the *Television Handbook* may be helpful. Questions concerning television theory appear on some versions of the exam.

There is an abundance of information about special circuits that won't be found in the usual amateur references. Color television may be more of a dream than a reality for most beginning ATVers, but the reader's appetite is whetted by a short summary of the principles involved. The contents of these chapters will be of interest long after your first ATV QSO.

The construction chapters are similar to the theory section. The sub circuits that comprise 450-MHz transmitters and receivers are tackled individually. It is not like the wire-by-wire description frequently found in some ham publications. There is adequate information for the experienced home-brewer. As a bonus, you will have a good understanding of the theory behind the design.

The recent appearance of commercial equipment and beginner-oriented literature has helped to put fast scan television within the reach of many hams. *Television Handbook for the Amateur* does not give complete coverage of the subject, but for a ham who aspires to be more than an appliance operator, it is bound to be useful.

Tim Daniel N8RK/1
Peterborough NH

OSCAR Orbits

Courtesy of AMSAT

The listed data tells you the time and place that OSCAR 7 and OSCAR 8 cross the equator in an ascending orbit for the first time each day. To calculate successive OSCAR 7 orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the day's first ascending (northbound) equatorial crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world from you, it will descend over you. To find the equatorial descending longitude, subtract 166° from the ascending longitude. To find the time OSCAR 7 passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR 7 when it is within 45 degrees of you. The easiest way to determine if OSCAR is above the horizon (and thus within range) at your location is to take a globe and draw a circle with a radius of 2450 miles (4000 kilometers) from your QTH. If OSCAR passes above that circle, you should be able to hear it. If it passes right overhead, you should hear it for about 24 minutes total. OSCAR 7 will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15° east or west of you, add another minute; at 30°, three minutes; at 45°, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

OSCAR 8 calculations are similar to those for OSCAR 7, with some important exceptions. Instead of making 13 orbits each day, OSCAR 8 makes 14 orbits during each 24-hour period. The orbital period of OSCAR 8 is therefore somewhat shorter: 103 minutes.

To calculate successive OSCAR 8 orbits, make a list of the first orbit number (from the OSCAR 8 chart) and the next thirteen orbits for that day. List the time of the first orbit. Each successive orbit is then 103 minutes later. The chart gives the longitude of the day's first ascending equatorial crossing. Add 26° for each succeeding orbit. To find the time OSCAR 8 passes the North Pole, add 26 minutes to the time it crosses the equator. OSCAR 8 will cross the imaginary San Francisco-to-Norfolk line about 11 minutes after crossing the equator. Mode A: 145.85-.95 MHz uplink, 29.4-29.50 MHz downlink, beacon at 29.40 MHz. Mode J: 145.90-146.00 MHz uplink, 435.20-435.10 MHz downlink, beacon on 435.090 MHz.

OSCAR 7 Orbital Information

Orbit	Date (Sep)	Time (GMT)	Longitude of Eq. Crossing °W
21928	1	0053:46	78.5
21941	2	0148:03	92.1
21953qrp	3	0047:23	76.9
21966	4	0141:40	90.5
21978X	5	0041:00	75.4
21991	6	0135:17	89.0
22003	7	0034:38	73.8
22016	8	0128:55	87.4
22028	9	0028:15	72.3
22041qrp	10	0122:32	85.9
22053	11	0021:52	70.7
22066X	12	0116:09	84.3
22078	13	0015:29	69.1
22091	14	0109:46	82.7
22103	15	0009:06	67.6
22116	16	0103:23	81.2
22128qrp	17	0002:44	66.0
22141	18	0057:00	79.6
22154X	19	0151:17	93.2
22166	20	0050:38	78.1
22179	21	0144:55	91.7
22191	22	0044:15	76.5
22204	23	0138:32	90.1
22216qrp	24	0037:52	75.0
22229	25	0132:09	88.5
22241X	26	0031:29	73.4
22254	27	0125:46	87.0
22266	28	0025:06	71.8
22279	29	0119:23	85.4
22291	30	0018:44	70.3

OSCAR 8 Orbital Information

Orbit	Date (Sep)	Time (GMT)	Longitude of Eq. Crossing °W
7593Jbn	1	0056:12	60.0
7607Jbn	2	0101:22	61.3
7621Abn	3	0106:31	62.6
7635Abn	4	0111:41	63.9
7649X	5	0116:50	65.2
7663Abn	6	0122:00	66.5
7677Abn	7	0127:09	67.8
7691Jbn	8	0132:19	69.1
7705Jbn	9	0137:28	70.4
7719Abn	10	0142:38	71.7
7732Abn	11	0004:33	47.2
7746X	12	0009:43	48.5
7760Abn	13	0014:52	49.8
7774Abn	14	0020:02	51.2
7788Jbn	15	0025:11	52.5
7802Jbn	16	0030:20	53.8
7816Abn	17	0035:30	55.1
7830Abn	18	0040:39	56.4
7844X	19	0045:48	57.7
7858Abn	20	0050:58	59.0
7872Abn	21	0056:07	60.3
7886Jbn	22	0101:16	61.6
7900Jbn	23	0106:26	62.9
7914Abn	24	0111:35	64.2
7928Abn	25	0116:44	65.5
7942X	26	0121:53	66.8
7956Abn	27	0127:03	68.1
7970Abn	28	0132:12	69.4
7984Jbn	29	0137:21	70.7
7998Jbn	30	0142:30	72.0

Awards

from page 28

SOUTH AMERICA

CE	Chile
CE0A	Easter Is.
CE9X	San Felix
CE0Z	Juan Fernandez
CP	Bolivia
CX	Uruguay
FY	French Guiana
HC	Ecuador
HC8	Galapagos Is.
HK	Colombia
HK0	Bajo Nuevo
HK0	Malpelo Is.
HK0	San Andres & Providencia
HP	Panama
HR	Honduras
HR9	Swan Is.
KZ	Canal Zone
LU	Argentina
OA	Peru
PJ	Bonaire
PJ	Netherlands Antilles
PY	Brazil
PY0	Fernando de Noronha
PY0	St. Peter & St. Paul
PY0	Trinidade & Martim Vaz Is.
PZ	Surinam
TG	Guatemala
TI	Costa Rica
TI9	Cocos Is.
VP1	Belize
VP8	Falkland Is.
VP8, LU	South Georgia Is.
VP8, LU	South Orkney Is.
VP8, LU	South Sandwich Is.
VP8, LU	South Shetland Is.
VP8W	South Grahamland
YN	Nicaragua
YS	Salvador
YV	Venezuela
YV0	Aves Is.
ZP	Paraguay
8R	Guyana
9Y	Trinidad and Tobago

EUROPE

C3	Andorra
CT	Portugal
CT2	Azores
DA-DL	Federal Republic of Germany
DM, DT	German Democratic Republic
EA	Spain
EA6	Balearic Islands
EI	Republic of Ireland
EJ0	Aran Is.
F	France
FC	Corsica
G	England
GD	Isle of Man
GI	Northern Ireland
GJ, GC	Jersey
GM	Scotland
GM	Orkney Islands
GM	Shetland Islands
GU, GC	Guernsey
GW	Wales
HA	Hungary
HB	Switzerland
HB0	Liechtenstein
HV	Vatican
I	Italy
IC	Ischia
IA	Tuscan Archipelago
IS	Sardinia
IT	Sicily
JW	Bear Is.
JW	Svalbard Is.
JX	Jan Mayan
LA	Norway
LX	Luxembourg
LZ	Bulgaria
M1	San Marino
OE	Austria
OH	Finland
OH0	Aland Is.
OJ0	Market Reef
OK	Czechoslovakia
ON	Belgium
OY	Faeroe Islands
OZ	Denmark
PA	Netherlands
SM	Sweden
SP	Poland
SV	Greece
SV	Crete
SV	Dodecanese
SV	Mount Athos
TF	Iceland
UA, UK1, 3, 4, 6	European RSFSR
UA1, UK1	Franz Josef Land
UA2, UK2F	Kaliningradsk
UB, UK, UT, UY5	Ukraine
UC2, UK2	White RSFSR
UO5, UK5O	Moldavia
UP2, UK2B, P	Lithuania
UQ2, UK2G, Q	Latvia
UR2, UK2R, T	Estonia
YO	Romania
YU	Yugoslavia
ZA	Albania
ZB	Gibraltar
3A	Monaco
4U	ITU, Geneva
9A	(See M1)

ASIA

A4X	Oman Is.
A5	Bhutan
A6X	United Arab Emirates
A7X	Qatar
A9X	Bahrain
AP	Pakistan
BV	Taiwan
BY	China
CR9	Macao
EP	Iran
HL, HM	North Korea
HL, HM	South Korea
HS	Thailand
HZ, 7Z	Saudi Arabia
JA-JR	Japan
JR6, KA6	Okinawa (Ryukyu Is.)
JD, KA1	Ogasawara
JT	Mongolia
JY	Jordan
KA	US Military in Japan
OD	Lebanon
S2	Bangladesh
TA	Turkey
UA, UK, UV, UW9-0	Asiatic RSFSR
UD6, UK6C, D, K	Azerbaidzhan
UF6, UK6F, O, Q, V	Georgia
UG6, UK6G	Armenia
UH8, UK8H	Turkoman
UI8, UK8I	Uzbek
UJ8, UK8J, R	Tadzhik
UL7, UK7	Kazakh
UM8, UK8M, N	Kirghiz
VS6	Hong Kong
VS9K	Kamaran Is.
VU	India
VU7	Andaman & Nicobar
VU7	Laccadives
XU	Khmer Republic
XV	Vietnam
XW	Laos People's Dem. Rep.
XZ	Burma
YA	Afghanistan
YI	Iraq
YK	Syria
1S	Spratly
4S	Sri Lanka
4X, 4Z	Israel
5B4, ZC	Cyprus
8Z4	Neutral Zone Saudi Arabia/Iraq
9H	Malta
9H4	Gozo & Comino
9K	Kuwait
9M2	West Malaysia
9M6	North Borneo
9M8	Sarawak
9N	Nepal
9V	Singapore
	Abu Ail, Jabal Attair

OCEANIA

A3	Tonga Republic
CR8	Portuguese Timor
C2	Republic of Nauru
DU	Philippines
FK	New Caledonia
FO	French Polynesia
FW	Wallis & Fortune Islands
H4, VR4	Solomon Islands
JD, KA1	Minami Torishima
JD, 7J1	Okino Torishima
KB, KH1	Baker, Howland, American Phoenix
KC6	Eastern Carolines
KC6	Western Carolines
KG6, KH2	Guam Island
KG6R	Rota
KG6S	Saipan
KG6T	Tinian
KH6	Hawaiian Islands
KH7	Kure Island
KJ, KH3	Johnston Island
KM, KH4	Midway Island
KP6, KH5K	Kingman Reef
KP6, KH5	Palmyra
KS6, KH8	American Samoa
KW, KH9	Wake Island
KX	Marshall Islands
P2	Papua, New Guinea
T2, VR8	Tuvalu Island
VK	Australia
VK	Lord Howe Island
VK9	Willis Island
VK9	Christmas Island
VK9	Keeling, Cocos Island
VK9	Mellish Reef
VK9	Norfolk Island
VK0	Macquarie Island
VR1	British Phoenix Islands
VR1	Gilbert Island
VR1	Ocean Island
VR3	Christmas Island
VR6	Pitcairn Island
VR7	Line Island, South and Central
VR8	(See T2)
VS5	Brunei
YB, YC, YD	Borneo
YB, YC, YD	Celebes
YB, YC, YD	Java
YB, YC, YD	Sumatra
YB, YC, YD	West Irian
YJ	New Hebrides
ZK1	North Cook Island
ZK1	South Cook Island
ZK2	Niue Island
ZL	New Zealand
ZL	Auckland & Campbell
ZL	Chatham Island
ZL	Kermadec
ZM7	Tokelaos
3D2	Fiji Islands
5W	Western Samoa

AFRICA

A2	Botswana
C5	Gambia
C9	Mozambique
CN	Morocco
CN2	Tangier
CR3	Guinea Bissau
CT3	Madeira Is.
D2, 3	Angola
D4	Republic of Cape Verde
D6	Comoros
EA8	Canary Islands
EA9	Ceuta and Melilla
EA9	Ifni
EA9	Rio de Oro
EL	Liberia
ET2	Eritrea
ET3	Ethiopia
FB8W	Crozet
FB8X	Kerguelen Is.
FB8Z	Amsterdam & St. Paul
FH	Mayotte
FR	Glorioso Island
FR	Juan de Nova, Europa
FR	Reunion
FR	Tromelin
H5	Bophuthatswana
IG	Lampedusa Island
IH	Pantelleria Island
J2, FL8	Djibouti
S7	Seychelles
S8	Transkei
S9	Sao Tome and Principe
ST	Sudan
ST0	South Sudan
SU	Egypt
TJ	Cameroon
TL	Central African Empire
TN	Congo
TR	Gabon
TT	Chad
TU	Ivory Coast
TY	Benin
TZ	Mali
VK0	Heard Island
VQ9	Aldabra Island
VQ9	Chagos (Diego Garcia)
VQ9	Desroches
VQ9	Farquhar
XT	Upper Volta
ZD7	St. Helena
ZD8	Ascension Island
ZD9	Gough Island and Tristan da Cunha
ZE	Rhodesia
ZS1, 2, 4, 6	South Africa
ZS2	Prince Edward Island
ZS2	Marion Island
ZS3	Southwest Africa (Namibia)
3B6, 7	Agalega & St. Brandon
3B8	Mauritius
3B9	Rodriguez Island
3C	Equatorial Guinea
3D6	Swaziland
3V	Tunisia
3X	Republic of Guinea
3Y	Bouvet Island
4W	Yemen
5A	Libya
5H	Tanzania
5N	Nigeria
5R	Malagasy Republic
5T	Mauritania
5U	Niger
5V	Togo
5X	Uganda
5Z	Kenya
6O	Somali
6W	Senegal
7O	People's Dem. Rep. of Yemen
7P	Lesotho
7Q	Malawi
7X	Algeria
8Q, VS9	Maldive Islands
9G	Ghana
9J	Zambia
9L	Sierra Leone
9Q	Republic of Zaire
9U	Burundi
9X	Rwanda

Corrections

In "So You Want to Raise a Tower" (July, 1979, page 110), Photo J shows what appears to be a vertical stacking of the cable lengths under the cable clamps. The cable lengths should be positioned in a horizontal side-by-side arrangement such that both halves of the cable clamps contact each side of each cable.

Gene Smarte WB6TOV/1
News Editor

In reference to "At Last! A Really Simple Speech Processor," June, 1979:

Thanks to W5VSR for pointing out the need for a circuit change. A 10k pot should be added at the emitter of the first transistor.

Sorry about any inconvenience this may have caused.

Jeff Stadelman W9UT
Pound WI

Ham Help

I just acquired an 80-10-meter amp. It's a TXL-80B made by Westcom Engineering. The problem is that the final transistors have been blown and I can't find any suitable replacements, as the transistors have a nonstandard "house number." I'd be grateful to anyone who could suggest a good replacement, or give me an address where I might find Westcom. Thanks in advance for helping.

Bob Howie WA4ZID/9
10432 Baseline Road
Lafayette CO 80026

I'm the president of the newly-formed Phoenix Honeywell Amateur Radio Club and could use some help. We have a lot of tube-type equipment and most of us would like to replace the front-end rf stage with an FET equivalent (such as a 6HA5). We would like to build them on a direct-replacement tube socket. Does anyone have tubes-to-FET conversion circuits? Also, does anyone have any application circuits for FET noise blankers or audio noise filters? Any help will be appreciated.

P.J. Scola, President
Phoenix Honeywell Amateur Radio Club
PO Box 6000
Phoenix AZ 85005

I am in need of a schematic for a Pride 150 bilinear amplifier, 80-10 meters. If anyone has one and could send a copy, it would be a great help.

Francis Whittier WB1CXX
RFD #1 Box 339
Madison ME 04950

LETTERS

from page 14

electronics experimenter, though, and guess I must agree with you that, in my experience, your mag is more with it in terms of construction articles than are the official publications of the ARRL. I tuned in too late to know the whole background of your seeming vendetta against this organization, but I suspect that you have some valid points, if only because too many organizations in and out of gov't (plus religions) get hardening of the arteries too soon, after which everyone wants to merely survive and not rock the boat. Being an iconoclast, I'm sympathetic.

Recalling the ARRL "pledge of allegiance," so to speak, that would have the ham saying that he owed his hobby to the ARRL, much as I owe my soul to the company store, I don't think I'd care to be represented by that "religious" denomination even if I were to become a ham.

Beyond that, there was a time when I used to buy the *Handbook* every few years, mainly for new test instrument circuits to build. Then I noted that it was about the last and least source of such information. Now I get the unchanging data I need (like the nice LCR resonance chart) from editions some 10 years old. The formula is still good, but magazines such as yours give me a better update on test instrument circuits, even though I scarcely need your July antenna issue, except maybe for my TV set.

Benjamin Johnson
Rochester NY

ECLECTICISM

It may interest the ham community to know that Sears, after seemingly abandoning ham radio in the Spring-Summer '79 catalog, has jumped back in with both feet.

On pp. 1238-9 of the Fall-Winter '79 catalog, the Sears 22-channel 2m FM xtal rig has returned, grouped with—brace yourself—the Midland (that's right, Midland—not a Sears nameplate in sight) 13-510A 2m syntho rig and the Midland (again!) 13-509 and 13-513 220 (!) FM rigs (xtal and syntho respectively). I'm not going to comment on prices (other than to say that they seem reasonable) because there is a bigger matter which this raises.

I was perusing Looking West in *73* #200 (May, 1977) which touched on the flak raised by Sears' first foray into amateur gear. This increased involvement (especially the 220 rigs) is bound to raise even more, so I thought I'd get my two cents in before inflation struck. At least Sears does point out that you must have a license, although I wish they could get it straight that it's *Technician*, not "Technical." I'm a Tech myself, and I like them to get my class right. What's more, the added exposure of 220 (use it or . . .) can't hurt! As for the bugaboo about "da CBer gonna getcha"—well, if we can't handle a few unauthorized signals (the price of the rigs will keep the CB-boom $39 radio crowd off the band), we are in trouble.

On other matters, keep the mag the way it is (if not better!). Don't be bullied away from the eclecticism, the controversy, and the general free attitude of the magazine! At this time, it's the only ham magazine (counting *Worldradio* as a newspaper) worth reading! Keep it up!!

Edward Eastman WD0ENF
Minneapolis MN

IGNORAMI

I cannot sit idly by any more and let some unintelligent and uneducated hams slash your wonderful magazine and enlightening editorials. I cringe every time someone says that Wayne is against ham radio (WD8DWO, Letters, *73 Magazine*, June, '79). These people must have read his editorials with their dunce caps on! Anyone who digests them with intelligence or has read Wayne's writings for a while can clearly see that Wayne Green is one of the leading proponents of ham radio and that ham radio is one of Wayne's lifetime loves.

I have been reading his editorials since I received my Novice license in September of '75, and while there have been times when I disagreed with Wayne, I have always been impressed with his honesty and his factual unbiased reports of many situations. I admire the way he has never backed down on an issue, nor been afraid to state his opinion on any issue. I also admire the way he has succeeded in his business ventures.

So the next time you read one of Wayne's dynamic editorials, read it intelligently and you will learn about the inside happenings of ham radio, politics, business, and about devotion. I have learned about these things and more from Wayne's editorials, and so even though I know Wayne will not let a few ignorami stop him, count me as one of his supporters and keep those unabashed, interesting, and provocative editorials coming. Your magazine is the best in ham radio and better than most of the others in other fields, so continue the good work and take it easy!

John Kerekes N9EI
South Bend IN

GREEN PAGES

I just received my first *73* issue on a new subscription. The article on "The KGCY Story" was worth the price of the subscription. Keep articles like this coming and I'll renew . . . could do with fewer "green" pages, however.

Ron Schwendt N3AR
Douglassville PA

EGYPTIAN PROGRESS

As the first woman member of the Egyptian Radio Club, Inc., Granite City IL, I feel compelled to respond to the "Letter to the Editor" written by Tania Miller WB9TKC that appeared in the August, 1978, issue of *73 Magazine*. Tania's letter was written as a result of the difficulty experienced by women who wished to become members of the club. At that time there were enough members who did not want women in the club to block any attempt by women to join. Since that time, however, open-minded members have been responsible for changes that allow any responsible amateur radio operator to join the club.

I believe that this progress shows that old traditions and ideas must be changed when they do nothing except cause hurt feelings or give people in control a feeling of power. There is no place in amateur radio for prejudice.

My husband and I have both enjoyed being members of the Egyptian Radio Club very much. We have met and learned from a super bunch of fellow hams. We are pleased with the progress that has been shown in the Egyptian Radio Club, Inc.

Bess J. Nelson WD0CZF
Florissant MO

NUKES

One year ago, I was one of those people who thought nuclear power would really help. I didn't question the authority of the geniuses who gave us Three Mile Island, Brown's Ferry, and the Karen Silkwood cover-up.

Since then I have learned a lot about the poor engineering, short-term monetary greed, and media whitewashing that goes hand in hand with the nuclear industry.

On June 30, I and forty to fifty thousand people were at the Diablo Canyon rally in San Luis Obispo, California. I saw exhibits there on solar and many types of alternative energy—alternatives that have been here for years. There were people from all walks of life there, and even some fellow amateurs.

I believe this is no longer a small minority issue. I feel that we hams should set a good example and use our excellent tinkering and engineering ability to apply to solar and alternative electricity sources.

Let amateurs use solar power at the home QTH, at Field Day, and at outdoor fairs.

Let amateur publications show conscience and responsibility by running how-to articles on alternative energy. Let amateurs, through their global communications capabilities, exchange information on solar and other alternative electric power.

I hope you will take these ideas to heart for technical articles, parts source articles, and editorials. I am one ham who doesn't need "nukes," and I know there will be others.

James G. Coote WB6AAM
Los Angeles CA

CONVERTING

Perhaps this information will be of interest to those of you converting 40-channel CBs to 10 meters. I received a Hy-Gain model 2681 board, less channel switch (which includes rotary dial and knob). I found that Hy-Gain parts are available through Telex Communications, Inc., 8601 Northeast Highway 6, Lincoln NE 68505, Attn: Jim Kepustka.

The parts noted above are listed as: part #700047, switch, $0.75; 40-ch dial, $0.50; channel knob, $0.50; shipping (very good box), $1.00.

The board is sold by Poly Paks, and costs about $12.00. They will supply a schematic diagram (specifically request it). Other info is supplied but it does not have much to do with the board received. It does give

info on another type of PLL which may or may not be used in another board they can furnish for more money. A complete Hy-Gain 40-channel set with all controls on the mike is available; the mike is an extra.

I haven't yet seen an SSB rig on sale through any of my contacts for less than $65. One should be available soon, as the popularity of CB in the crowded cities is going down fast.

The big surprise is that the going price for a divider-type switch used with other rigs seems to be from $16 to $25. I get that from the CB repairmen, who say that they practically never have to replace them. Look at the price I paid for it (75 cents). When I figured out how to build a switch to divide by 278 or so, I thought $20 was pretty fair.

Henry B. Plant W6DKZ
San Jose CA

CLASSICS

Being a Novice of about three months, I find my subscription to *73* thoroughly satisfying and enlightening in all aspects. It is very gratifying to have a publication on our behalf that pulls no punches and has its cards laid out on the table instead of putting up a smoke screen and being cloaked with the "official final authority" attitude approach. In your June issue (#225, page 13) Letters department, Don Hurley VE3HAN suggested an "equipment evaluation" booklet of rigs dating back over the past twenty years. Sounds like a great idea. Obviously an enormous amount of time and effort would need to be put into a big project on that order. Consider, though, how much value such a reference-type booklet like that could be . . . it would be ideal to bring along to that next hamfest for when you're rummaging through those tables of used Hallicrafters, Hammarlunds, Johnsons, Nationals, etc. If an "equipment evaluation" booklet is not conceivable, then how about running a feature article in *73* on some of those more popular older classic rigs?

Speaking of so-called outdated gear, if you tune around the bands listening carefully, there are plenty out there sporting their well-maintained vintage equipment . . . just another facet of the art. I run those "oldies but goodies," a Viking Valiant I transmitter with a Hammarlund HQ-100 receiver. Keep up the superb work.

Bill Wolf KA2EEV
Newark NJ

FEARL

Any hams working in the military or for the military services as civilians should definitely bring their gear along on permanent changes of station to Japan. Write to FEARL, c/o Sam Fleming KA2SF, USAGH D10, APO SF 96343, or call 228-4703 (military number in Japan) for info. Licensing is done by US Forces, Japan. All US license classes get full privileges, except that no mobile portable operation is allowed (except MARS, where we have 2m frequencies and repeaters, etc.).

SFC W. J. Graham KA2WG
Signal Act-N
APO SF 96343

OLDIE

I would like to comment on your review concerning the Daiwa CN-720 swr and rf power meter (June, page 24). Your statement, ". . . why someone didn't think of it before . . ." left me bewildered.

On page 386 of the September, 1952, issue of *DL-QTC*—yes, 1952—G. Blaeser DL1GX describes a standing-wave indicator which uses a cross-pointer instrument similar to the one used in the CN-720.

DL1GX's work was based on the work of a Mr. Buschbeck. Mr. Buschbeck's idea and invention was published in Volume 61, April, 1943, of *Hochfrequenztechnik und Elektroakustik,*" decimal classification DK 621.717; 621.396.61.

In the June issue of the *Technical Library* of the Northwest German Radio Network, 1949, Dr. Roland Walter describes this type of instrument again because, due to the war, most of the original material got lost or was destroyed.

Telefunken marketed a version for use on high-power BC and shortwave transmitters in the early 50s, with power handling capacities of up to 100 kW. It was called "supervisory equipment for feedlines for short, medium, and long waves." It became a standard on all major transmitting equipment in DL-land.

Ergo, the idea of the cross-pointer instrument in the context of swr measurements is about 36 years old.

Kurt U. Grey VE2UG
Sept Iles, Quebec

MISS AMERICA

This is to advise of the following station activity: Special Event—Miss America Pageant, Atlantic City, New Jersey. Station K2BR will be operating from the Miss America Pageant Headquarters in Atlantic City NJ, September first through eighth, 1979. It will be sponsored by the Southern Counties Amateur Radio Association (SCARA). Approximate frequencies: CW—3560, 7060, 14060, 21060; Novice—3730, 7130, 21130; Phone—3935, 7235, 14280, 21380. QSL to K2BR, 591 White Horse Pike, Egg Harbor NJ 08215 (SASE, please). Traffic to and from the Miss America contestants will be accepted.

Henry G. Rainville K2HG
Miss America Pageant/
SCARA coordinator
Ventnor NJ

HAMMARLUND

I have been trying hard to find a replacement variable tuning capacitor for my Hammarlund HQ-170A VHF receiver and finally found one at Pax Mfg., 100 Montauk Hwy., Linden Hurst NY 11757, (516)-884-4300.

In talking with Mr. Peter Kjeldsen of Pax Mfg., he indicated that they have most replacements for Hammarlund capacitors. Maybe this information will help someone else find parts.

Leroy Marion W8CGQ
Marlette MI

JAMMING

As printed in "Letters" of the June, 1979, issue of *73*, reader K6EGM is ". . . appalled that you could publish something ("The 2-Meter ECM Caper," *73*, February, 1979) tantamount to sanctioning the jamming of another station . . ." and says that such "new" ideas are not in the best interest of amateur radio.

Apparently K6EGM is not well versed in the history and romance of amateur radio. "Jamming," intentional, accidental, or fantasized, is not a "new" idea. It has been going on for over 50 years in every and any call area.

I suggest that K6EGM read "The Templeton Case" by K9ODE which appeared in the January, 1963, issue of *QST* magazine.

Byron H. Kretzman W2JTP
Huntington NY

New Products

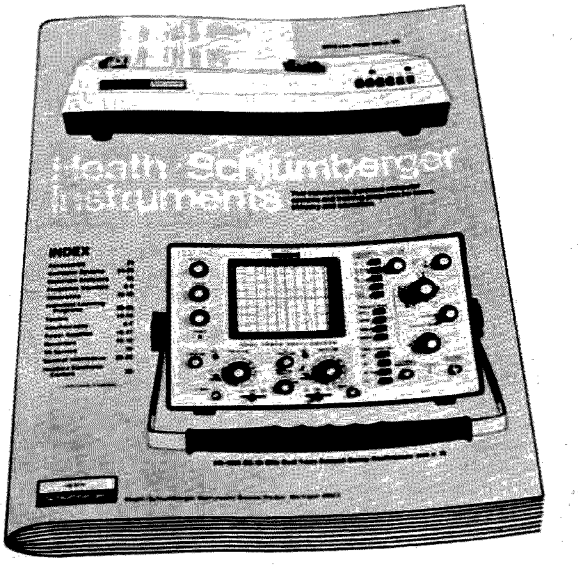
from page 40

The new pocket scanner features sturdy construction, with an anodized aluminum front panel to withstand demanding on-the-go use. A flexible "rubber ducky" antenna is supplied, but the radio can also be used with a wire antenna. The radio can be operated from external power, as well as from internal batteries. Also contributing to the radio's versatility are provisions for plugging in an external battery charger, headphone, and external speaker. For further information, contact *Electra Company, PO Box 29243, Cumberland IN 46229.* Reader Service number E40.

TRAC CMOS ELECTRONIC KEYER

TRAC's Model TE133 keyer.

TRAC Electronics, Inc., has introduced an addition to its line of state-of-the-art CMOS keyers. The TRAC CMOS Electronic Keyer, Model TE133, contains all CMOS integrated circuitry. Included features are self-completing dots and dashes; both dot and dash memory; iambic keying with any squeeze paddle; 5-50 wpm; speed, volume, tune, and weight controls; and built-in sidetone and speaker. Low-current-drain CMOS allows portable battery



Heath/Schlumberger's new catalog.

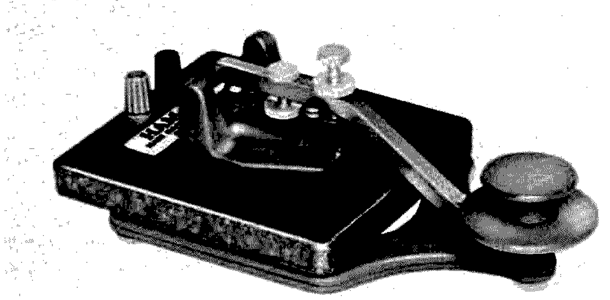
operation. The rear panel contains deluxe quarter-inch jacks for output and keying. The TE133 CMOS Electronic Keyer is operated on a single 9-volt battery and keys both positive and negative keyed rigs. For further information, contact *TRAC Electronics, Inc., 1106 Rand Building, Buffalo NY 14203.* Reader Service number T18.

HEATH/SCHLUMBERGER OFFERS LATEST INSTRUMENTS CATALOG

Heath/Schlumberger has announced the publication of its latest instruments catalog. This new catalog features Heath/Schlumberger's complete line of fully assembled and tested computers and peripherals and gives complete descriptions and specifications for their line of electronic test instruments. Included are oscilloscopes, laboratory-grade strip and X-Y recorders, power supplies, various signal and function generators, counters, and a full line of multimeters (from analog to digital).

In addition, the publication contains a complete listing of Heath/Schlumberger Continuing Education Programs for industrial training, including ac and dc electronics, semiconductor devices, digital techniques, microprocessors, and test instruments.

For further information, contact *Heath/Schlumberger, Dept. 350-870, Benton Harbor MI 49022.* Reader Service number H5.



Ham Radio Center's HK-3M.

THE HK-3M KEY

Ham Radio Center has introduced a new modified straight key which replaces their popular Model HK-3 Ham-Key™. The new model is the HK-3M; it features a new anti-tip bracket that defies even a pump-handle type of operator from tipping over. The beauty of this new feature is that any HK-3 now in the field can be converted to an HK-3M by merely adding the easily-installed AT-B bracket.

For further information, contact *Ham Radio Center, PO Box 28271, St. Louis MO 63132.* Reader Service number H2.

Ham Help

I would like a schematic and input/output impedance for an RME 80-10 preselector. The model is unknown, but I think it matched the RME 6900 receiver. Thanks.

William F. Mollenhauer N2FZ
Box 3, RFD 1
Glassboro NJ 08028

I would like to receive schematics for any modifications to the Ten-Tec PM2/2A QRP rig.

H. Goldberg VE3JBU
PO Box 913, Stn. B
Ottawa, Ontario
Canada K1P 5P9

I would like to get in touch with amateurs who believe in UFOs, who have made a sighting or who are members of any organization that investigates UFOs. I would to like to organize an international net.

Anastasios Panos SV1IG
PO Box 2563
Athens, Greece

I got a flood of replies to my request in the June issue. Thanks a lot, fellows! Instead of a brief visit in August, I have decided to come on the "HOUSA" student exchange/work scheme from November, 1979, to February, 1980. Under this scheme, NZ students can come to the US or Canada to work and sightsee.

Ideally, I would like to work for short periods in various parts of the US, and would appreciate information on temporary jobs and accommodations.

I would also like to hear about UHF FM repeaters, as I intend bringing along my home-brew mobile rig (cheap, but good), based on our club design. Do UHF repeaters need the special access techniques, e.g., tone burst, etc., like your 2-meter ones?

Ash Nallawalla ZL4TBU
PO Box 6159
Dunedin, New Zealand

I have been following the articles on the conversion of CB sets to 10 meters and I have been trying to convert a SBE Sidebander II mobile rig, but have run into problems.

Does anyone have any information on the conversion of this unit? I did find the article on the SBE Sidebander III model (January, 1979, *73*), which is strictly sideband (no AM) and am told that the boards are entirely different.

I have changed the base crystals up 1.535 MHz to put channel 1 on 28.500, but, after complete alignment, which makes the set very hot on both receive and transmit, we find ourselves on a *lower* frequency than even 11 meters. Around 25.535.

James W. Barnes WB7PKR
PO Box 283
Mesa AZ 85201

I need a schematic or conversion info on an ARC R-19 aircraft receiver which tunes 118-148 MHz. Expenses will be reimbursed.

Howard S. Robb AFØW
Box 17
Bird Island MN 55310

I need a manual, or a copy, for a Gonset G-76 transceiver. I will pay costs.

Tim Rulon WA2KQD
12 Morahopa Rd.
Centerport NY 11721

I would like to get in touch with anyone who shares my interest in model railroading for a 40m CW sked on the Novice portion.

Rick Todd KA8AKL
14470 Basslake Rd.
Newbury OH 44065

RIPPED OFF?

If you have a serious problem with a ham firm, send them a letter with all the facts in detail, plainly and simply . . . and send a copy to Wayne Green W2NSD/1, c/o 73 MAGAZINE. 73 protects its readers more than any other magazine.

Social Events

Listings in this column are rovided free of charge on a oace-available basis. The)llowing information should be ıcluded in every announce- ıent: sponsor, event, date, me, place, city, state, admis- ion charge (if any), features, alk-in frequencies, and the ame of whom to contact for ırther information. Announce- ıents must be received two ıonths prior to the month in vhich the event takes place.

GEORGETOWN IL
SEP 1-2

The 1979 Danville, Illinois, \rea Hamfest will be held on ;eptember 1-2, 1979, at the ;eorgetown, Illinois, fair- jrounds, located ten miles ;outh of Danville on Illinois Rt. I. Gates open at noon on Satur- lay for vendors to start setting ıp their displays. Gates open to he general public at 6:00 am Sunday. Facilities will consist of a large enclosed building 50 x 150 feet with electrical ıookups available at no charge. Please bring your own tables and chairs and power cords. Outside space is also available at a $2.00 per person gate charge. Overnight camping on the fairgrounds is available at $5.00 per vehicle. For information, contact Bob Wilson K9RBW, c/o Illiana Repeater Systems, Inc., PO Box "G", Catlin IL 61817.

TEXAS CITY TX
SEPT 1-2

The Tidelands Amateur Radio Society (TARS) will hold its Hamfest '79 on September 1-2, 1979, at the Nestler Civic Center on 5th Street, Texas City, Texas. The registration and hospitality period will be held on Saturday evening, with the final prize drawing to be held on Sunday afternoon. There will be many small prizes, plus TARS will be giving away the winner's choice of a Kenwood TS-120S or Drake UV-3, a Wilson Mark II HT, and a Wilson System III beam. For further information and pre-registration, write Hamfest '79, PO Box 73, Texas City TX 77590.

PENSACOLA FL
SEP 2

The Five Flags Amateur Radio Association, Inc., will hold its 1979 Ham-A-Rama on September 2, 1979, at the Pensacola Municipal Auditorium, Pensacola, Florida.

ROSEMONT IL
SEP 7-9

The Quarter Century Wireless Association will hold its 1979 Chicago Convention on September 7-9, 1979, at the O'Hare/Kennedy Holiday Inn, Rosemont, Illinois. The complete package for the three days is $35.00. Special room rates will also be available. There will be the annual banquet, special ladies' program, various tours, and prizes. For reservations and information, write Phil Haller W9HPG, 6000 S. Tripp, Chicago IL 60629.

BLOOMINGTON IN
SEP 8

The second annual Hoosier Backyard Hamfest will be held on September 8, 1979, at the Hensonberg School, just east of the intersection of state highway 37 and Vernal Pike, in Bloomington, Indiana. Tickets are $1.00 per head over age 12. Features of the event will include ATV, an ATV repeater, SSTV demonstrations, a home-computer show, inside swap area, plenty of parking, food, and some door prizes. Talk-in on 147.78/.18. Send all inquiries to HBYH, 7391 W. Hwy. 46, Ellettsville IN 47429.

AUGUSTA NJ
SEP 8

The Sussex County Amateur Radio Club will hold its hamfest on Saturday, September 8, 1979, from 9:00 am to 5:00 pm, rain or shine, at Sussex County Farm and Horse Show grounds, off Rte. 206, Augusta, New Jersey. There will be a large indoor selling area and tailgating. Admission for buyers is $1.00, which includes a chance at the door prizes. YLs, XYLs, and harmonics will be admitted free. Admission for indoor sellers is $6.00 at the door and $5.00 in advance. For tailgaters, admission is $5.00 at the door and $4.00 in advance. Talk-in on 147.90/.30 and 146.52. For registration and information, write Sussex County Amateur Radio Club, PO Box 11, Newton NJ 07860, or call Ed Woznicky AC2A at (201)-852-3268.

UNIONTOWN PA
SEP 8

The Uniontown Amateur Radio Club will hold its 30th annual Pie Gabfest on September 8, 1979, starting at noon at the club grounds, Old Pittsburgh Rd., at the bypass on Rte. 51.

Uniontown, Pennsylvania. Registration is $2.00, with a chance for a main prize of a Tempo S-1. There will also be a Swap 'n Shop.

MENA AR
SEP 8-9

The QWHC is celebrating the 10th anniversary of the Queen Wilhelmina Hamfest on September 8 and 9, 1979, at the Queen Wilhelmina State Park lodge, atop Rich Mountain just north of Mena, Arkansas. Featured will be displays, a free flea market, a banquet, a live band, church services, activities for XYLs and harmonics, and much, much more. There will be a grand prize of a Yaesu FT-101ZD, and many more prizes. Look for WB5MFI/P5 operating from the lodge. Admission is $2.00. Tickets for the grand prize are $2.00 each or 3 for $5.00. Talk-in on 3995, 146.19/.79, and 146.52. For additional information, contact Steve Myers WB5MFI, SS103 Carlson Terrace, Fayetteville AR 72701, or phone (501)-443-3489.

MONTGOMERY AL
SEP 8-9

The 2nd annual Central Alabama Hamfest is scheduled for September 8-9, 1979, at the Montgomery Civic Center, 300 Bibb St., Montgomery, Alabama. The FCC will administer exams beginning at 8:00 am on Saturday, September 8. Bring your Form 610. All activities will be indoors in air-conditioned comfort. There will be prizes and a ladies' program. Talk-in on 146.04/146.64. For more information, contact Ed Sensintaffar WA4NKU, 745 Dubuque Dr., Montgomery AL 36109 or Sam Windham WB4RGX, 1834 Shoreham Dr., Montgomery AL 36106.

FINDLAY OH
SEP 9

The Findlay Radio Club will hold its 37th annual Findlay Hamfest on Sunday, September 9, 1979, at Riverside Park, Findlay, Ohio. There will be both commercial and amateur display space available. Ticket donation is $1.50 in advance and $2.00 at the hamfest site. For more information, write the Findlay Radio Club, c/o Randy Peterson, Hamfest Chairman, 6016 Marion Twp. 243, Findlay OH 45840.

BUTLER PA
SEP 9

The Butler County Amateur Radio Association, Inc., will hold "Ye Olde Fashioned Hamfest" on September 9, 1979, from 10:00 am to 4:00 pm at the Butler County Farm Show Grounds adjacent to Roe Airport on Rte. 68, west of Butler, Pennsylvania. The $1.00 charge includes free parking and admission to the outside flea market. Children under 12 are admitted free. Overnight campers are welcome. Tables for the indoor flea market are $3.00 for an 8-foot table provided by us, or $2.00 for an 8-foot table provided by you. Food and refreshments will be available. Mobile check-ins on .52 and 147.90/.30 (W3UDX). Fly-ins welcome (80 + 100 aviation gas will be available). YL, mobile, and fly-in prizes will be awarded. There will be six main prizes plus other prizes to be drawn every 15 minutes. For more information, contact Fred Young WB3HGC, 195 Robbie Way, Portersville PA 16051, or phone (412)-368-3386.

PECATONICA IL
SEP 9

The Rockford Amateur Radio Association will hold its second annual Rockford Hamfest and Illinois State ARRL Convention on Sunday, September 9, 1979, at the exhibition hall at the Winnebago County Fairgrounds at Pecatonica, Illinois, just west of Rockford on US Rte. 20. Tickets are $2.00 in advance or $2.50 at the gate. Tickets are available by mail by writing RARA, PO Box 1744, Rockford, Illinois 61110. Please include an SASE for tickets by mail. Prizes include a Kenwood TS-520S transceiver and an Atlas receiver. Campsites are available on site, with electric and sanitary hookup available. There are 300 flea-market tables available at a nominal charge. Plenty of free parking is available. Featured will be speakers, forums, demonstrations, and discussions. A hamfest menu, including hot dogs, BBQ, and soft drinks will be available at reasonable prices. Talk-in on 146.01/.61 or 146.52.

PENNSAUKEN NJ
SEP 9

The South Jersey Radio Association will hold its hamfest on September 9, 1979, at Pennsauken Senior High School, Hylton Rd. at Rtes. 3, 130, and 70. Admission is $2.00, tailgating is $3.00, and an inside table is $5.00. For further information, contact Bruce Eichmann WA2NBM, Hamfest Chairman, 204 E. Lake Blvd., Marlton NJ 08053, or phone (609)-983-0106.

VALPARAISO IN
SEP 9

The Porter County Amateur Radio Club will hold its annual hamfest on September 9, 1979, at the Porter County Fairgrounds, Valparaiso, Indiana. Featured will be a flea market, prizes, and technical sessions. Admission is $2.00. There will be no charge for a flea market space but do bring your own tables. Talk-in on 147.96/.36 and 146.52. For advance tickets and information, write Art Cushman N9FB, 944 N. 100 W., Valparaiso IN 46383.

HUDSONVILLE MI
SEP 15

The Grand Rapids Amateur Radio Association, Inc., will hold its annual Swap 'n Shop on Saturday, September 15, 1979, at the Hudsonville Fairgrounds, Hudsonville, Michigan. Gates open at 6:00 am; sales begin at 8:00 am. Talk-in on .16/.76, .63/.03, and .52/.52.

PEORIA IL
SEP 15-16

The 21st annual Peoria Superfest 1979 will be held on September 15-16, 1979, at Exposition Gardens, W. Northmoor Rd., Peoria, Illinois. Advance tickets are $2.00. Door tickets are $3.00. Camping will be available Friday night on the grounds. There will be free indoor and outdoor flea market space available. Tickets will be sold on the grounds for hourly prize drawings. Main prize drawing will be at 3:00 pm both days. Continuous demonstrations of the latest equipment and technology will be given by major manufacturers and dealers. All dealers, distributors, and manufacturers write or call for info on free commercial table space. There will be movies, forums, talks, and displays of interest to all given daily. For the ladies: There will be a free bus trip to the Northwoods Mall on Sunday at 12:00 noon, plus daily displays and demonstrations and also a ladies' flea market. An informal get-together will be held at the Heritage House smorgasbord, 8209 N. Mt. Hawley Rd., (Rte. 88) at 7:30 pm Saturday, September 15th. No reservations are necessary. Price will be approximately $5.75 per person. Talk-in on 146.76 W9UVI and .76, .85, and .97. For advance tickets, write Peoria Hamfest, 5808 N. Andover Ct., Peoria IL 61614, or phone (309)-692-8763.

ROSS OH
SEP 16

The Greater Cincinnati Amateur Radio Association, Inc., will hold its 43rd annual Cincinnati Hamfest on Sunday, September 16, 1979, at Strickers Grove on Ohio Rte. 128, one mile west of Ross (Venice), Ohio. Exhibits, prizes, food, and refreshments will be available.

✓ Reader Service—see page 195

Featured will be a flea market with radio-related products only, music and good fellowship, a hidden transmitter hunt, and a sensational air show. Admission and registration are $4.00. For further information, write Lillian Abbott K8CKI, 1424 Main St., Cincinnati OH 45210.

MT. CLEMENS MI
SEP 16

The L'Anse Creuse Amateur Radio Club will hold its 7th annual Swap and Shop on September 16, 1979, at the L'Anse Creuse High School, Mt. Clemens, Michigan. Take I-94 eastbound to the Metro Parkway exit. Then take the Metro Parkway to Crocker. Go left on Crocker to Reimold and then right on Reimold to the last school, L'Anse Creuse High School. Admission is $2.00 at the door, or $1.00 in advance. There will be plenty of food and parking plus hourly prize drawings. Prizes include a first prize of $200.00, a second prize of $100.00, and a third prize of $50.00. Talk-in on 147.69/.09 and 146.52. For more information, send an SASE to WD8ITS, 3488 Ashley, Pontiac MI 48055.

HARRISBURG PA
SEP 16

The Central Pennsylvania Repeater Association, Inc., will hold its 6th annual High Rise Hamfest on Sunday, September 16, 1979, from 8:00 am until 3:00 pm at the Park and Shop Garage, 200 block of Walnut Street, Harrisburg, Pennsylvania. Admission is $3.00, with tailgating, wives, and kids free of charge. There will also be door prizes.

QUEENS NY
SEP 16

The Hall of Science Amateur Radio Club, Inc., will hold its 2nd annual indoor/outdoor, rain or shine electronics hamfest on September 16, 1979, from 9:00 am to 4:00 pm at the municipal parking lot, one block off Queens Blvd. at 80-25 126th St., Queens, New York. There will be free parking, refreshments, and free prizes. Admission is $2.00 for sellers and $1.00 for buyers. Talk-in on. .52/.52 and .96/.36.

WHITESTONE NY
SEP 20

The Tu-Boro Radio Club will hold its auction on Thursday, September 20, 1979, from 6:00 pm to 10:00 pm at the Odd Fellows Hall, 149-14 14th Avenue, Whitestone, New York. Donation is $1.00. Talk-in on 145.62 and 146.52.

ELMIRA NY
SEP 22

The Elmira Amateur Radio Association will hold its fourth annual International Hamfest on September 22, 1979, from 8:00 am to 5:00 pm at the Chemung County Fairgrounds, Elmira, New York. There will be prizes, programs, a free flea market, and dealers' and manufacturers' displays. Talk-in on .52, .96/.36, and .10/.70. For more information, contact John Breese WA2FJM, 340 West Avenue, Horseheads NY 14845.

ADRIAN MI
SEP 23

The Adrian Amateur Radio Club will hold its 7th annual hamfest on Sunday, September 23, 1979, at Lenawee County Fairgrounds, Adrian, Michigan. Featured will be prizes, games, and programs. Tables are available at $5.00 per 8 ft. space, $3.00 per 4 ft. space, $1.00 per 8 ft. trunk space, and $2.00 for an inside space. Talk-in on 146.31/.91 and 146.52. For ticket and table information, write Adrian Amateur Radio Club, Inc., PO Box 26, Adrian MI 49221, or call Bob or Sally Fay of Sword Enterprises at (517)-263-3597.

FLINT MI
SEP 23

The Genesee County Radio Club, along with the Bay Area Radio Club, the Lapeer County Radio Club, the Saginaw Valley, and the Shiawassee County Radio Club, will hold their 2nd annual 5-County Swap 'n Shop on September 23, 1979, from 7:30 am to 4:00 pm at Southwestern High School, Flint, Michigan. Take I-69 to the Hammerberg Rd. exit, turn south to the 12th St., then left on 12th to the high school. Admission is $2.00 for adults, with children under 12 free. There will be refreshments, prizes, and fun for all. Talk-in on 146.52, 147.27, and 146.91. For information, contact Don Williams WD8QPM, 5114 Knapp Dr., Flint MI 48506.

BEREA OH
SEP 23

The fourth annual Cleveland Hamfest will be held on Sunday, September 23, 1979, at the Cuyahoga County Fairgrounds, Berea, Ohio. The hamfest will be an all-indoor operation. There will be 10-foot booths available with an 8-foot table and two chairs for $30.00.

GAINESVILLE GA
SEP 23

The Lanierland Amateur Radio Club will hold its sixth annual Hamnic at the Lake Lanier Islands Dogwood Pavilion on September 23, 1979. There will be two large covered pavilions and a large parking area for the swap shop and exhibits. Food will be available. There will be no entry fee for Hamnic; however, Lanier Islands charges a $2.00 entry fee per car. There will be picnicking, hiking, and swimming available for the kids. Trailer hookups and camping are also available on site. First prize will be a KDK FM2015R; there will be many other prizes. Talk-in on W4IKR .07/.67. For further information, write Bob Cochran W4DNX, 607 East Lake Drive, Gainesville GA 30501.

BOULDER CO
SEP 23

The Boulder Amateur Radio Club will hold Barcfest '79, on September 23, 1979, beginning at 9:00 am at the Boulder National Guard Armory, North Broadway, at the city limits, Boulder, Colorado. There will be an auction and a snack bar. Admission is $2.00 which includes a door prize drawing. Talk-in on 146.10/.70 and .52/.52. For further information, contact Mark Call NØMC, 4297 Redwood Ct., Boulder CO 80301, or phone (303)-442-2616.

SUTTON NH
SEP23

The Connecticut Valley FM

Association will hold its hamfest on September 23, 1979, from 9:00 to 5:00 pm at King Ridge ski area, Exit 11 off I-89, Sutton, New Hampshire. Admission at the gate is $2.00 per person over 16. Advance admission is $1.50. Send to C. A. Breuning, 54 Myrtle Street, Newport NH 03773. Festivities include an indoor/outdoor flea market, a florist exhibit, a frisbee toss, a horseshoe competition, dealers' exhibits, food, overnight camping available for self-contained units only, and a consignment room. Door prizes will be awarded, including a grand prize of a handheld, portable synthesized 2-meter rig, plus a raffle of a 19" color television at 5:00 pm. Talk-in on .52/.52 and .16/.76.

ERIE PA
SEP 23

The Radio Association of Erie, Inc., will hold its annual Ham Jam '79 on September 23, 1979, between the hours of 8:00 am and 4:00 pm at Rainbow Gardens, Waldemeer Beach Park, at the head of Presque Isle Bay, Erie, Pennsylvania. Tables can be reserved on a first-come, first-served basis, at a cost of $5.00 per table. There will be plenty of free parking and lots of indoor display area. Admission is $3.00 at the gate and includes a door-prize ticket, a YL ticket, a main-prize ticket, and a free coffee. Commercial displays will also be available. There will be a $1.00 charge per car for display space in the flea market area. Refreshments will be served on the premises. Talk-In on 146.34/.94, 146.34 simplex, and 7,250 kHz. For additional information or advanced tickets, send an SASE to Ham Jam '79, c/o the Radio Association of Erie, PO Box 844, Erie PA 16512.

LOUISVILLE KY
SEPT 29-30

The ninth annual Greater Louisville Hamfest and Kentucky State ARRL Convention will be held on September 29-30, 1979, at the West Hall of the Kentucky Fair and Exposition Center in Louisville, Kentucky. Follow QSY signs off either I-65 or I-264. There will be a gigantic indoor air-conditioned exhibitors' area and flea market plus meetings, forums, and ladies' program. FCC exams will be given on Saturday with a banquet on Saturday night. Admission is $3.00 in advance, $3.50 at the door, and $9.75 for the banquet. Exhibitors and flea market vendors should write for a special information sheet. For other information, contact the Greater Louisville Hamfest, PO Box 34444, Louisville KY 40232, or phone (502)-634-0619.

WARNER ROBINS GA
SEP 30

Central Georgia ARC's first annual hamfest will be held on September 30, 1979, from 8:00 am to 5:00 pm at the City Recreation Center, on Watson Boulevard, Warner Robins, Georgia. Dealers and flea market will be indoors. The Georgia Single Side Band Association and Georgia CW Association both plan their annual meetings with us. Talk-in on 3,975 LSB and 146.25/.85 and 146.52. For more information, call or write Bill Atkins WD4ASB, 201 Avalon Drive, Warner Robins GA 31093, or phone (912)-923-3454.

GAITHERSBURG MD
SEP 30

The Foundation for Amateur Radio will hold its annual hamfest at the Gaithersburg Fairgrounds, Gaithersburg MD, on Sunday, September 30, 1979, rain or shine. Featured are a large flea market, food service, exhibits, ladies' events, a supervised children's program, and many prizes. The main events are all indoors. Picnic grounds and free parking are available. Participation fee is $2.00, sales space for flea market is $6.00, and for tailgate, $5.00 (spaces available on a first-come basis). Commercial exhibitors' spaces are $15.00 with pre-registration required. Talk-in service provided and nearby motel rooms available. For information, write or call Ron Levin W3GBU, 802 Greenview Court, Reisterstown MD 21136, or telephone (301)-833-1816.

BLACKSBURG VA
OCT 1-6

Two expanded workshops on 8080/8085/Z80 microcomputer design, microcomputer interfacing, software design, and digital electronics are being given by the editors of the popular Blacksburg books. Participants have the option of retaining the equipment used in these courses. Dates are October 1-6, 1979. For more information, contact Dr. Linda Leffel, C.E.C., VPI and SU, Blacksburg VA 24061 or phone (703)-961-5241).

SIOUX FALLS SD
OCT 5-7

The '79 ARRL Dakota Division Convention will be held from October 5-7, 1979, at the Sioux Falls Airport Ramada Inn, located off Exit 81 on I-29, Sioux Falls, South Dakota. Featured will be technical and operating forums, a ladies' program, an ARRL forum, a large exhibit area, and a banquet. Prizes include an advance-registration prize of a DenTron GLA-1000 amplifier, a grand prize of a Kenwood TS-820S and a second grand prize of a Wilson System One™ antenna and WR-500 rotor. Registration is $15.00 ($16.00 after September 1) or $6.00 for the convention only ($7.00 after September 1). Talk-in on 146.16/.76. For further information and convention-rate hotel accommodations, write Sioux Falls Amateur Radio Club, Box 91, Sioux Falls SD 57101.

HOUSTON TX
OCT 5-7

The Houston Area Amateurs will host the ARRL West Gulf Division Convention on October 5-7, 1979, in Houston, Texas. For further information, contact Houston Ham Conventions, Inc., PO Box 79252, Houston TX 77024, or phone (713)-466-0518 or (713)-223-3161.

WARRINGTON PA
OCT 6

The Mt. Airy VHF Radio Club Inc., will hold its Hamarama '79 and Mid-Atlantic States VHF Conference on Saturday and Sunday, October 6-7, 1979. The conference will be held on Saturday, October 6, from 9:00 am to 5:00 pm at the Warrington Motor Lodge, Rte. 611, Warrington, Pennsylvania. Featured will be an all-day VHF program, a cocktail hour and get together, and a buffet dinner. Registration is $3.00 in advance, or $4.00 at the door, which includes the flea market. The buffet dinner is $9.00. The flea market will be held on Sunday, October 7, from 8:00 am to 4:00 pm, rain or shine, at the Bucks County Drive-In Theatre, also on Rte. 611. Registration is $2.00 with tailgating $2.00 per space (bring your own table). Featured will be amateur radio equipment, electronic parts, surplus, and door prizes. Talk-in on 146.52 W3CCX. For information, write Ron Whitsee WA3AXV, Chairman, PO Box 353, Southampton PA 18966, or phone (215)-355-5730.

CORNWALL NY
OCT 6

The Orange County Amateur Radio Club will hold its annual auction on Saturday, October 6, 1979, at Munger Cottage, Cornwall, New York. Admission is $1.00 and includes a chance on a door prize. The auction begins at 1:00 pm and sellers should arrive at noon. Talk-in on .52. For further information, contact Bill Lazzaro N2CF, 11 Jefferson St., Highland Mills NY 10930.

ROME GA
OCT 7

The Northwest Georgia Amateur Radio Club will hold its annual Rome Hamfest on October 7, 1979, at the Coosa Valley Fairgrounds, Rome, Georgia. Gates will open at 9:00 am. Talk-in on 146.34/.94 and 146.085/.685. For further information, contact WB4AEG, Box 274, Adairsville GA 30103.

ROCK HILL SC
OCT 7

The York County Amateur Radio Society will hold its 28th annual hamfest on Sunday, October 7, 1979, starting at 8:00 am, at Josiin Park, Rock Hill, South Carolina. Registration is $2.75 each, or 2 for $5.00 in advance, or $3.00 at the gate. The main prize is a Yaesu FT-901DM. A barbecue dinner is available at the park. Talk-in on 146.43/147.03 and 146.52. For more information, write York County Amateur Radio Society, Inc., PO Box 4141 CRS, Rock Hill SC 29730.

BERRIEN SPRINGS MI
OCT 7

The Blossomland Amateur Radio Association will hold its fall Swap Shop on Sunday, October 7, 1979, at the Berrien County Youth Fairgrounds, north of Berrien Springs, Michigan, on US 31, beginning at 8:00 am. There will be commercial exhibits, prizes, refreshments, plenty of free parking, and display space. Space for self-contained campers, at $3.50 including electricity, is on the grounds. Talk-in on 146.22/.82. Advance tickets are $1.50; $2.00 at the gate. Eight-foot tables are $2.00 and are restricted to electronic items. For advance tickets and information, write Charles White, 1940 Union Ave., Benton Harbor MI 49022.

TAYLOR MI
OCT 7

The 3rd annual Radio and Electronic Equipment Swap & Shop will be held on Sunday, October 7, 1979, from 9:00 am until 3:00 pm, at Kennedy High School, Taylor, Michigan. Admission is $2.00. Featured will be door prizes and food. Talk-in on .93/.33, .52/.52, and .99/.39. For information, write RADAR, Inc., PO Box 1023, Southgate MI 48195.

OTTAWA ONT CAN
OCT 12-14

The Radio Society of Ontario will hold its 11th annual convention at the Skyline Hotel, Ottawa, Ontario, Canada. On Friday evening, there will be a buffet and dance. On Saturday, there will be demonstrations, forums, technical sessions, a women's program, and a banquet and dance. On Sunday, there will be a flea market and delegates' meeting. For information, write PO Box 5076, Station F, Ottawa, Ontario, CAN K2C 3H3.

ASHEVILLE NC
OCT 13

The Western Carolina Ama-

teur Radio Society will hold Its Asheville Autumnfest on Saturday, October 13, 1979, at the Asheville Civic Center, Asheville, North Carolina. There will be ample space for manufacturers, dealers, and the flea market, which will be in another part of the arena. A concession stand will be operated by the Civic Center. All manufacturers and dealers will have separate booths. And it will be possible to drive directly to your booth for unloading.

SYRACUSE NY
OCT 13

The Radio Amateurs of Greater Syracuse will hold its annual hamfest on October 13, 1979, from 9:00 am until 6:00 pm at the New York State Fairgrounds, located adjacent to I-690, 3 miles southeast of the New York State Thruway, Exit 39, one mile northwest of Syracuse, New York. For commercial exhibitors, a fee of $15.00 will include a booth with a display counter ten to fifteen feet in length or a table and two chairs. Included in the $15.00 fee will be two tickets to the hamfest. Accommodations are available at nearby motels or travel trailer and motor home space will be available on the grounds. Commercial exhibitors will be able to set up their displays Friday night from 7:30 to 10:00 pm or on Saturday morning from 7:30 to 9:00 am. For more information, contact Bod Edgett or Paul Dunn, exhibitor chairmen, c/o Radio Amateurs of Greater Syracuse, PO Box 88, Liverpool NY 13088.

MEMPHIS TN
OCT 13-14

The Mid-South Amateur Radio Association and participating Memphis-area clubs will sponsor the Memphis Hamfest and Tennessee State ARRL Convention on October 13-14, 1979, at the Youth Building at the Mid-South Fairgrounds, Memphis, Tennessee. Featured will be forums, exhibits, a giant flea market, FCC exams, a hospitality party, and commercial and manufacturer exhibits. The display area will be open from 9:00 am to 4:00 pm on Saturday, and from 9:00 am to 2:30 pm on Sunday. Fifty trailer hookups are on the premises, which the Memphis Park Commission will rent for $5.00 per night.

BEAVER OK
OCT 14

The Beaver Hamfest will be held on October 14, 1979, at the Fairgrounds Building in Beaver OK. Doors open at 8:00 am, with registration at 10:00 am. Tickets are $2.50 each. There will be a covered-dish luncheon, a short program at 1:30 pm, swap tables, and door prizes. Camper hookups are nearby and the event is airport-close. Talk-in on .01/.61 and .52. For details, contact Stella Shaw WB5VUN, Box 310, Beaver OK 73932, (405)-625-3368.

LIMA OH
OCT 14

The Northwest Ohio Amateur Radio Club will hold its annual hamfest on October 14, 1979, at the Allen County Fairgrounds, Lima, Ohio. Two large heated buildings will house the hamfest where tables will be available for $3.00 each. A flea market will be held outside for free. Advance tickets are $2.00 each. For information, send an SASE to NOARC, PO Box 211, Lima OH 45802.

WEST GHENT NY
OCT 14

The Northeastern States 160-Meter Amateur Radio Association will hold its annual election and banquet on Sunday, October 14, 1979, at Kozel's Restaurant, Rte. 9H, West Ghent, New York. There will be a flea market in the rear parking lot at 1:00 pm and a roast beef dinner at 5:00 pm. All hams and XYLs are welcome. For reservations and details, contact William Derby WA5IOD, Secretary/Treasurer, 14 Plain St., Medfield MA 02052.

ISLIP LI NY
OCT 14

The Long Island Mobile Amateur Radio Club, Inc., will hold its Hamfair '79 on Sunday, October 14, 1979, from 9:00 am until 4:00 pm at the Islip Speedway, Rte. 111 (Islip Ave.), one block south of Southern State Pkwy., Exit 43, or come south from the Long Island Expressway, Exit 56, Islip, Long Island, New York. There will be free parking, door prizes, and several contests. Admission is $1.50 (non-hams are free) and $3.00 per seller's space, which permits one person to enter. For information, call Hank Wener WB2ALW, nights, at (516)-484-4322, or Sid Grossman N2AOI, nights, at (516)-681-2194.

ANAHEIM CA
OCT 19-21

The ARRL Southwestern Division Convention will be held on October 19-21, 1979, at the Sheraton-Anaheim Hotel, located at Ball Rd. and I-5, Anaheim, California. The convention will begin on Friday evening with registration and exhibits from 4:00 pm until 9:00 pm. On Saturday, registration will begin at 8:00 am and exhibits and technical sessions will run from 9:00 am until 3:30 pm. FCC testing will continue until 3:30 pm also. The ARRL Forum will be held from 4:00 pm until 5:30 pm, with a no-host cocktail party being held until the 7:30 pm banquet. The Wouff Hong pageant will be held at 00:01 am PST on Sunday morning. At 9:00 am Sunday morning the various breakfasts will be held and the exhibits will again be open until noon. The preregistration deadline is September 15, 1979. Advanced registration price, which includes complete program, banquet, exhibits, and technical sessions, is $17.00, and $19.00 at the door. The charge for the banquet only is $12.00, and for exhibits and technical sessions, the charge is $5.00, pre-registration; $6.00 at the door. The ladies' program and luncheon is $6.00, preregistration only. For more Information and pre-registration, contact Hamcon, PO Box 1227, Placentia CA, or phone (714)-993-7140.

CEDAR RAPIDS IA
OCT 19-21

The 1979 ARRL Midwest Division Convention and CVARC Hamfest will be held on October 19-21, 1979, at the Five Seasons Center, Cedar Rapids, Iowa. Tickets are $4.00 in advance or $5.00 at the door. Forums will include FCC, ARRL, DX, antenna, AMSAT/OSCAR, FM and repeaters, microprocessors, modern CW, and more. A flea market will be held at $5.00 per table with 150 tables available. Reservations are good for Saturday and Sunday and must be paid in advance. Pre-registrations will be taken through October 1, 1979. Setup begins at 6:00 am Saturday. FCC exams also will be given on Saturday. (Send Form 610 and copy of license two weeks in advance.) There will be many prizes, including a grand prize of a deluxe HF transceiver, a TH6DXX antenna, a HAM III rotor, and a 60-ft Rohn 25G tower. There will be a Saturday-evening banquet, with Senator Barry Goldwater K7UGA as guest speaker. There are many hotels and motels available. Talk-in on 146.34/.94. For information, write Convention, Cedar Valley Amateur Radio Club, Box 994, Cedar Rapids IA 52406.

BILOXI MS
OCT 20-21

The Gulf Coast Ham/Swap Fest will be held on Saturday and Sunday, October 20 and 21, 1979, at the International Plaza, located at the west end of the Biloxi-Ocean Springs bridge on Highway 90 In Biloxi MS. Tables are $3 per day or $5 per weekend. Talk-in on 146.13/73 and 146.52. For information, advance tickets, and tables, contact Al Williams WD5GNR, 311½ DeMontluzin Ave., Bay St. Louis MS 39520.

READING MA
OCT 20

The Quannapowitt Radio Association will hold its annual auction on October 20, 1979, at the Knights of Columbus Hall in Reading, Massachusetts. Doors will open at 10:00 am and the auction will start at 11:00 am. Food and refreshments will be available. Talk-in on 146.52. For information, call Bob Reiser AA1M at (617)-272-6219.

NORFOLK VA
OCT 20-21

The fourth annual Tidewater Hamfest-Computer Show-Flea Market will be held on October 20-21, 1979, starting at 9:00 am at the Norfolk, Virginia, Cultural and Convention Center SCOPE, Norfolk, Virginia. There will be 60,000 square feet of air-conditioned exhibit and flea market tailgating space available. Featured will be ARRL meetings, DX and traffic forums, and a CW contest. FCC exams are planned for amateur upgrading on Saturday from 9:00 to 12:00 am. A special feature will be a dinner cruise and banquet on the *Spirit of Norfolk* cruise ship on Saturday night for $16 per person, or $30 per couple. Advance registrations are $2.50 (include an SASE) or $3.50 at the door. Flea market tailgate spaces are $3.00 per day. For tickets and information, write TRC, PO Box 7101, Portsmouth VA 23707.

LONDON ONT CAN
OCT 28

The London Amateur Radio Club will hold its 2nd annual Swap and Shop on October 28, 1979, from 8:00 am until 4:00 pm at Lord Dorchester High School in Dorchester, just off 401. Admission and tables are both $2.00. Featured will be displays and prizes. Talk-in on .78/.18. For more information, write VE3CSK, RR #1, Ailsa Craig, Ontario, Canada N0M 1A0.

FRAMINGHAM MA
NOV 11

The Framingham Area Radio Association will hold its Indoor electronic flea market on Sunday, November 11, 1979, from 10:00 am until 2:00 pm at the Framingham Police drill shed behind the police station, Framingham, Massachusetts. From Rte. 9, take Rte. 126 south to the center of Framingham. Sellers' setup time is from 9:00 am to 10:00 am. Advance table reservations will be $5.00, with tables available at the door for $7.50. Refreshments will be served outside the flea market area. Talk-in on .75/.15 and .52. For information or reservations, write Framingham Area Radio Association, PO Box 3005, Framingham MA 01701.

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7A	7	7	7	7	7	14	14	21	21
ARGENTINA	21	14	14	14	7	7A	14A	21A	21A	21A	21A	21A
AUSTRALIA	21	14	7	7B	7B	7B	7B	14	14	14	21A	21A
CANAL ZONE	21	14	14	7	7	7	14	21	21A	21A	21A	21A
ENGLAND	14	7	7	7	7	14	14	21A	21A	21A	14A	14
HAWAII	21A	14	14	7	7	7	7A	14B	14A	21	21A	21A
INDIA	14B	7B	7B	7B	7B	7B	14	21	14A	14	14	14B
JAPAN	21	14	14B	7B	7B	7B	7	7	14B	14B	14	21
MEXICO	21	14	7A	7	7	7	14	14A	21	21	21A	21A
PHILIPPINES	21	14	14B	7B	7B	7B	14B	14B	14	14	14	21
PUERTO RICO	14	14	7	7	7	7	14	14	21	21	21A	21
SOUTH AFRICA	21	14	7	14	14	14	21A	21A	21A	21A	21A	21A
U. S. S. R.	7	7	7	7	7B	7B	14	21	21A	21	14	7B
WEST COAST	21A	21	14	7	7	7	7A	14A	21A	21A	21A	21A

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7A	7	7	7	7	7	14	14	14A	14A
ARGENTINA	21	14	14	14	7	7	14	21A	21A	21A	21A	21A
AUSTRALIA	21	14	14	7B	7B	7B	7B	14	14	14	21A	21A
CANAL ZONE	21	14	14	7A	7	7	14	21	21A	21A	21A	21A
ENGLAND	14	7	7	7	7	7B	14	14	21A	21A	14A	14
HAWAII	21A	21	14	14B	7	7	7A	14B	14A	21A	21A	21A
INDIA	14	14	14B	7B	7B	7B	7B	14	14	14	14	14B
JAPAN	21	14A	14	14B	7B	7B	7	7	14B	14	14	21
MEXICO	21	14	7	7	7	7	7	14	14A	21	21	21
PHILIPPINES	21	14A	14	14B	7B	7B	7B	14B	14	14	14	21
PUERTO RICO	21	14	7A	7	7	7	14	21	21	21	21A	21A
SOUTH AFRICA	21	14	7	7B	7B	7B	14	21A	21A	21A	21A	21A
U. S. S. R.	7	7	7	7	7B	7B	14B	14	21	14A	14	7B

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7	14	14	14	14
ARGENTINA	21	21	14	14	7A	7	7A	21	21A	21A	21A	21A
AUSTRALIA	21A	21A	21A	14	14	14	7	7	14	14	21A	21A
CANAL ZONE	21A	21	14	14	7	7	7	14A	21	21A	21A	21A
ENGLAND	14	7	7	7	7	7B	7B	14	21	21A	14A	14
HAWAII	21A	21A	21	14	14	14	7A	14B	14A	21A	21A	21A
INDIA	14	14	14	7B	7B	7B	7B	14B	14	14	14B	7B
JAPAN	21A	21A	14A	14	7B	7B	7	7	14	14	14A	21
MEXICO	21	14A	14	7	7	7	7	14	21	21	21A	21A
PHILIPPINES	21A	21A	21	14	7B	7B	7B	7B	14	14	14	21A
PUERTO RICO	21A	14	14	14	7	7	14	21	21	21	21A	21A
SOUTH AFRICA	21	14	7	7B	7B	7B	14B	14	21	21A	21A	21A
U. S. S. R.	7B	7	7	7	7B	7B	7B	14	14A	14	14	7B
EAST COAST	21A	21	14	7	7	7	7A	14A	21A	21A	21A	21A

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor
SF = Chance of solar flares

september

sun	mon	tue	wed	thu	fri	sat
						1 G
2 G	3 F/SF	4 F/SF	5 F/SF	6 F/SF	7 F	8 G
9 G	10 G/SF	11 G/SF	12 P/SF	13 P/SF	14 P	15 G
16 G	17 F	18 G	19 G	20 G	21 G	22 G
23/30 G/F	24 F	25 G	26 G	27 G	28 G	29 G

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Info

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W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

GLORY-SEEKING

Having failed to make contact between Pack Monadnock mountain in New Hampshire and the WA1KPS DXpedition to New York State on 10 GHz, it appeared that sterner measures would be necessary. The Pack is a 2,500-foot mountain and has the benefit of a road going right to the summit. The only problems with that are the surprising cold and wind which can strike even on relatively warm days . . . and the pesky little black flies which can make a hot, windless day wretched. These tiny but persistent devils get into your hair, crawl up your sleeves and into your shirt, and BITE!

Not far from the Pack is Grand Monadnock mountain, reaching up 3,500 feet. Since this one has to be climbed on foot, it is nowhere near as popular as the Pack. But, with six states already contacted on 10 GHz and with all contacts being over a path of at least 50 miles, I reluctantly agreed to take an expedition up in the interests of science and a world record . . . Guinness, please note.

Tim N8RK/1, Sherry, and I struggled up Grand Monadnock the previous Sunday in order to make the Connecticut to New Hampshire contact. It took us about two hours to scramble up the 2½-mile path of rock, but at least we were rewarded by getting a nice signal report over that path. Chuck Martin of Tufts Electronics was on the other end with Steve Murray K1KEC and Eric Williams WA1HON. On the second trip, I was able to talk Tim into going again, but Sherry had more sense and she passed up the great event. Jim Grubb WB1AFC, who works for Chuck, drove up from Boston and helped us cart the equipment up the mountain.

We'd just taken along a barefoot Gunnplexer for the Connecticut contact. That was small enough to fit in a knapsack, so it was easy to carry. The signals from that unit had not been overpowering, so we decided this time to take along some insurance in the form of a two-foot dish and a tripod. That was a bit more formidable to haul up the rocky path. Some of the rocks are *big*.

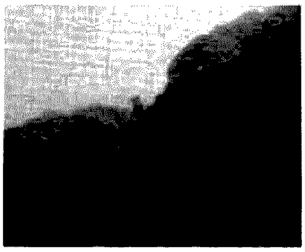
Sunday arrived and the three of us headed for the mountain, talking with Chuck and his DXpedition to New York via the Mt. Greylock repeater. To say that I was not enthusiastic about the climb would be quite an understatement. My normal exercise is to walk from my desk to the kitchen and back for a meal . . . maybe 100 feet total . . . three times a day. Then, exhausted from this, I stagger 20 feet more and up a flight of stairs to my apartment to rest. Typing my editorials strengthens little more than the outrage level in Newington.

Nothing short of the prospect of achieving an almost unbeatable world record of seven states worked on 10 GHz could have gotten me a second time onto that accursed trail up Monadnock. My knees had finally stopped making me limp a day or two earlier, and here I was about to insult them again with another struggle up the endless rocks, although I suppose that two and a half miles of stairs would pretty much do a person in, too. And on the way down, while you don't have your knees pulling your weight up, they do have to take shock after shock as you jump down one to two feet at a time.

The day was warm and very damp. A dense cloud sat over the entire mountain, dripping now and then and threatening to dump rain on us at any moment. We had HTs along for both 146 and 220 MHz and we kept track of downpours which were just a few miles away as we huffed and puffed our way up . . . the sweat pouring off. I'd lost three pounds the Sunday before, and only by virtue of really diligent eating had I managed to regain my fighting weight in time for this ordeal.

The top part of the mountain is all rock. Fires a hundred years or so ago had cleared the trees and shrubbery and allowed the dirt to be washed away, making the mountain one of the most accessible with ecological characteristics that normally are found only above the tree line of other mountains. Naturalists apparently travel hundreds of miles to scramble up these rocks and dote on amazing ecology. I just sweated on it as I climbed. The top part was cooler as we got out of the trees, and there was no protection from the wind. It felt wonderful . . . even in the dense fog.

Just to convince you that when I say rocks, I mean rocks . . . here is what they call a "trail." It's foggy, and you can't see more than about 50 feet.



Perhaps you can make out Tim with the disk on his back, disappearing into the fog. Just to the left is Jim, bringing the tripod on his back. I brought a camera plus my most prized possession . . . me.

Eventually we made it to the top, and here are Tim and Jim setting up the 10-GHz system. The two HTs at the bottom left provided us with communications with the New York contingent . . . Chuck, Eric, and Steve, in the Taconic Range of the Berkshire Hills, some 30 miles east of Albany.

Tim is looking around for a flat spot to set up the tripod and dish, a place with a view to the west *and* New York, hopefully. This brought up the question of which way was west. There is a compass rose painted on the top of the mountain, but it was almost 100 feet from where we were setting up, so we had to sort-of relay the correct bearing through the fog to aim the dish from Jim, standing at the rose, to Tim, halfway between, and me at the site. A passing climber lent us a compass just to check out the dish heading, and we'd come very close.

We got set up a little bit before Chuck and the others reached their hill in New York, so we sat and cooled off a bit, resting. When Chuck was finally set up, we put on the headset and crossed our fingers. Would the whole trip be for nothing? There was no way in the world they would get me to go through that ordeal a third time; whether we made it or not, this was the one and only try . . . so it had better work. Our topographical maps indicated that it was very chancy. Maps of the horizon from the top of Monadnock didn't give us much hope. The signals on 220 MHz, usually a very good indicator of a line-of-sight path, were marginal. I had to hold the HT just in the right spot to make contact. Two meters was a bit better, working on a direct simplex channel.

The moment arrived . . . Chuck finally had his unit, with a four-foot dish, set up and ready to go. We both turned on the switches at the same time and the signal-strength needle swung right off scale . . . whoopee, we'd made it! Now what do you talk about on a solid and very private path like that? After a round of "Come here, Watson, I need you" and some swinging of the dishes to peak the signals, we called it a day and packed up for the trip back home.

The only incident of note was about halfway back down when Jim slid on a rock and went head over heels, landing on his pack on another rock. The only damage was a ruined canteen, which was better than a busted back. My knees hurt only a day or two after the ordeal this time, so I suppose that I might be able to make the climb with no strain if I kept at it for a few more weeks. Don't worry, I won't. And I wasn't nearly as tired this time as the week before . . . hmm. It's too bad exercise takes so much time and is so little fun.

If any of you happen to see Chuck, you might congratulate him on having the world record for working one state from the most other states. I remain the only human being who has worked seven different states from New Hampshire, and I'll bet I will hold that record for a while.

DONATE

The question of ARRL finances seems to get murkier all the time. We see letters crying for donations and we read about the horrible losses they are sustaining with their staff, with few old-timers left and empty offices everywhere . . . offices which were just recently built at enormous expense.

The donations for their WARC efforts are particularly difficult to justify. Noel Eaton testified before the manufacturers that they have over $600,000 available, if they wish to spend it. In addition to that rather tidy sum, I see by the latest Annual Report that they still have kept up their $100,000 fund for the defense of amateur frequencies . . . and WARC would seem to qualify in this department.

Now, it is entirely possible that the League is intending to spend more than $750,000 at Geneva this year. If their perfor-

Continued on page 20

WORLD'S BEST JOB

How would you like to spend your time setting up and operating all of the latest ham gear . . . and getting paid for it? We at *73 Magazine* are searching for a good technician to come to Peterborough, New Hampshire, and work in the *73* ham shack. We want someone capable of installing, repairing, and evaluating equipment, and generally keeping things in good working order. Some writing ability is also desirable, since we'll want equipment reviews for *73*.

All in all, this is probably the world's best job for an active and curious ham. When you're not erecting a new tower or troubleshooting a balky linear, you'll find that Peterborough is one of the best DX and contest locations anywhere. If we can hear 'em, we can work 'em . . . and we hear 'em all. New Hampshire also offers other advantages, such as no state sales or income taxes.

If you can handle the job and don't smoke, drop us a line—tell us about yourself. Write to: *73 Magazine*, Opportunity of a Lifetime Dept., Peterborough NH 03458. Attention: Jeff DeTray WB8BTH.

Looking West

Bill Pasternak WA6ITF
24854-C Newhall Ave.
Newhall CA 91321

I have yet to hear from the FCC in answer to the questionnaire I mailed to them in May (reprinted here in the August column). I didn't expect a quick response, but two and a half months ago isn't exactly yesterday. Wheels in Washington move rather slowly as we all know, and in the meantime, the malicious interference problem out here grows worse. I suspect that it may be the same elsewhere; my mail seems to indicate this from time to time. Anyhow, when and if the FCC ever gets around to answering, I will quickly share the information with you.

The ARRL has formed the ECRBA! What's that, you say? The ARRL did *what*? I suspect that some clarification is necessary. The "ARRL" I am speaking about is *not* the Newington, Connecticut, variety, but an organization known as the *Atlantic Region Repeater Legion*. (Isn't that a great play on a set of logo letters!) This "ARRL" has now sprouted the east coast's first organized remote-base owners' organization, entitled aptly, the East Coast Remote Base Association (ECRBA). Founded on May 26, 1979, the ECRBA currently has about a half-dozen member systems, with more joining each month.

Unlike its west coast counterpart, SCRRBA, the ECRBA does not act as a frequency coordination council and does not assign systems to specific channels. In the areas in which their member systems operate, such activities are the domain of established frequency coordination councils such as TSARC. Its main purpose is to act as an affiliation of, and thereby a voice for, individual amateurs and amateur clubs along the eastern seaboard who either now operate or are interested in the construction of amateur remote-base stations.

It was to that end that the ECRBA established the following goals for itself:

1) The promotion and support of current remote-base technology and activity.

2) The designation of simplex frequencies on VHF and UHF amateur bands upon which remote-base systems can meet.

3) The coordination and filing of existing remote-base systems in geographically diverse areas along the eastern seaboard so that communications over long distances can be achieved through the creation of remote-base networks.

4) Such other purposes as may later be defined by the ECRBA membership.

The ECRBA appears to be the first such organization to be formed outside the far western and southwestern United States whose avowed purpose is fostering interest and expansion of remote-base operation. If you want more information, send an SASE to the East Coast Remote Base Association, c/o Atlantic Region Repeater Legion, 333 West 57 St., #306, New York NY 10019. For your efforts, you will receive an information sheet and an application for membership.

THE INTERTIE DEPARTMENT, OR "IT'S TIME FOR A REAL GAME PLAN"

How many repeaters are there? 1,000? 3,000, possibly? Experts peg the number of repeaters operational in the continental USA at close to 5,000, with over 3,000 of them on two meters alone! Let's face it. That's a heck of a lot of rf hardware sitting atop tall buildings, broadcast towers, and mountaintops. What do we do with most of it? By and large we use it simply to gab a bit further than we could without such relay devices. In doing so, we miss one of the greatest communication challenges ever placed at our fingertips. The challenge? The creation of a coast-to-coast, border-to-border VHF intertie. An intertie that would permit amateurs from all over the nation to converse and communicate with but handheld transceivers.

With all this hardware operational already, why has such an intertie not yet been developed? Was not one of our greatest objectives in overturning the results of Docket 18803 to permit restoration of intercommunity relay communication and again permit repeaters to interlink for greater range? What have we done with this freedom we gained a few short years ago? Little! True, there have been a number of regional and interregional experimental interlinks, most, if not all, privately owned and operated with highly restricted access and usership. The few local open interties are a minority within a minority. The potential exists, the equipment is there already, and with the addition of a bit more human communication, a national system could come into being within a year or two.

The key to the establishment of an open national intertie is to set our goal and then utilize what we already have. At the outset, a national organization to oversee the implementation of such an intertie is not necessary, although it could make the job a whole lot easier. Once off the ground, such an organization, filled with many layers of bureaucracy that are the byword of such organizations, will develop. Who knows, if we do a good enough job, the American Radio Relay League may even take all the credit for it. Right now, though, we must begin in as simple a way as we can, building outward from the local level.

You might start by locating another repeater in your area some distance away and arrange some form of permanent interlink between the two. Then add a third system in the same or another direction. Exactly where you wind up, geographically speaking, is not that important. Communicating with one another outside the normal coverage area of your favorite repeater is. If enough systems jump on this bandwagon, and if normal growth patterns prevail here as they have in repeater operation development itself, then a national open intertie can and will develop of its own accord.

What's nice about doing it in this way is that we need not add any new systems to the already overcrowded two-meter spectrum. The radio links can be on 420 MHz or, in areas where 420 to 450 is already totally utilized, the 220-MHz band would be an ideal choice. Even in areas where UHF is overflowing with activity, in most cases the 220 MHz band lies dormant. Can you think of a better use for 220 MHz?

There is another important prerequisite. For this idea to work, each area has to know what the next area is doing. To that end, "Looking West" could provide the space necessary to disseminate information. I can act as an informational clearinghouse and thereby give you monthly updates of who is accomplishing what, where. How about it? Does the idea of such a national intertie intrigue you? Do you find interesting the idea of driving in downtown Chicago while conversing on VHF with two friends many thousands of miles away?

At the very close of Dave Bell's new film, "The World Of Amateur Radio," the film's narrator, Roy Neal K6DUE, states: "We look forward to the day that members of our fraternity will be going into space, to the moon and beyond." Maybe for the moment this is but a dream of the future, but when Art Gentry W6MEP placed K6MYK (now WR6ABN) on the air back in the 1950s, I'll bet that he had no idea where it would all lead. Art had made one of his dreams come true, and out of early experiments such as K6MYK grew the VHF and UHF relay activity we have today. In reality, we have far more repeaters in more places than we know what to do with. Many lie dormant day after day awaiting some form of utilization. We have at our fingertips the ability to make the future part of the present. Any dreamers out there? Any takers?

THE VIDEOTAPE DEPARTMENT

A few months ago, I purchased a truly great toy of the 70s. It's called a Sony Betamax videocassette recorder-player and it has brought me many hours of joy. It sits comfortably in a special cabinet in our living room just below our Sony 19" Trinitron color TV, and it gets quite a bit of use, especially with my busy schedule. Originally, it was the "time-shift" feature that caused me to purchase it: the ability to be elsewhere and yet not miss something I wanted to see. Of late, though, I have come to see other uses for my toy, uses that transform it from the toy category into a useful tool—one that can be applied to amateur radio. First, however, let's take a look at what is available in home video recording equipment today.

The Sony Corporation really started what would lead to the home video revolution back in 1968 when it introduced in the US marketplace a video machine that used ¾" tape packaged in a convenient-to-use, fully-enclosed tape cassette. The unit was called the U-Matic, and it was not long before it became a standard in the broadcast industry. While it was not as good as 2" high-band quad, it gave excellent results and soon began to nudge film from the limelight in news gathering and dissemination. By the early 70s, with the advent of the portable videocassette recorder-player along with light-weight (by comparison) cameras, what is now called the "electronic news gathering" or "electronic journalism" era had begun. Today, the majority of news we see on TV is on videotape rather than film.

For consumers like us, things lagged behind. Only the truly affluent could afford a U-Matic type machine. Tape cassettes were rather expensive and offered but one-hour record-play time. However, Sony foresaw the coming video revolution, and around 1975 it introduced its first ½" format home videocassette system to which it

Continued on page 178

DX

Chuck Stuart N5KC
5115 Menefee Drive
Dallas TX 75227

These are the heydays of DXing. If it seems like we keep repeating ourselves on this subject, bear in mind that we only want to make you aware that this is not the normal state of things. We are now at the peak of cycle 21, and, although there are many good days ahead for the deserving DXer, we are now on the downhill slide. Work everything in sight; those QSL cards will help you make it through the doldrums ahead. Hopefully some of the following information will help you in your quest.

HEARD ON THE BAND

VR3AH left Christmas Island July 22 and returned to the states. VR3AR plans to remain active until February or March and there is a new operator there waiting only for the necessary license to begin operating. There is a possibility that Greg WB4PRU will handle the QSLs for this new station. During the period May 28, 1979, to July 8, 1979, while Doug VR3AH was in the states for a little R & R, Slim paid a visit to his station and managed a number of QSOs. If you logged VR3AH during this period, know that you have met the Slim one himself.

Jerry WA1ZXF sent in the following in response to our request for more CW activity reports. It covers a typical night on 20 meters and while nothing super rare is covered, it shows there is plenty of "bread and butter" DX there for the taking.

FC9UC—On regularly from 1700 to 1900 UTC between 1410 kHz and 14160 kHz. Jean is always happy to answer a CW call.

UK2GAT—A club station operated by the various members. On nightly from 2300 UTC between 14050 kHz and 14070 kHz with a strong signal.

YU2CAL—Mladen is a nightly regular around 14030 kHz.

SP8RJ—Another almost nightly regular. Jurek puts a strong signal into the states around 14035 kHz.

LZ1GC—Stan is on nightly from 0400 UTC around 14070 kHz.

Jerry says there are many more such stations available nightly for the deserving DXer.

EA6DD, formerly EA3EG, shown with his nice station in Palma in the Balearic Islands. Eighty years young and still going strong, he prefers CW and can usually be found on the low end of fifteen or twenty when the band is open.

The second annual International Island DX Contest sponsored by the Whidbey Island DX Association begins at 0000Z on January 12, 1980, and runs through 2400Z January 13, 1980. This is a good chance to pick up some of the rarer islands for *your* DXCC. Contest entry forms are available from Gary Pierson WA7GVM, Box C, LaConner WA 98257.

Roy W5VJT reports receiving QSL cards from UC2AF, UC2AFA, and UC2AFB. UC2AF is father to UC2AFA and UC2AFB.

CK2CRS was the official station of the Canoe/Kayak World Championship. QSL to Serge Freve VE2FIT, 1505 des Martinets, Chicoutimi, Quebec G7H 5X9, Canada.

Jean Ghys, formerly ON4KU, reports that Slim seems to have taken a liking to his old call because he has been receiving a number of QSLs for stateside contacts he never made. Jean says he is no longer active and that any contacts with anyone signing ON4KU are bogus.

We received numerous responses to our comments concerning the trend towards DXpeditions spreading the calling stations out over a 40 to 50 kHz portion of the band, thereby making it useless for any normal use. Those defending such operations pointed to the fact that this method resulted in the highest QSO-per-hour rate. That argument misses the point entirely. The QSO-per-hour rate is not the problem. The problem is that while such an operation is in process, all normal day-to-day communications come to an abrupt halt. This hardly endears us to our fellow hams. While a few wrote to say that all split-frequency operations should be banned (transceiver owners, no doubt), the majority favored spreading the calling stations out over no more than 15 to 20 kHz. If this proves inadequate, the DX station can go by call areas or even by prefixes within call areas. There are many ways to ensure a successful DXpedition, but widespread calling is not one of them.

Johanna OY5J has been showing on 14240 kHz Mondays after 2330Z. This is the group led by WA2JUQ and a number of rare-type DX stations can usually be found checking in looking for the deserving ones.

5H3KS has been drawing massive CW pileups almost daily on 21022 kHz from 2330Z.

Seems like 7J1 is still high on most-needed lists in the W2 area. The JARL is reportedly aiming for another all-out effort after the monsoon season.

OE6EEG is said to be planning another 8Z4 effort for right about now.

Scotty K5CO and Dave N2KK plan to remove the entire Indian Ocean area from your needed list and are right on schedule. They plan to start on FR7 Reunion Island around the first of December and then sweep through the area, taking no captives. Dave is gearing up for some extensive 40 through 160 action, while Scotty handles the 10/15/20 demand.

Seven or eight S79 stations did manage to get their licenses renewed on June 1st, but the fee was a bit stiff—$82.00 each.

FH8OM and FH8YL ask that cards be sent via their managers only. Seems that someone in the local post office is an avid green-stamp and IRC collector.

Those new J7 prefixes replace the old VP2D prefixes. Al VP2DD now signs J7DD.

VQ9TC now signs KG6JIQ.

There is a new DX-DX SSB net on 7082 kHz at 0500Z. N5RQ takes stateside check-ins at 0630Z on 7165 kHz.

CQ Magazine has raised the price on all DX Certificate applications to $5.00.

Any ZA activity you might hear is probably Slim, but, of course, work them anyway. It will keep you in practice for that day when the real thing appears. The present situation is as follows: The license application by SM4CMN and SM3VE is being ignored, DL7FT (who was

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LETTERS

BEFUDDLED

I must admit that I like your magazine; technically, it strikes a middle ground between the continuous brilliance of *Ham Radio* and the occasional gems in *QST*. Nevertheless, the political ramblings leave me a bit befuddled.

For instance, I notice regular references to the "debacle" of incentive licensing. So what's the hassle? If you want the greater privileges, you get off your ass, stop complaining, and study for the next higher license.

If any body should *not* be complaining, it's you, Wayne. The way I figure it, you do a pretty penny's worth of business in code tapes and study guides for aspiring applicants. Seems to me if incentive was dumped, you'd have a major "walletectomy" there.

But, ignoring that, I *still* don't see what's so bad. Incentive licensing is the same system that made America great: Those with higher rank get higher privileges. I'm convinced any one of us could get the Extra if he was motivated to study enough. At least, unlike business or military worlds, hard work guarantees results.

Seems to me incentive licensing is like the American socioeconomic system in a microcosm. I don't see how you could like one and not the other.

By the way, I don't hold the Extra class, so this isn't the voice of the "haves" telling the "have-nots" to be happy and shut up. It's just in recognition of a damn good system that apparently still needs defense.

I also doubt that this will ever get into your rag since I've tacitly called all of you anti-incentive types un-American.

At any rate, your mag is basically good, if all you read is the technical stuff. I *may* even renew.

Bob Lombardi WB4EHS
Ft. Lauderdale FL

Bob, you need to talk with someone who has been around amateur radio for a few years and then you would understand the irony of the term "incentive licensing." Sure, the system is working pretty well now, but do you honestly think that what you see now is all we ever had?

In 1963, the League proposed what they called "incentive licensing." The idea was to go back thirty years to the licensing system of the 1930s. They proposed taking most of the phone bands away from the General class, the way it was pre-WWII. I put up such a fuss that eventually the FCC only took half the phone bands away. The whole idea was to get amateurs to upgrade. I said they would do better if they gave rewards for upgrading; the ARRL said it would be better to take frequencies away and then give them back if you upgraded. The basic difference was one of punishment vs. rewards.

This brought on ten years of zero growth, little upgrading (I have published the facts and figures showing the extent of this disaster), and the death of all of the major manufacturers. Then the FCC put through my suggestion of giving the callsign of your choice to Extra class licensees...and clubs responded to my plan for getting them to offer Novice study courses, for which I published instruction manuals and provided code tapes. Amateur radio finally started to grow again and at last we had an increase in Extra class licensees.

The League saw what was happening and put out their own code course and did their best to cover over the incentive licensing fiasco. By the way, the FCC admitted that this was a complete debacle . . . that's why they changed the system to the present one . . . which is working reasonably well.—Wayne.

STRIKING DISTANCE

It was over a year ago that you very kindly sent me the *73* code system tapes, i.e., 5, 6, 13, and 20+ wpm, which were available at that time.

Now that I'm copying the 20+ at about 95% and working out at that speed, I thought you might like a breakdown of progress since starting and until now.

First, let me say that I think your system is excellent and without it would never have passed my CW test nor obtained my ZS (unrestricted) license here In South Africa.

Being a Master Mariner and a Nautical Examiner of Masters and Navigating Officers and also an ex-lecturer/training officer of cadets preparing for the Mercantile Marine, I feel I'm qualified to give an opinion on your training method, which I feel is without equal.

Second, although I'm 54 years of age, I have always, since going to sea at 14, known the Morse code, so I didn't have to learn the characters from start. But, in the Mercantile Marine, candidates for the various Certificates of Competency are required to "satisfy the examiner of their ability to send and receive signals in Morse code by *flash lamp* up to 6 wpm."

I think you will agree that there is a world of difference between copying a flashing light at 6 wpm and sound. So I virtually had to start from scratch insofar as sound was concerned.

I started on the 5 wpm tape in May, 1978. In July (just over 2 months later), I passed the CW test (12 wpm) and received my ZS license. Since then, I have had nearly 500 QSOs on CW and I can thank you for giving me that pleasure.

From the 13 wpm tape, I moved to the 20+ wpm tape in August, and by December, some 5 months later, I was copying about 80%. As I have said already, I'm copying about 95% now.

Now I'm practicing on local weather reports in order to learn to copy at 25-30 wpm. It has been your excellent system which has placed me within striking distance of my goal.

Norman Caseley ZS5NC
Pinetown, South Africa

CUSHCRAFT

It seems that we are always hearing stories of problems with service, quality, and delivery from the many manufacturers and dealers of amateur radio equipment and supplies. I feel equal recognition should go to the manufacturer or distributor who gives service above and beyond the call of duty.

A couple of weeks ago, I purchased from a local dealer a Cushcraft ATB-34 triband beam. At the same time, I contracted a man with a crane to help me put it on my tower. Upon assembling the antenna 3 days before it was to be installed, I unfortunately encountered a defective part. I thought my deposit to the installer was lost because I contracted for a particular time and day and I knew for sure that the part would never make it from the wilds of New Hampshire to New Jersey in the 2 days I had left. After a phone call to Cushcraft and a conversation with a gentleman named Hugh, I found out my worries were unfounded. At their expense, they navigated through the woods and mountains of New Hampshire to the nearest post office immediately after my phone call. They had the part shipped Express Mail with a promise from the US government that the part would be at my door within 24 hours. Sure enough (for a change), the government was right. I had the part the next morning and the antenna went up the following day as scheduled.

This personal service was, in my opinion, far beyond what can be generally expected from most of the companies with whom I have dealt in the past. Granted, if something you purchase is under warranty, it will be repaired or a defective part replaced, but usually with a long delay even under emergency conditions as was my case.

This experience with Cushcraft service shows the concern the company has for the consumer *after* the sale is made. Unfortunately, this cannot be said for many other companies I have dealt with.

Ed Feins WA2ZDN
Linden NJ

WOODPECKING

I heard something on twenty last night that bothered the heck out of me. Please recall the correspondence concerning the "Russian woodpecker" and its cure from about two months ago. If you have not heard already, this cure (CW tones in pace with the radar pulses) no longer works.

Apparently the defense taken by amateurs was too effective for the Russians, for they have modified their system. The tones are no longer the broadband clicks of yore, but seem now to be a type of broadband FM. It sounds like the only way to cope with this would be to sync slow-scan signals on top of the radar, or use recordings out of sync to throw off their video display. Either cure is worse than the disease, with slow-scan and radar recordings chasing the intruder up and down the band!

Wayne, please tell your readers that *any time* they hear the "woodpecker," they should immediately call the nearest FCC monitoring station. It's been said before, but if they get bothered with enough calls, we may get something done.

I haven't listened to the bands in the last week or so, so

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RTTY Loop

Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

As much as I hate to do this, I am starting this month's column with a word of caution. In my February, 1979, "RTTY Loop," I relayed a blurb sent to me by a firm called "Teleprinter Art, Ltd." in Urbana, Illinois. The company presented itself as a source for all kinds of RTTY artwork, at reasonable prices. Its catalog is decorated with samples and stocked with many delightful bargains. If only it were true! Over the past few months, I have received letters from several individuals who have ordered material from Teleprinter Art, Ltd., and never received anything but their cashed checks. Communication with the management of the company has been fruitless, and as of this writing almost one month has elapsed since I sent a letter of inquiry to them. No reply has yet been received. While I acknowledge that to date there is no conclusive evidence of wrongdoing by Teleprinter Art, Ltd., I would urge anyone anticipating doing business with that firm to approach the transaction with reasonable caution. If anyone has further experiences regarding this company, either positive or negative, I would be interested to hear from you. I shall try to forward any such information to you all as received, and to keep you posted on the situation in general.

Moving from the questionably secret to the openly clandestine, many of you have been writing in asking about press and weather frequencies. Fig. 1 is an attempt to answer some of those questions. Now, before you get all bent out of shape and totally snowed by the chart, let me do some explaining. As suggested a few months ago, most of the commercial RTTY stations do not transmit "ham standard" 60-wpm, 850-Hz or 170-Hz shift, low-space RTTY. They *do* send anything they darn well want to, including strange shifts, shift direction, or speed. Thus the table.

Whether or not you can copy the transmitted shift is more a function of the converter than anything else. By straddle-tuning, almost any shift should be copyable. The ST-6, for example, can copy 425-Hz shift with the autostart turned off. You will just have to try yours and find out.

The speed may present more of a problem if you are using a machine which is not geared for the frequently-found 67 wpm speed. Most Model 15s and 19s will do fairly well if the range selector is set to the high end. Again, experimentation may be the best bet.

As more of these frequencies are received, I will try to compile them and include a list, periodically, in the column. Let me know what you hear, and I'll pass it along.

A letter received from Richard Black W2DBU asks about the use of the ASR-33 on a Baudot/Murray circuit following code conversion. Richard writes, "... you mentioned that the ASR-33 is just too slow to receive 60-wpm RTTY. I do not understand this as I believe that the old Baudot printers could copy this speed. Is not 60 wpm about 45 baud?"

The answer to the question is, "Yes and no!" While 60 wpm is 45.45 baud and the ASR-33 copies at 110 baud (or 100 wpm), that is not the problem. The statement was made with respect to a code conversion program which used a software UART for receiving the RTTY. Thus, decoding could not begin until the last data pulse had been received. Following decoding, the data must be sent to the printer before the next start pulse is expected. In a worst-case situation, i.e., receiving at "machine speed," this leaves the length of the stop pulse, about 31 ms, to send the character to the printer. In order to send one ASCII character in 31 ms, you need to send at a rate of at least 300 baud. That is where the problem lies. If you are content to pause 100 ms or so after each character is sent, the ASR-33 will be able to follow. But you can't do that practically, so you really can't use a 110-baud printer.

Remember, however, that the constraint on the system is that the processor must be available for the full time that a character is being received. What if, you might suppose, you presented the entire character at one time; could you then use a 110-baud output? Of course, you can! The way to implement this is to use a hardware UART such as a 1013 to receive the RTTY, allow the processor a few microseconds or so to do a code conversion, and dump the ASCII into another UART or ACIA. This would work just fine, but it was not the scheme of the program. Hope this clears things up for you, Richard.

NEAT TRICKS DEPARTMENT

From time to time, I will try to pass along some neat tricks which can save you time and money while playing with your RTTY. I am sure that most of you are aware that replacement ribbons for your Teletype™ machines are available at any stationery and many variety stores. No, they may not be labeled as such, but any ribbon which fits an Underwood standard typewriter will fit your Teletype machine just fine. There comes a time, however, when you need a dark image and no new ribbon is available. What then? Well, it turns out that most light ribbons are not out of ink, they are just dried out. A little solvent will frequently bring new life to an old ribbon, with almost no effort. What I do is spray some contact cleaner (I use one called LPS-1) along the length of the ribbon while the machine is spacing. Don't spray too much or you will have an inky mess of a machine. You want to just dampen the ribbon. Wait overnight for the excess to evaporate, and you have a rejuvenated ribbon. Like I said, *neat trick*!

FREQUENCY (kHz)	SHIFT	NORM/REV	SPEED	COMMENTS
14484	425	REV	67	Reuter News
14573	?	?	67	French News
14600	425	REV	67	New York News
14700	425	REV	67	Polish News
14845	425	NORM	67	UPI News
14900	425	NORM	67	Spanish News
14974	425	REV	67	English News

Fig. 1. Some RTTY press frequencies.

W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

from page 6

mance at the last WARC in 1959 is any criterion, where League officials were flown over at League expense, even with their salaries being paid by the League, and for no more important function than to attend some lavish parties, then they might indeed run through the three-quarters of a million.

Will the League again have a lavish suite of rooms in one of the most expensive hotels in Geneva, all paid for by some 80,000 generous League members? The concept of Yankee thrift seems not to extend down to Connecticut. If you are sucker enough to eagerly send in your hard-earned money for these turkeys to enjoy themselves at your expense, so be it.

While on the one hand I keep hearing the moans of poverty from Newington, on the other I look at their recent balance sheet and find that their net worth increased last year by almost 10%. Most firms would count that as a profit, but the League, being "non-profit," shuffles the bookkeeping around and puts the funds into stocks and bonds (they have over $1.5 million sitting in securities).

The election of directors is coming up this fall and half of the directors are up for re-election. If you blindly return these chaps to office, then *you* must share in the responsibility for what is happening. With the exception of Don Miller, you have nothing to lose by turning the lot of them out. Darned few are active hams anyway... they are politicians and they're using your money for gratifying their egos. With some new directors, you might have a chance of getting the entrenched clique kicked out of HQ and getting someone with business experience into the job.

I think every amateur really wants to be able to be proud of the ARRL and see it regain its leadership position. But we can't respect it when we see the double-talk and cover-ups... and when we see everyone we've known at HQ for years getting the hell out... except for Baldwin and Dannals.

It is the responsibility of the directors to see that they have an HQ staff which will run the organization in the black. It is the responsibility of the members to see that they vote in directors who will run the organization and not be buffaloed by a couple of people at HQ. In the meanwhile, sending more money to the League will

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Microcomputer Interfacing

Jonathan A. Titus
Christopher A. Titus
David G. Larsen
Peter R. Rony

The purpose of this month's column is to introduce the reader to some of the characteristics of the Intel 8253 programmable interval timer, an extremely versatile I/O chip that can be used in a wide variety of potential applications, such as a real-time clock, event counting, and period counting, in addition to the replacement of software-implemented timing loops.

The 8253 is a 24-pin integrated circuit that requires a single 5-volt supply and contains three independent 16-bit *interval timers*, each of which can be operated in six different modes. An *interval timer* has been defined by Graf's *Modern Dictionary of Electronics* as a device for measuring the time interval between two actions or a timer that switches electrical circuits on or off for the duration of the preset time interval. Fig. 1 serves the dual purpose of giving the pin diagram of the 8253 chip and showing how the chip can be interfaced with an 8080A/8085-based microcomputer system using memory-mapped I/O.

The 8253 chip contains four internal registers (three interval timers and a control register) that are decoded as memory locations 200 000 through 200 003 with the aid of the address bus signals A0, A1, and A15 (see Fig. 1 and Table 1). Observe in Table 1 that the $\overline{RD}$ and $\overline{WR}$ control inputs determine whether you are loading or reading a specific register. It is not possible to read the contents of the control register.

Table 2 summarizes the coding for the 8-bit control register within the 8253 chip. Observe that bits D7 and D6 determine the selection of the interval timer, bits D5 and D4 determine the nature of the read/write operation associated with the chosen timer, bits D3, D2, and D1 determine the mode of operation of the chosen timer, and bit D0 determines whether the timer counts down in binary or binary-coded decimal (BCD).

Fig. 2 provides a block diagram for a typical counter in the 8253 chip. The microcomputer loads the 16-bit down counter as two successive bytes, a HI byte and a LO byte, via the bidirectional data bus, D0 through D7. If the gate line GATE is active, negative edge transitions at the CLK input decrement the counter. When the counter reaches zero, OUT becomes active, its actual behavior depending upon the mode programmed into the control register for the counter (see Table 2). The 8253 chip contains three independent 16-bit counters, and each can be programmed independently in any one of the six modes of operation. The counter inputs and outputs, CLK, GATE, and OUT, for the chosen counter are independent of the CLK, GATE, and OUT input/output of the remaining two counters on the chip.

In addition to the address bus, data bus, and control bus connections shown in Fig. 1, the CLK0 and GATE0 inputs to counter #0 are respectively connected to the $\phi 2$ (TTL) microcomputer clock output (typically 2 MHz) and to bit 0 of accumulator output port 000. Any TTL level clock with a frequency of less than 2 MHz can be used as input to CLK0, and any suitably debounced switch or source of strobe pulses can be used to control the timer at GATE0. The output of the counter OUT0 can be connected to an oscilloscope to permit observation of each of the six timer modes of operation.

$\overline{CS}$	$\overline{RD}$	$\overline{WR}$	A1	A0		Memory address in demonstration program and interface circuit
0	1	0	0	0	Load counter #0	200 000
0	1	0	0	1	Load counter #1	200 001
0	1	0	1	0	Load counter #2	200 002
0	1	0	1	1	Load control register	200 003
0	0	1	0	0	Read counter #0	200 000
0	0	1	0	1	Read counter #1	200 001
0	0	1	1	0	Read counter #2	200 002
0	0	1	1	1	No operation (three state)	–
1	X[a]	X	X	X	Disable chip (three state)	–
0	1	1	X	X	No operation (three state)	–

X[a] = don't care (logic 0 *or* logic 1).

Table 1. Addressing the 8253 programmable interval timer.

Bits			Control function
	D7	D6	
	0	0	Control word is for counter #0
	0	1	Control word is for counter #1
	1	0	Control word is for counter #2
	1	1	–
	D5	D4	
	0	0	Latch both bytes of chosen counter for read operation
	0	1	Load or read only most significant byte of chosen counter
	1	0	Load or read only least significant byte of chosen counter
	1	1	Load or read LS byte first, then MS byte of chosen counter
D3	D2	D1	
0	0	0	Mode 0: Output = 1 on zero counter
0	0	1	Mode 1: Retriggerable variable-width one shot
X[a]	1	0	Mode 2: Programmable rate generator
X	1	1	Mode 3: Programmable square wave generator
1	0	0	Mode 4: Delayed strobe (software triggered strobe)
1	0	1	Mode 5: Triggered strobe (hardware triggered strobe)
		D0	
		0	Count down in binary
		1	Count down in binary-coded decimal (BCD)

X[a] = don't care (logic 0 *or* logic 1).

Table 2. Coding for the 8-bit control register in the 8253 chip.

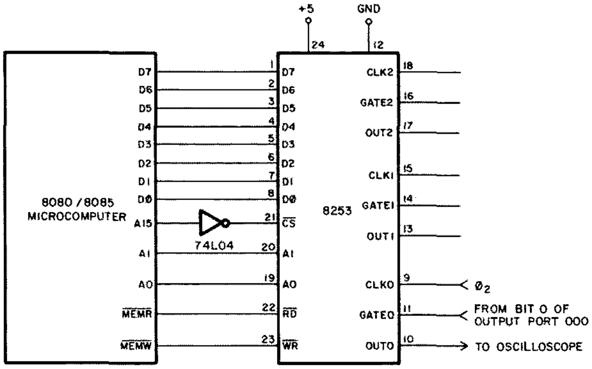


Fig. 1. Interface circuit between a 8253 programmable interval timer and an 8080/8085 microcomputer. The 8253 chip uses four locations of memory in this memory-mapped interface circuit.

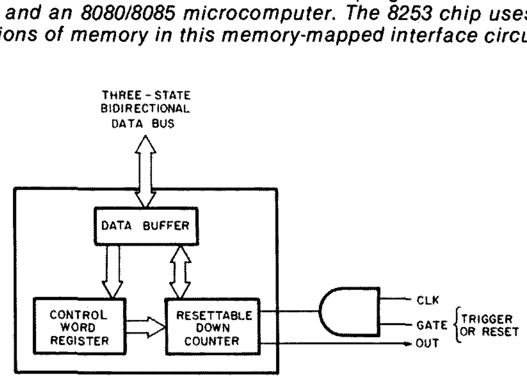


Fig. 2. Functional diagram of each of the three 16-bit interval timers in the 8253 chip. The gate input acts alternatively as a gate, trigger, or reset input, depending upon the mode chosen.

Ham Help

I need some help. I have recently inherited a Hammarlund HQ-120X receiver and I am badly in need of a diagram. If anyone out there can help, I would gladly pay for copying costs. Thank you.

Louis A. Johnson
32 Crosscreek Drive, Apt. I 3
Charlestown SC 29412

I am in need of maintenance manuals for the following:

1. Standard signal generator, model 82, manufactured by the Measurements Corporation of Boonton NJ.

2. Frequency meter, FR-114 A/U, made by Sentinel Electronics, Inc.

3. Signal generator, TS-323 U/R.

I will be happy to purchase these manuals or copies of the pertinent maintenance data, schematics, etc., and pay cost of mailing.

Robert L. Marcon W5CBW
Rt. 7, Box 96A
Lucedale MS 39452

Awards

Bill Gosney WB7BFK
2665 North 1250 East
Whidbey Island
Oak Harbor WA 98277

Note: The address shown for Bill Gosney in the August issue of 73 was incorrect. The correct address is that shown above.

As editor of *73*'s newest column, I'm quite impressed with the warm reception received from so many of our readers situated throughout the world. Obviously, my recent announcement of an exclusive *73* Awards Program has turned quite a few heads and stimulated the interest of a great many. I thank you all for your written support arriving from all continents on the globe.

Without further to-do, let's turn to part II of our two-part series and learn for the first time about the four stateside award programs being sponsored by *73*. Keep in mind that these awards were not meant to be an overnight venture nor were they designed to duplicate any in existence today. Each offers its own degree of difficulty and creates a sense of accomplishment amongst those who are happy recipients.

WORK ALL USA AWARD

Sponsored by the editors of *73 Magazine*, this award is available to licensed amateurs throughout the world. To be valid, all contacts must be made January 1, 1979, or after. There are no band or mode restrictions; however, single-band accomplishments will be recognized.

To qualify, applicants must work each of the 50 US states within the same calendar year (January 1 through December 31). Annual endorsements will be afforded those applicants who can substantiate their claim.

To apply for the Work All USA Award, make a self-prepared list of claimed contacts in alphabetical order by US state, beginning with the state of Alabama. Indicate the state, the callsign of the station worked, the date and time in GMT, and the band and the mode of operation.

Do not sent QSL cards! Have your list of contacts verified by two amateurs, a local secretary, or a notary public. Forward your application along with the award fee of $3.00 or 8 IRCs to: Bill Gosney WB7BFK, *73* Awards Editor, 2665 North 1250 East, Oak Harbor, Whidbey Island, Washington 98277 USA.

As you quickly surmised, the Work All USA Award with its 12-month limitation, more or less in a manner of speaking, separates the men from the boys when it comes to working all states.

Regardless of how difficult it may first appear, applicants who choose to work a few of the contesting events held each month or check into a few of the WAS nets will find the USA Award a relatively easy accomplishment.

Now, on the other hand, should you care to undertake an even greater challenge, take a hard look at this next award. This one was designed to appear fairly simple at first glance, but will drive you right up the wall with frustration as it is pursued. Known as the District Endurance Award, you'll need to find yourself an accurate timepiece, as you'll have exactly sixty minutes to work all US call districts. Simple, huh? Read on; there is a catch:

DISTRICT ENDURANCE AWARD

This award, sponsored by the editors of *73 Magazine*, is offered to licensed amateurs throughout the world. To be valid, all contacts must be made January 1, 1979, or after. There will be no band or mode restrictions. Contacts while a contest station or while working a contest station will not be allowed. Likewise, contacts made on any type of net operations will be invalid.

To qualify for this award, applicants must work all ten US call districts in one hour or less. The time will commence the moment the first contact is made and will end with the time logged for the last district required.

To apply, applicants must prepare a signed declaration that all contacts were independent of contest or net operations. Applications should include a self-prepared list of claimed contacts in order of their prefix. Include the date and time worked in GMT, the band and mode of operation, and the state.

Do not send QSL cards! Have your list of contacts verified by at least two amateurs, a local radio club secretary, or a notary public. Forward your application along with the award fee of $3.00 or 8 IRCs to the attention of: Bill Gosney WB7BFK, *73* Awards Editor, 2665 North 1250 East, Oak Harbor, Whidbey Island, Washington 98277 USA.

What would an awards program be like without some sort of QRP incentive? With this in mind, the editors of *73* feature a special ten-meter achievement award. Being an avid user of converted Citizens Band equipment, I found personal interest in this award and hope our readers will share the challenge.

TEN-METER 10-40 AWARD

Available to licensed amateurs worldwide, this award sponsored by the editors of *73 Magazine* offers a challenge second to none. To be valid, all contacts must be made on the 10-meter band using only "channelized" converted Citizens Band equipment or similar type "commercial units." Power is limited to 15 Watts pep output. External amplifiers may not be used.

To be eligible, all contacts must be made October 1, 1978, or after on either AM, SSB, CW, or FM. Mixed mode contacts are not valid.

To qualify for this Ten-Meter Award, applicant must work and confirm at least forty (40) of the 50 US states. An endorsement for all fifty states will be issued to those who verify their claim.

To apply, make a list of contacts in alphabetical order by US state beginning with Alabama. Include the full callsign, date and time worked in GMT, band and mode of operation, and a brief description of the equipment used for each contact claimed.

Do not send QSL cards! Have your list verified by two amateurs, a local radio club secretary, or a notary public. Send your application along with your award fee of $3.00 and 8 IRCs to: Bill Gosney WB7BFK, *73* Awards Editor, 2665 North 1250 East, Oak Harbor, Whidbey Island, Washington 98277 USA.

As noted in the Ten-Meter Award rules, recognition is given for single-mode contacts only. To the best of my knowledge, this award is the only one in existence that offers FM endorsement. Should you or a friend be involved in the latest craze of 10-meter FM operation, be sure to pass the word along that we have an award designed especially for you. While you are at it, why not lend your September as well as this October issue of *73* to fellow amateurs who are not aware of our new awards program? All eight domestic and DX achievements are outlined.

Though the title may be deceiving, this next award is probably the ultimate in our domestic program. Consider it the toughest to attain. A look at the requirements clearly identifies the degree of difficulty in obtaining this award. Luckily we were sympathetic enough to eliminate any time limitations.

CENTURY CITIES AWARD

This award, sponsored by the editors of *73 Magazine*, is available to licensed amateurs throughout the world. Designed as a dual Work-All-USA effort, the applicant who qualifies for this accomplishment will realize he has achieved what is probably the greatest feat in domestic award programs available today.

As with all the *73*-sponsored awards, with the exception of the 10-meter incentives, all contacts must be made January 1, 1979, or after to be valid.

To qualify, the applicant must work and confirm a minimum of two cities or towns in each of the fifty (50) US states for a total of 100 US cities.

To apply, prepare a list of claimed contacts, listing each one in alphabetical order by state. As shown below, include the full callsign of the station worked, the date, the band, and the city. Beginning with Alabama, your list will look something like the following example:

Alabama—W4ZZZ, March 31, 1979, 14 MHz, Decatur; N4XXY, February 1, 1979, 21 MHz, Mobile. Alaska—KL7AB, January 22, 1979, 7 MHz, Anchorage; WL7WW, May 19, 1979, 28 MHz, Fairbanks.

Do not send QSL cards with your application! Have your list of contacts verified by two amateurs, a local radio club secretary, or a notary public. Enclose your verified list along with the award fee of $3.00 or 8 IRCs and send to: Bill Gosney WB7BFK, *73* Awards Editor, 2665 North 1250 East, Oak Harbor, Whidbey Island, Washington 98277 USA.

ARROWHEAD RADIO AMATEUR FIFTY-YEAR CERTIFICATE

A free certificate is being offered by the Arrowhead Radio Amateur Club of Duluth, Minnesota/Superior, Wisconsin, to celebrate fifty years of organized amateur radio in the Twin Ports area.

For this award, any amateur within fifty air miles of Duluth/Superior is considered an Arrowhead amateur. To receive this award, US and Canadian amateurs must work five Arrowhead amateurs; all foreign amateurs must work two Arrowhead amateurs during the month of October, 1979.

Contacts made during the Arrowhead Radio Amateurs Fiftieth Anniversary QSO Party on October 20 and 21, 1979, may be used for this certificate.

Logs must show band, mode, date, time in UTC, and stations worked to receive this award. Send logs, with SASE or IRC, to Arrowhead Radio Certificate,

Continued on page 176

Contests

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

CALIFORNIA QSO PARTY
Starts: 1800 GMT October 6
Ends: 2359 GMT October 7

Single-operator stations are limited to 24 hours operating time with on and off periods clearly marked in the log. Multi-operator stations may operate the full 30 hours. Stations may be worked once per band per mode, simplex only. CA stations that change counties may be considered new stations.

EXCHANGE:

CA stations send QSO number and county. All others send QSO number and state, province, or ARRL country.

FREQUENCIES:

CW—1805, 3560, 7060, 14060, 21060, 28060.

SSB—1815, 3895, 7230, 14280.

Novice CW—3725, 7125, 21125, 28125.

SCORING:

Each complete contact is worth 2 points; CA stations count the 50 states plus VO/VE 1-7 and VY1 for a maximum of 58 multipliers; non-CA stations will use the number of different CA counties worked, a maximum of 58. Final score equals QSO points times the multiplier.

ENTRIES:

Summary sheet and logs must be postmarked not later than November 1 and sent to: NCCC, c/o Alan Brubaker K6XO, 34456 Colville Place, Fremont CA 94536. Please include a business-size SASE with your entry. Awards for individuals and clubs will be awarded.

QRP ANNUAL OCTOBER QSO PARTY
Starts: 2000 GMT Saturday, October 6
Ends: 0200 GMT Sunday, October 7

Sponsored by the QRP Amateur Radio Club International, Inc., the contest is open to all amateurs and all are eligible for the awards. Stations can be worked once per band for QSO and multiplier credits. General call is "CQ QRP."

EXCHANGE:

Members send RS(T), state/province/country, QRP number. Non-members send RS(T), state/province/country, power input in Watts.

SCORING:

Each member QSO counts 3 points. Non-members count 2 points per QSO. Stations other than W/VE count as 4 points. Multipliers are as follows: more than 100 Watts input = x1, 25 to 100 Watts = x1.5, 5 to 25 Watts input = x2, 1 to 5 Watts input = x3, and less than 1 Watt input = x5. Final score is QSO points times total number of states/provinces/countries per band times the power multiplier.

FREQUENCIES:

CW—1810, 3560, 7060, 14060, 21060, 28060, 50360.

SSB—1810, 3985, 7285, 14285, 28885, 50385.

Novice—3710, 7110, 21110, 28110.

All frequencies plus or minus 5 kHz to clear QRM.

AWARDS:

Certificates to the highest-scoring station in each state, province, or country. Other places will be given depending on activity. One certificate for the station showing three "skip" contacts using lowest power.

ENTRIES:

Send full log data, including full name, address, and bands used, plus equipment, antennas, and power used. Entrants desiring result sheet and scores please enclose a business-size SASE. Logs must be received by October 31 to qualify. Send all logs and data to: QRP ARC Contest Chairman, E. V. Sandy Blaize W5TVW, 417 Ridgewood Drive, Metairie LA 70001.

9-LAND QSO PARTY
Starts: 1800 GMT Saturday, October 13
Ends: 2359 GMT Sunday, October 14

A maximum of 24 of the 30-hour period may be worked.

EXCHANGE:

9-land stations send RST, county, and state. All others send RST, state, province, or ARRL country. The same station may be worked once per band and mode. If any station change counties, it may be worked again.

SUGGESTED FREQUENCIES:

CW—1805, 3560, 7060, 14060, 21060, 28060, +VHF.

SSB—1815, 3895, 7230, 14280, 21355, 28600, +VHF.

Novice—3725, 7125, 21125, 28125.

AWARDS:

Certificate to top score in each state, province, and ARRL country, 2nd and 3rd if justified. Also top mobile, portable, multi-single, multi-multi, club, and Novice.

SCORING:

Each QSO is worth 2 points. Scores shall be computed as follows: 9-land—(#QSOs) (states + provinces + ARRL countries + 9-land counties) (2 points/QSO) = total; others—(#QSOs) (9-land counties) (2 points/QSO) = total.

REPORTING:

Submit summary sheet and log. Each new multiplier shall be clearly indicated. Send logs and a large SASE to Ill Wind Contesters, c/o John W. Sikora WB9IWN, 8155 Woodlawn Street, Munster IN 46321, for results.

ARROWHEAD FIFTIETH ANNIVERSARY QSO PARTY
Operating periods:
1500 GMT October 20 to 0300 GMT October 21
1500 GMT to 2359 GMT October 21

This QSO party is sponsored by the Arrowhead Radio Amateurs Club and is to help celebrate fifty years of organized amateur radio in the Duluth MN-Superior WI area. The club was first affiliated with the ARRL in 1929. The contest is open to all radio amateurs. All amateurs within 50 air miles of Duluth/Superior are considered Arrowhead amateurs in this contest. Arrowhead amateurs may work anyone; amateurs outside the area may work only Arrowhead amateurs. The same station

Continued on page 174

Calendar

Oct 6-7	**QRP Annual October QSO Party**
	California QSO Party
	VK/ZL/Oceania DX Contest—Phone
Oct 13-14	**ARRL CD Party—CW**
	9-Land QSO Party
	VK/ZL/Oceania DX Contest—CW
	RSGB 21/28 MHz—Phone
Oct 20-21	**ARRL CD Party—Phone**
	Arrowhead Fiftieth Anniversary QSO Party
	WADM Contest
	Jamboree on the Air
	RSGB 7 MHz—Phone
Oct 27-28	**CQ Worldwide DX Contest—Phone**
Oct 28	**Crazy Eight Net QSO Party**
Nov 3-4	**ARRL Sweepstakes—CW**
	RSGB 7 MHz—CW
Nov 10-11	**CQ-WE Contest**
	IPA Contest
Nov 11	**OK DX Contest**
Nov 17-18	**ARRL Sweepstakes—Phone**
	Austrian 160 CW Contest
Nov 24	**DAFG Short Contest—SW**
Nov 24-25	**CQ Worldwide DX Contest—CW**
Nov 25	**DAFG Short Contest—VHF**
Dec 1-2	**ARRL 160 Meter Contest**
Dec 1-3	**North Carolina QSO Party**
	Connecticut QSO Party
Dec 8-9	**ARRL 10 Meter Contest**

Results

RESULTS OF THE 1979 COUNTY HUNTERS SSB CONTEST

Fixed		*Mobile*	
N7TT/2	2,034,760**	N4UF	555,385**
WD4FGW	835,835*	AI5P	477,688**
WA9MSW	809,710*	K3KX	253,242*
WB4UPW	786,828*	WA0YJL	94,188*
W8WT	346,104*	W0BK	62,964*
K9GTQ	341,964*	W5AWT	51,531*
W7JYW	173,019*	W9EWH	48,160*
WB9DCZ	165,200*	VE3IR	17,861*
WA2GPT	83,185*	K9DZG	15,067*
W1DIT	64,288*		
WD4PZN	60,288*	W8QWS	343,555
N7SU	54,802		(check log)
WD8MDG	50,400		
VE3RN	39,344	*DX*	
K2EL	8,250	CT1BY	81,238**
K8BBH	5,810	I2PHN	48,440*
N5QQ	3,320	VK4VU	45,288*
WA9WGJ	3,124	CT1TZ	1,804
WB1ANT	1,088	LA5YF	1,812*
VE3IR	460	*SWL*	
**Plaque Winner		SWL-NL-4278**	
*Certificate Recipient		Netherlands 24,336	

OSCAR Orbits

Courtesy of AMSAT

The listed data tells you the time and place that OSCAR 7 and OSCAR 8 cross the equator in an ascending orbit for the first time each day. To calculate successive OSCAR 7 orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the day's first ascending (northbound) equatorial crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world from you, it will descend over you. To find the equatorial descending longitude, subtract 166° from the ascending longitude. To find the time OSCAR 7 passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR 7 when it is within 45 degrees of you. The easiest way to determine if OSCAR is above the horizon (and thus within range) at your location is to take a globe and draw a circle with a radius of 2450 miles (4000 kilometers) from your QTH. If OSCAR passes above that circle, you should be able to hear it. If it passes right overhead, you should hear it for about 24 minutes total. OSCAR 7 will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15° east or west of you, add another minute; at 30°, three minutes; at 45°, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

OSCAR 8 calculations are similar to those for OSCAR 7, with some important exceptions. Instead of making 13 orbits each day, OSCAR 8 makes 14 orbits during each 24-hour period. The orbital period of OSCAR 8 is therefore somewhat shorter: 103 minutes.

To calculate successive OSCAR 8 orbits, make a list of the first orbit number (from the OSCAR 8 chart) and the next thirteen orbits for that day. List the time of the first orbit. Each successive orbit is then 103 minutes later. The chart gives the longitude of the day's first ascending equatorial crossing. Add 26° for each succeeding orbit. To find the time OSCAR 8 passes the North Pole, add 26 minutes to the time it crosses the equator. OSCAR 8 will cross the imaginary San Francisco-to-Norfolk line about 11 minutes after crossing the equator. Mode A: 145.85-.95 MHz uplink, 29.4-29.50 MHz downlink, beacon at 29.40 MHz. Mode J: 145.90-146.00 MHz uplink, 435.20-435.10 MHz downlink, beacon on 435.090 MHz.

OSCAR 7 Orbital Information

Orbit	Date (Oct)	Time (GMT)	Longitude of Eq. Crossing °W
22304qrp	1	0113:01	83.9
22316	2	0012:21	68.7
22329X	3	0106:38	82.3
22341	4	0005:58	67.2
22354	5	0100:15	80.8
22367	6	0154:32	94.3
22379	7	0053:52	79.2
22392qrp	8	0148:09	92.8
22404	9	0047:29	77.6
22417X	10	0141:46	91.2
22429	11	0041:06	76.1
22442	12	0135:23	89.7
22454	13	0034:44	74.5
22467	14	0129:01	88.1
22479qrp	15	0028:21	73.0
22492	16	0122:38	86.6
22504X	17	0021:58	71.4
22517	18	0116:15	85.0
22529	19	0015:35	69.9
22542	20	0109:52	83.5
22554	21	0009:12	68.3
22567qrp	22	0103:29	81.9
22579	23	0002:50	66.7
22592X	24	0057:06	80.3
22605	25	0151:23	93.9
22617	26	0050:44	78.8
22630	27	0145:01	92.4
22642	28	0044:21	77.2
22655qrp	29	0138:38	90.8
22667	30	0037:58	75.7
22680X	31	0132:15	89.3

OSCAR 8 Orbital Information

Orbit	Date (Oct)	Time (GMT)	Longitude of Eq. Crossing °W
8011Abn	1	0004:26	47.5
8025Abn	2	0009:35	48.8
8039X	3	0014:44	50.2
8053Abn	4	0019:53	51.5
8067Abn	5	0025:02	52.8
8081Jbn	6	0030:12	54.1
8095Jbn	7	0035:21	55.4
8109Abn	8	0040:30	56.7
8123Abn	9	0045:39	58.0
8137X	10	0050:48	59.3
8151Abn	11	0055:57	60.6
8165Abn	12	0101:06	61.9
8179Jbn	13	0106:15	63.2
8193Jbn	14	0111:24	64.5
8207Abn	15	0116:33	65.8
8221Abn	16	0121:42	67.1
8235X	17	0126:51	68.4
8249Abn	18	0132:00	69.7
8263Abn	19	0137:09	71.0
8277Jbn	20	0142:18	72.3
8290Jbn	21	0004:13	47.8
8304Abn	22	0009:22	49.1
8318Abn	23	0014:31	50.4
8332X	24	0019:40	51.8
8346Abn	25	0024:49	53.1
8360Abn	26	0029:58	54.4
8374Jbn	27	0035:06	55.7
8388Jbn	28	0040:15	57.0
8402Abn	29	0045:24	58.3
8416Abn	30	0050:33	59.6
8430X	31	0055:42	60.9

FCC

Some 73 readers have inquired about the legality of building and using the MDS receiving system featured in the August, 1979, issue ("You Can Watch Those Secret TV Channels"). In response to these inquiries, an FCC Public Notice (dated January 24, 1979) on MDS is reproduced here.

The key issue seems to be whether the reception of MDS transmissions by an amateur experimenter constitutes an illegal "benefit" under Section 605 of the Communications Act. Before you construct your own MDS receiving system, we urge you to read the material below.

UNAUTHORIZED INTERCEPTION AND USE OF MULTIPOINT DISTRIBUTION SERVICE (MDS) TRANSMISSIONS

In response to a few informal inquiries and complaints, this Notice is a reminder that the unauthorized reception and beneficial use of addressed communications in the Multipoint Distribution Service (MDS) is a violation of Section 605 of the Communications Act of 1934 (47 U.S.C. §605).

MDS is a common carrier service which utilizes an omnidirectional radio transmission to distribute addressed broadband communications (usually forms of television information) for simultaneous reception at multiple fixed receive points by the members of commercial, or other institutional, subscribers in accordance with their specific transmission, reception, and informational requirements.

MDS stations are not television broadcasting stations. They operate on microwave radio frequencies (2150-2162 MHz) which are allocated for common carrier service between fixed points, and which, because of their high frequency, are not receivable by conventional television or other receivers. Additional equipment is required to down-convert or to demodulate the microwave signal before it can be utilized by those television receivers, facsimile terminals, or computer data display terminals authorized to receive the communication by its sender.

Nor are MDS stations disseminating radio communications intended to be received by the general public. MDS station transmissions generally consist of various forms of private television, high-speed computer data, facsimile, control information, or other forms of addressed broadband communications. This programming is provided to the station by its institutional subscriber and is intended to be received only by members of the subscriber organization located at the multiple receive points. The MDS station transmits this programming pursuant to a federally-regulated tariff and is responsible for both its transmission and reception under Section 21.903 of the Commission's Rules and Regulations (47 C.F.R. §21.903). Although this rule permits the station's institutional subscriber the option of owning the microwave receiving equipment, such equipment must be installed, maintained, and operated pursuant to the carrier's instruction and control.

Section 605 of the Communications Act makes it unlawful:

—for a person not authorized by the sender to intercept radio communications and divulge or publish the existence, contents, substance, purport, effect, or meaning thereof to any persons; or,

—for a person not entitled thereto to receive radio communications and *use such communication or any part thereof for his own benefit* or for the benefit of another who is not entitled thereto (emphasis added).

Because material transmitted over stations is not intended to be "broadcast" material within the meaning of Section 605, authority for its reception and use must be given by the sender. Therefore, persons will be in violation of the law if they divulge, publish, or use for their own benefit any MDS communications which they were not authorized to receive.

Violations of Section 605 can result in either criminal prosecution or civil lawsuit, or both. *See KMLH Broadcasting Corp. v. Twentieth Century Cigarette Vending Corp.*, 264 F. Supp. 35 (C.D. Calif. 1967).

Ham Help

I have a Heathkit® SB-110A 6m SSB/CW transceiver. I was thinking about getting a new rig that was more up to date, but after I saw the price tags on them, I decided to keep the 110A. Can anyone recommend a noise blanker for this rig?

I'd like also to find out about all mods that can be done to the SB-110A to modernize it. I would appreciate any information that anyone can give me. Thanks.

SSG Gary Kohtala HL9TG
USAFS-K, Box 194
APO San Francisco 96271

New Products

ICOM'S IC-701 ALLBAND ALL-SOLID-STATE TRANSCEIVER

When an Icom IC-701 transceiver arrived at the *73* shack, I was pleasantly surprised by the size of the three boxes that the rig, its companion power supply, and several other accessories were packed in. Times had certainly changed from when I stumbled through the door with a brand new tube-type rig just a few years ago. The 701's size (111 mm x 221 mm x 311 mm) and 7.3-kg weight make it an ideal competitor in the growing mobile radio market.

There is no tune-up to worry about, since the radio is broadbanded. You just set the band and frequency and start talking. It's almost as easy as operating a 2-meter rig. The 701 has full coverage of the HF spectrum in the USB, LSB, CW, and RTTY modes. Receive capability for the 15-MHz WWV signal is also included.

After the rig was unpacked, there was concern as to how such a small box could possibly do so much. The controls seemed to be crowded and it looked easy to make a mistake. A month of operating has proven this to be an ill-founded fear. The front panel is well laid out—Icom certainly engineered it well.

The solid-state finals don't need any coaxing to reach their rated 200-Watt input level. A thermostatically controlled fan is included, but in normal SSB use it has never had to kick in. This rig runs cool. It is important to use a well matched antenna with your 701, a small price to pay in an age when many ham shacks have antenna tuners already. If the transmitter does overheat, the flashing frequency display lets you know that it's time to pull the switch and find out what's wrong.

Versatile Vfos

Anyone who operates *73*'s IC-701 mentions the synthesized tuning as an outstanding feature. The computer-compatible tuning system allows 110-Hz increments in frequency selection. Even the most discriminating amateur should be pleased with being no more then 50 Hz from the desired frequency. The musical effect that occurs when a heterodyne is tuned in always brings a smile to the face of a first-time user.

The tuning knob has a 5-kHz per revolution change, but a "fast tune" position allows the band to be covered in seconds. The only analog readout available is from the 100-Hz and 1-kHz dial markings. The idea of being totally dependent on a digital display doesn't seem so bad when you remember that dial backlash and the like are things of the past with the IC-701. No external vfo is needed, since the rig contains two independent ones. It is handy to set vfo "A" on a particular receive channel and use vfo "B" for transmitting when working DX. Total flexibility is the best way to describe it.

This rig stands apart from the rest when an Icom IC-RM2 is hooked to the accessory socket. It is a whole new world of operating when you can change bands and enter frequencies from a keypad. Push a button and you are on a completely different band and predetermined frequency; push another button and the 701 scans to the band edge, all in less time then it takes to say your callsign. The RM2 provides a second digital readout that is smaller than the 701's display, but it is still very useful. Four frequencies may be stored in memory and three different scanning rates are available. Any number of schemes involving remote operation, crossband repeaters, etc., are possible, thanks to the computer-compatible tuning system.

Icom's IC-701 transceiver.

Helpful Extras

No matter how versatile the Icom IC-701 synthesizer is, the rest of the rig must also be considered. Despite the lack of any pre-select control, the receiver seems to offer a sensitivity that is comparable to tuned rigs. SSB reception lacks any tinny or echoing quality, and the external speaker does a more than adequate job. The passband and RIT features are very smooth and go a long way in eliminating troublesome QRM. The instruction manual honestly states that the noise blanker works best with pulse-type noise, but may not be effective in all cases. Mobile operators may not be interested in features like a 10-dB attenuator and selectable agc, but Icom includes them for amateurs who take their operating seriously.

Speech processors have become more than just an option with most new transceivers, and the 701 is no exception. Icom advertisements suggest that the rf processor may be left on all the time without worrying about the final transistors. However, we found that the added punch given by the processor means slightly less fidelity for the operator on the other end. Processing is definitely used when I am in a pileup or similarly tough situation. The proper adjustment of the speech processor and microphone gain can be a bit confusing at first, especially when you switch to CW and the process control knob sets the output level. Hams who split their time between SSB and CW will be pleased with the 701's separate VOX delay values for each mode. No compromise here—there is even a separate volume control for the sidetone.

The four VOX adjustments, plus seven other controls, are found under the access cover which is conveniently located on top of the radio. Icom has included an swr metering circuit. Unfortunately, it is easy to leave the "set" switch on, canceling the power-out (PO) metering. The swr meter is nice for making occasional antenna checks, but it can't compete with the external variety. Another frill is the dimmer switch. This allows the frequency display and meter illumination to automatically change when the room lighting shifts.

A Few Bugs

The IC-701's most noticeable deficiency was revealed when it came time to interface the rig to the real world. Use with many linear amplifiers will require the addition of a small 12-volt relay for switching and a 10k pot to control the ALC level. A more frustrating problem occurred when I tried to use an electronic keyer. The instruction manual dictates that the terminal voltage of any external keying device must be less then .4 volts dc. Since many keyers use electronic switching, they will not work here. When I contacted an Icom representative about this problem, he suggested that the keyer output circuit be modified. It was also mentioned that Icom does not consider this to be a fault of the 701, and no changes are planned.

To save space, a miniature phone jack is used for the key rather then the universally accepted ¼-inch type. If you want to use the IC-RM2 remote controller in addition to other accessories, it will be necessary for you to modify the 24-pin accessory plug or obtain the IC-EX1 extension terminal. The EX1 overcomes the switching relay problem and offers a ¼-inch-jack-to-miniature-phone-plug combination for CW keying. Although the interfacing problems are not insurmountable, they can mean an unneeded delay for the amateur who expects easy hookup.

Since the IC-701 relies heavily on digitally-based circuitry, rf shielding is very important. Correspondence with other hams—and on-air testing—have shown that feedback problems may occur, especially when the IC-RM2 remote controller and high-power amplifier are used. Good grounding practices and careful attention to the audio lines help to cure these bugs. The instruction manual gives adequate information on problems that may result from misadjustment of the normal user controls, but little information is available about other difficulties that may crop up.

Icom has incorporated more then 470 solid-state devices in the 701. The theory documentation provides a general outline of the design, but with a few exceptions, it does not give a detailed description of individual circuits. Because of the complexity and small size of the IC-701, it is doubtful that most hams would want to service it. Some instructions for internal adjustments are given. These often require a frequency counter, rf voltmeter, signal generator, or oscilloscope. A highly competent dealer or

Icom distributor is the best source of help for the less adventuresome owner.

Being limited to admiring the rig's outward appearance is not an unpleasant pastime. The IC-701 is a sharp looking, highly functional unit. Except for peeling lamination on the faceplate of the RM2, our 701, with accessories, has performed well during daily use for the past month. Although Icom's compact "black box" seems dwarfed by the nearby antenna tuner, it is a real performer. *Icom, 3331 Towerwood Drive, Suite 304, Dallas TX 75234; (214)-620-2780.*

Tim Daniel N8RK
Peterborough NH

30-MEGAHERTZ, DUAL-TRACE, PORTABLE MINISCOPE

Non-Linear Systems has increased the number of their Miniscope oscilloscopes to three with the introduction of their Model MS-230 30-megahertz, battery-operated, dual-trace miniscope. Its size is 2.9 inches high by 6.4 inches wide by 8.5 inches deep. The weight is 3.5 pounds, including batteries.

The MS-230 features alternate, chopped, and separate sweep modes. Internal and external trigger modes are included. There are 12 vertical gain settings for each channel's range, from 0.01 to 50 volts per division. Timebase settings range from 0.05 microseconds to 0.2 seconds per division. Verniers are provided for timebase and vertical amplifier adjustment.

The MS-230 Miniscope includes a horizontal input channel and an internal calibrator. The graticule consists of .25-inch divisions arranged 5 across and 4 high.

The MS-230 comes complete and ready to use. Included are input cables and a battery charger permitting battery or line operation. Accessories include a 10:1, 10-megohm probe and a leather carrying case with shoulder strap and belt loop.

For further information, contact *Non-Linear Systems, PO Box N, Del Mar CA 92014; (714)-755-1134.* Reader Service number N22.

The Model MS-230 Miniscope.

A CRITICAL REVIEW OF THE DRAKE UV-3

Drake's three-band VHF/UHF FM transceiver has gotten a good deal of attention and discussion. I've had one since Christmas, and I'd like to pass on comments about my experiences with it.

Vital Statistics

The UV-3 is a synthesized unit with 5-kHz steps. Coverage is all of 2 meters, all of 220, and 440 to 450 MHz. The unit can be ordered with any one band, any two, or all three. Built-in offsets are zero, plus or minus 600 kHz *on 2 meters*, plus or minus 1.6 MHz on 220, and plus or minus 5 MHz on 440. Up to three additional offsets may be programmed on a plug-in diode board, and the same three are shared between all bands. The frequency may be set up on front-panel switches, or up to four frequencies in each band can be diode-programmed. A master switch selects either the front panel or any of the programmed frequencies. The bandswitch is unconditional. There are *no* tune-up controls.

Each band uses a separate rf section, each adding 2½" to the depth of the case. Each band has a separate antenna jack. Maximum power is 25 W on 2 meters and 10 W on the other bands. The "low" setting of the power switch is about 10% of full power, and this can be changed by resistor substitution. There is a scan function which allows either programmed frequency #4 or the front-panel frequency to be checked every few seconds—momentarily interrupting the selected frequency—and locks in if carrier is present. A non-encoding mike is supplied, but the jack is wired to accept a Drake encoding mike. A mobile mounting bracket is included. There is an accessory jack.

Viewpoint

To make use of a theater review, it's necessary to be aware of the critic's prejudices and biases in order to put his comments in proper context. The same is true of a product review.

I take the attitude that any piece of equipment built for a serious purpose, of which repeater communication is sometimes a prime example, should have a set of features and specifications that follow with logical precision from that purpose. That is, it should do exactly what it's supposed to do.

There should be sufficient reserve performance to allow for expected component deterioration. It should be free of quirks that get in the way of its intended use or which require attention from the user beyond that which is inherently required by the function being fulfilled. It should be rugged, in the sense that conditions to be expected during use will not cause failure or degradation. It should be maintainable; assembly and disassembly needed to reach components should be easy, straightforward, and quick; parts should be readily available; and the design should be comprehensible, at least to the extent of avoiding peculiar tricks.

This is the standard by which a commercial workhorse is judged. There's an awful lot of ham gear around that wouldn't begin to measure up to that level. The first thing to say about the UV-3, though, is that it's a serious piece of engineering. The things that I will be criticizing probably would not even be mentioned in a review of a lesser piece of gear.

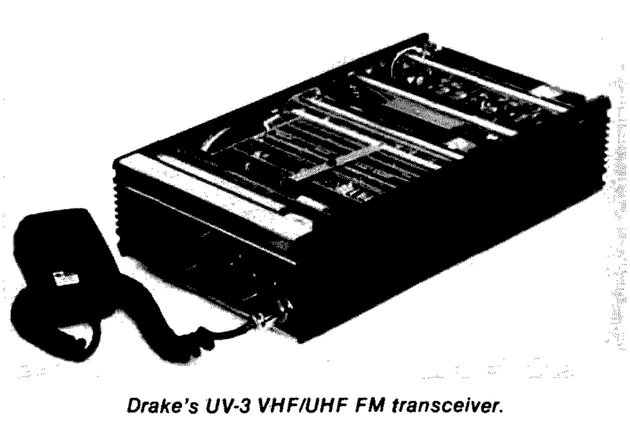
Performance

The UV-3's strong suit seems to be raw performance. There is no heterodyne synthesis; instead, a single vco for each band is retuned in going from receive to transmit. While I have not had the opportunity to check the spurious output specs with the spectrum analyzer, this approach tends to eliminate most spurs right at the source. The spec is −60 dB on 2 meters and 220, and −40 dB on 440. The lock range of the vco's easily exceeds spec; on the 2-meter band it held almost from 142 to 150 MHz.

Although the rf section is broadbanded and needs no tuning adjustments (except for dialing up the synthesizer), the output power was about 5% above specs across the rated bandwidth and didn't drop off too badly until the vco lost lock.

An apparent instability in power output turned out to be an effect of running off a storage battery with the charger turned off. Power is somewhat sensitive to supply voltage, but this is not a criticism. It just likes to be run off rated voltage, which is 11.5 to 15 volts. Incidentally, the negative side is grounded to the chassis, as are the antenna jacks. It requires a positive supply.

The audio is very good, to the point of attracting attention. I've repeatedly been asked, "That rig sounds pretty good; what is it?" To the ear, the response sounds smooth and distortion is not noticeable. There are no special audio shaping circuits; this makes it possible to wire the touch-tone™ encoder directly across the mike and have the correct twist relationship. On receive, the sound reminds the listener of the music receiver, allowing, of course, for the 12-kHz i-f bandwidth. The unusually large magnet in the speaker has to be one reason for this. If anything keeps you from communicating, it won't be the rig's audio. I



Drake's UV-3 VHF/UHF FM transceiver.

don't consider this a luxury; I do consider it a benchmark against which to measure other rigs.

Some highlights from the published specs:

Frequency accuracy—0.0005%, 0° to 60°C, 11.5 to 15 V dc.

Sensitivity—0.5 uV max., 12-dB SINAD.

Adjacent channel rejection—60 dB, 15 kHz away.

Image rejection—80 dB on the 140 band, 60 dB on the 220 band, and 55 dB on the 440 band.

While there is no spec as such covering overloading under very high off-channel field strength, the UV-3 is one of the few transceivers, ham or commercial, that doesn't misbehave going through the infamous "Intermod Alley" along Boston's Route 128. Intermod attenuation is given as −80 dB on 2 meters, −75 dB on 220, and −55 dB on 440. Figures like this don't tell the whole story because any receiver has an overload point at which the front end goes nonlinear and mixing begins. This one has a very high overload point; I have operated other transmitters near it without breaking squelch.

Construction

It's in the mechanical structure and assembly that the attitude of Drake's people shows most clearly. There is a great deal of attention to detail—detail that most other manufacturers might have skipped to save a few cents. I give Drake a lot of credit for resisting the temptation.

You won't find sheet metal screws in the UV-3. Pemnuts are pressed into the aluminum, giving a deep steel thread. Repeated disassembly won't damage any sheet metal parts. Lock washers are used freely inside, so screws are unlikely to shake loose in mobile operation.

Access to almost all of the insides is obtained by removing two screws at the back of the top cover and sliding the cover straight back along a pair of grooves in the side extrusions. The bottom cover comes off the same way, if necessary. There are ripples along the edges of the top and bottom covers which, at first glance, appear to be warpage in thin metal. When you look at the covers from the inside, though, it becomes obvious that those ripples were put there on purpose by a specially made tool. What they do is serve as springs, to wedge the covers tight in the grooves. That keeps down rattles at fairly high receive audio levels and most likely helps with rf shielding.

Most of the circuitry is built on epoxy-glass circuit boards which plug into a motherboard. These boards aren't going to crack if the rig gets dropped; there's a partial card cage to take care of flexing, and a hold-down is secured by a screw and the top cover. There was a little cost reduction here, but no real corner-cutting. The screw that holds the hold-down is about 1/16" too short so that it has to be backed all the way out to remove a card and tends to drop into the works. A board puller is stored inside in a clip next to the speaker. It's a simple type and has to be used carefully, but it cuts the risk of hurting a board or a socket.

The front panel carries no rf. It is removed by taking out four screws and pulling it straight out of the chassis. This is done when the remote control kit is used.

The rf modules are full of shielding and tight construction and don't look particularly easy to take apart in the field. A nice touch, though, is the accurate mechanical alignment of the side extrusions where the modules meet the main chassis and each other. There is no tendency for the top and bottom covers to catch at the joints.

The aluminum parts have anti-corrosion surface treatment, apparently Iridite. Outside surfaces are black anodize, black vinyl, or black paint.

Uses

The UV-3 fits in as a main desktop or mobile workhorse for dependable local communication. The design clearly doesn't contemplate operation while in motion on foot. While this is not wholly out of the question, it would require a lot of external accessories, and the rig is a pretty hefty hunk of hardware as well as a power-eater. The power requirements are targeted at car electrical systems and can be supplied easily from an ac-operated power supply. In emergency operation from a storage battery, or during very long periods of mobile operation with the engine shut down, there could be a problem. More about this later.

Drawbacks

There are a number of deficiencies in the unit that have nothing to do with its communication capabilities. These are failures of concept rather than of design or manufacturing.

Probably the most important is that the current drain on receive is much higher than it should be. This one spec is anything but state-of-the-art. It is 0.9 A. Almost half of this is used up by the dial lights that make the frequency switch settings visible. Thus, in emergency operation in a disaster involving general power failure, a battery small enough to carry easily to an operating position would be hard put to keep going for a day or two. A full-size car battery would be called for.

No method is provided for turning off the lights, and if the lights are simply disconnected to save power, the dark plastic window makes the dials almost impossible to read. As a stopgap measure, I cut a piece of 1/16" acrylic sheet the same size as the window (which drops easily out of its groove when the meter is pushed back against the mounting spring) to make a clear window and disconnected the lights. Unfortunately, this makes the 5 visible whether the last digit is zero or 5.

A better fix would be to glue a reed switch to the top edge of the lamp board just under the top cover, wired in series with the lights. Laying a magnet on top of the cover would then kill the lights and allow the use of the original window without using the lights—except to get on frequency. Drake really should do something about this. There should be a light switch at the very least, and putting in knobs that have markings out in the open would be better. As part of the latter, replacing the 0/5 toggle switch with a rotary like the rest would make operation a little easier.

This leads us to the way you change frequency on a UV-3—the same way you preflight an airplane. That is, you do a complete checklist, examining and verifying the position of *every* switch and knob on the panel. If you're only moving within the same megahertz, you can get away with just twisting knobs in the display row. Any more than that and you're likely to end up with the wrong offset, out of band, or not changing frequencies at all.

A few hours of thought about human engineering would have helped here. If the panel were as good as what's behind it, the frequency could be read unambiguously from one row of digits—band, offset, and all. And if the diode board and selector switch were retained at all, it would be obvious to the eye when the dial was disabled.

Another thing that didn't receive quite enough thought at the brainstorming stage is the remote control feature. Remoting, by itself, allows theft protection of the expensive parts by mounting the rig in the trunk or wherever else the owner's imagination and determination allow. However, security is only one of the purposes of remoting—the other is space conservation in the crowded front seat areas of today's cars.

The panel of the UV-3 is plenty big! Remoting cuts down on depth, but doesn't do a thing for the frontal area. I wouldn't particularly care to have a collision while a UV-3 panel was next to my legs, either. Using standard components, I figure a control panel could be made about twice the area of the end of a walkie-talkie and maybe 3 inches deep. Then if a blank panel were put on the main chassis with a recessed socket to take the miniature control panel, removal from the vehicle would be accomplished by unplugging the cable from the main chassis panel and popping the control panel into the chassis. This, incidentally, is not an unreasonable homebrew project.

Two of the features could just as well have been left out, to make space available for more useful things.

The first is the scan feature. When a carrier comes up on the priority scan channel, the voice you were listening to goes away in mid-word. I can hardly conceive of anyone wanting to hear everything said on some other channel in preference to the QSO in progress. Reversing the priority might make some sense, but monitoring another machine really requires a separate receiver. Also, whenever the frequency jumps to check the priority frequency and carrier is present on the selected channel, there is a short but loud burst of noise as the vco settles on the other frequency. This gets very annoying when it happens every couple of seconds and soon forces the user to shut the scan feature off.

This should not influence anyone's decision on whether or not to buy the UV-3. When a feature is useless in principle, it doesn't matter whether or not it works.

The other thing that could be eliminated is the diode programming. It was necessary on such early rigs as the IC-22S, but when any frequency can be dialed up directly from the front panel, internal diode programming is redundant. Elimination would also get rid of the confusion with the channel switch. If you do program the diodes, do it on a day when you have plenty of time, and use a good light and decent tools. Check your work thoroughly, or, better still, get somebody else to do the checking. The layout of the diode boards is such as to invite mistakes. One thing they did right was to supply diodes

Continued on page 164

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Extremely Low Frequency Radiation: Cause for Worry?

—studies on ELF are inconclusive, but the battle is joined

Invisible health hazards may hang over America—radiation from high-voltage power lines.

Scientists and researchers worldwide are beginning to understand more about the effects of Extremely Low Frequency, ELF, as they call it. And some of these scientists are becoming concerned.

Most people believed, at the time when high-tension wires first appeared, criss-crossing and looping over our major cities and the countryside, that the electricity in the wires stayed there—that it did not leave the metal and pass through the insulation.

Now, of course, we know better. The flux set up by wires carrying high voltages is composed of two distinct forces: electric and magnetic fields.

We also know that these fields, at the right intensities, can reach us. But, unlike microwaves, which have been proven to be dangerous, little is known of the possible dangers of low-frequency radiation.

Presently, there are more than 100,000 miles of overhead high-tension lines in the United States which carry up to 765,000 volts at 60 Hz (50 Hz in Canada, 25 Hz in most of Europe). For the future, power companies are looking to lines carrying 1 million and 1.5 million volts—and that's what has many people concerned. The fluxes formed by such high voltages are enough to make your hair stand on end if you walk near them. And, if you hold a 40-Watt fluorescent bulb underneath a 345,000-volt line within about 100 feet of the line's right of way, it will light up.

Why do we need such high voltage? The answer is simple. The higher the voltage, the cheaper it is to transmit. Line losses are reduced as the voltage is increased.

Around 1967, realizing that the way to go was higher and higher voltages, studies funded by the American Electric Power Company and carried out by Johns Hopkins University looked at linemen who worked near high-voltage lines to see if they were being affected by the fields.

The linemen's health was studied, and so were some mice in the laboratory who also received exposure to similar ELF fields. Several of the linemen showed nominally low sperm count, but nothing conclusive. The mice seemed unaffected except that their progeny had slightly stunted growth. Again, however, the departure from normal fell within statistically acceptable limits. Even so, for most scientists and for the electric power companies, this showed a need for further experimenting and tests.

Then came Project Sanguine, a Navy project to build a huge antenna network covering hundreds of acres in Wisconsin. It was designed to transmit radio messages to submerged submarines throughout the world's oceans. The transmitting frequencies would be near those of an overhead power line—actually a bit lower, in the 15-20-Hz range.

The project was, to say the least, controversial. Environmentalists objected to it because it would literally rip up large tracts of land needed to bury the antenna. Others pointed to a study done by the University of Wisconsin which showed that ELF affected the physiology of a slime mold. Other studies done during Sanguine's planning stages also showed that ELF affected some lower organisms. The studies did not necessarily show ill effects, but they indeed showed a cause-and-effect relationship. Those studies, and citizen protests, were enough to table Project Sanguine.

Around this time, the late 1960s and early 1970s, a lot of other people started to get into the ELF act. For more than three years, New York State's Public Service Commission held hearings on the ELF situation. As a result of those hearings, packed by folks who didn't want a proposed 765,000-volt line running across their farmland, the PSC admitted that ELF presents some health threat to those who live and work near the lines.

The PSC did two things in response to its ELF hearings. It created an Administrative Research Council which would fund research on ELF's effects, and it widened the right of way of new lines from 350 feet to 1,200 feet. Right now, however, the Power Authority of New York is fighting the ARC on the grounds that

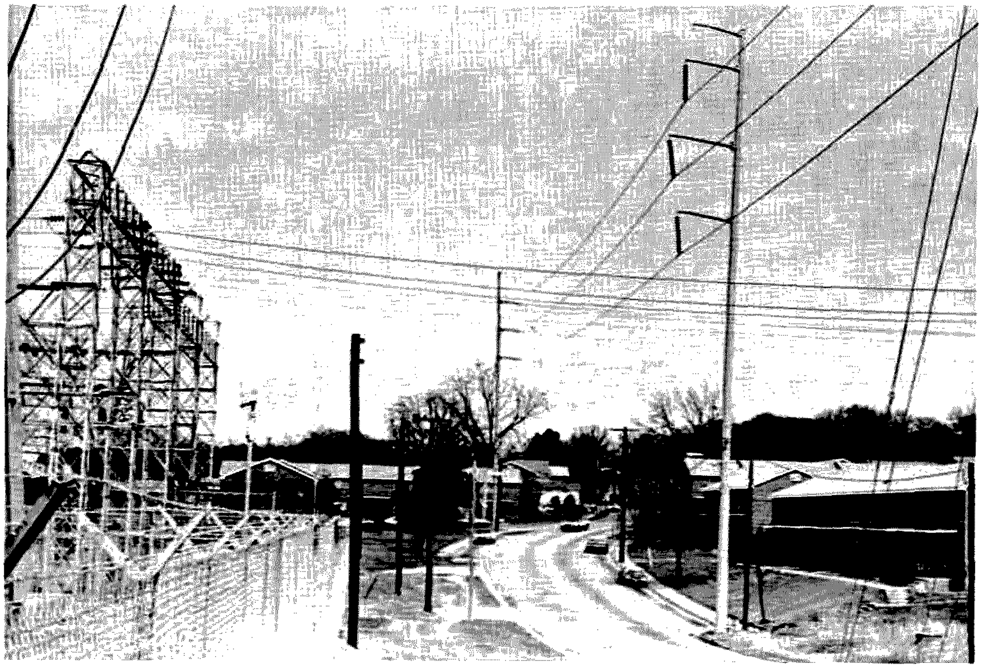
setting up a research group is not within the PSC's jurisdiction. The courts have not yet ruled on that point of law.

One of the more vocal speakers at the hearings was Dr. Andrew Marino, a researcher at the Veterans Administration Hospital in Syracuse, New York. "There is little doubt from the literature that biological changes do occur in humans exposed to high-tension wires," he said. Marino has been studying the effects of ELF on mice for about 3 years under a $75,000 National Institute of Health grant. In previous studies, he found that mice exposed to ELF had stunted growth. Results of his present studies have not yet been released.

The US Department of Energy has allocated about $3 million for high-voltage studies, and Bob Flugum, assistant director of DOE's Power Delivery Program, said that about $7 million is being spent on research throughout the world.

A famous study done in the Soviet Union showed that switchyard workers who worked near high-voltage equipment showed pulse rate changes and blood pressure fluctuations. It also showed that the men and women had tremors during or shortly after exposure. The studies were not conclusive, however, because only about 300 workers were studied — certainly not a large enough test sample. Even so, the Soviets have set maximum exposure standards for their citizens. The US has not. The Soviets, you may remember, also set standards for microwave exposure before the US government even acknowledged that the super-high frequencies were harmful.

"The most important proof that ELF alters biology is that some researchers



are using it to heal bones," said Marino. "There is no doubt it effects living organisms, but exactly what those changes are, we are not yet certain."

Dr. Harry Kornberg, a researcher for the Electric Power Research Institute in Palo Alto, California, is not as convinced as Marino that ELF affects humans. He said that work so far showing effects on humans and animals has been shoddy and not within good scientific procedure. EPRI is a research funding group sponsored by American utility companies, each of which gives the Institute money for its work. Kornberg said, however, that we are just beginning to see the start of what he calls "highly controlled, high quality, clinical testing."

Farmers will tell you that grass turns brown under high-tension wires, and just recently Penn State reported that leaf tips turn brown in the lab under similar conditions. Another recent study which Kornberg believes was done with good control was one at the University of Illinois. It showed that honeybees exposed to ELF build unusually small hives.

But Kornberg still disagrees that high-tension wires affect humans. "There have been no definitive studies which show it," he said. And he is correct.

No one has yet studied large groups of people exposed to ELF for long periods of time. Only then could we be certain that statistical and other laboratory anomalies did not creep into the results.

But even as scientists are beginning now to pull together all the information on ELF, and excellent studies are being done both in and out of the lab, a new wrinkle has been added — direct current. In an attempt to make power transmittal even more economical, power companies have begun experimenting with dc in voltages reaching over 1 million volts.

In case you haven't seen the papers in the past year, a battle over such a line has been brewing in Minnesota. The fight is between environmentalists and farmers on one side and the power companies on the other. A 400,000-volt dc power line was planned from North Dakota to the Minneapolis-St. Paul area. While the line's towers were being built, there was harassment allegedly from the farmers' side. They supposedly tore down towers and generally made life miserable for those building them.

Right now, the farmers seem to have lost the war. The line has been built and is now under test awaiting a power plant's completion in North Dakota.

Mike Casper, chairman of the Physics Department of Carleton College in Northfield, Minnesota, is writing a book about the struggle. "Very little is known about dc's effects at such high voltage," he said, "and the line, once in operation, will be the largest dc carrier in the nation." There is now one in California.

Casper, who has followed the fight from its inception several years ago, said that he expects to see continued guerrilla tactics from now until the 400-mile line carries its first electron . . . if it ever does. ■

An LED Display for the HW-2036

—eliminates unwieldy thumbwheel switches

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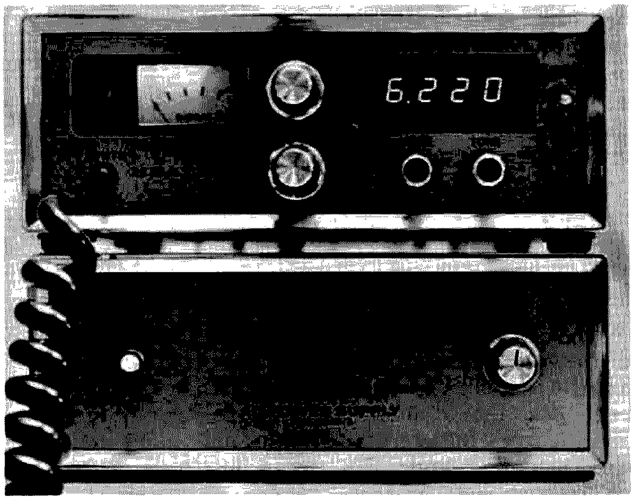
Since I purchased and built the HW-2036, I have had only praise for the unit. However, after operating the HW-2036 for some time, I found the thumbwheel switches quite worrisome. It is almost impossible to see how to change frequency in the car at night and very difficult to get to the switches while driving. For these reasons, I decided to modify my 2036. When the idea for this modification was in its earliest stages, I knew I wanted to put the digital display in place of those awkward thumbwheels, but I did not know what to use to set the operating frequency. I knew an external box to enclose such a unit would look messy, and that went against my main objective which was to enhance the looks and capabilities of my HW-2036. Then the idea came to me to enclose a circuit board inside the Micoder™ that would do just that. It was neat, compact, and would make the Micoder able to switch frequency and also keep it a touchtone™ pad, just as before. The finished product has a very professional appearance and I think it will appeal to those who want to update their units to digital readout.



HW-2036 with digital modification installed.

Circuit Description

I decided to put common-cathode seven-segment LEDs behind a red plastic lens to display the frequency being used. I implemented the Fairchild decoder/driver because it drives the LEDs directly (Fig. 1). This means that dropping resistors are not needed from the driver to the display. In order to hold the BCD frequency and to feed it to the synthesizer board, I used SN74LS298s. These are quad two-input multiplexers with storage. The zero—or five-kHz digit is developed by a BCD-to-decimal decoder. This, in turn, is fed to an inverter for conditioning and then to a five-input NOR gate for the final 0/5-kHz output signal. This signal is connected to pin X on the synthesizer circuit board.

The microphone cable can be replaced with a new one that has at least twelve conductors. I revamped the Micoder so that it is a touchtone pad in the transmit mode, and so that the operating frequency can be selected in the receive mode (Fig. 2). Three chips were installed into the 2036-MB (MicBoard). The NE555 was used as a clock generator for the MC14419 keypad-to-BCD decoder. The MC14410 keypad tone integrator is also installed on this board. The original microphone element is retained but I added a 2.2k resistor from the original Micoder board. Two 7805 voltage regulators were added to supply the necessary voltage for the additional circuitry (Fig. 3).

Chassis

To accomplish the modifications, proceed as follows: Remove all the covers and knobs from your 2036. Care should be

taken not to ruin the synthesizer lock LED as you separate the front panel subplate and bezel. Next, remove the thumbwheel switches and save the four supporting screws and nuts. Fit the red plastic window over the thumbwheel switch window and mark the locations for the four holes that you will drill to accommodate the previously-removed supporting screws. On the side of the window where the 0/5 switch is located, a small notch should be filed in order for the nut (that holds the 0/5-kHz switch to the subchassis) to clear when assembled. Two #6 screw holes have to be drilled to hold the 7805 regulators against the subchassis. The first hole should be drilled beside the speaker and below the synthesizer board. See Fig. 4. To get to the second hole, you will need to pull the power amplifier board a few inches away from the back panel (Fig. 5). Drill these holes with care and do not let shavings fall near the boards. Install both 7805 voltage regulators as illustrated in Figs. 4 and 5 using silicone grease. Then reinstall the power amplifier board.

Now remove the microphone cable from your rig. It will be replaced by a 12- to 24-conductor cable. Place some type of insulation over the speaker connections and side magnet, preferably electrical tape. This will keep the snug-fitting 2036-DB (display board) from shorting on the speaker. The display board should be on a horizontal plane with the bottom of the display window. Use a plastic washer on the rear and front mounting hole of the 2036-DB. This will keep the mounting screws and nuts from shorting the bottom of the circuit board. Use 6-32 × 1¼" countersunk mounting screws for the 2036-DB (Fig. 4).

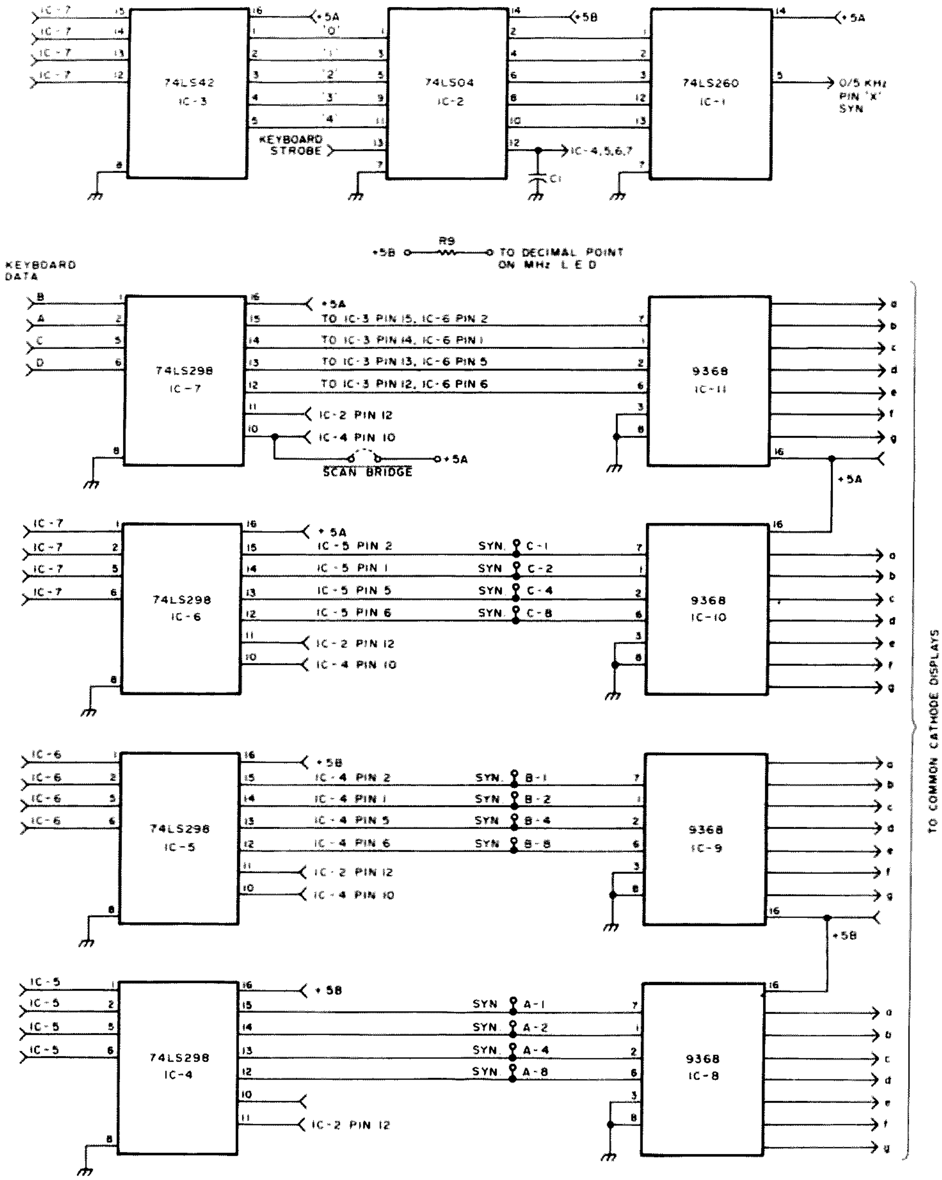


Fig. 1. 2036-DB Display Board schematic.

MicBoard 2036-MB

Disassemble the Micoder completely by unsoldering all the wires and by removing the board. Clean the terminal strip of all solder and wire. Retain the 2.2k resistor and join it to one of the microphone element leads. Connect a ground wire to the microphone element ground. The remaining lead is connected for audio output. See Fig. 6. Remove the pin sockets from your old Micoder board and reinstall in the new 2036-MB. These are the pin sockets that will hold the keypad. Put the chips in on the component side. Do observe correct pin locations. Connect pin 8 on the MC14410, pin 8 on the MC14419, and pin 1 on the NE555 to the ground plane. Notice that the .01-uF and .047-uF capacitors are electrolytic, so observe the correct polarity. The only parts that go on the underside of the board are the 1 MHz crystal and the .01-uF clock capacitor, if the disc type is being used.

After all parts are set up on the 2036-MB, follow the correct cable color code for interconnection to the 2036 (Fig. 7). On the 24-conductor microphone cable that I used, the end with pin connectors should go in the microphone housing.

Connect one wire to +5 V dc on receive, one to +5 V dc on transmit, one to +5 V dc, one to ground, and the last to audio output—all on the 2036-MB. The +5 V dc on transmit is labeled pin 3, +5 V dc on receive is pin 1, and audio output is pin 2. The +5-V dc power for the 2036-MB is acquired from the 7805 IC-1 originally in the rig.

Display Board 2036-DB

Molex pins may be used as well as low profile

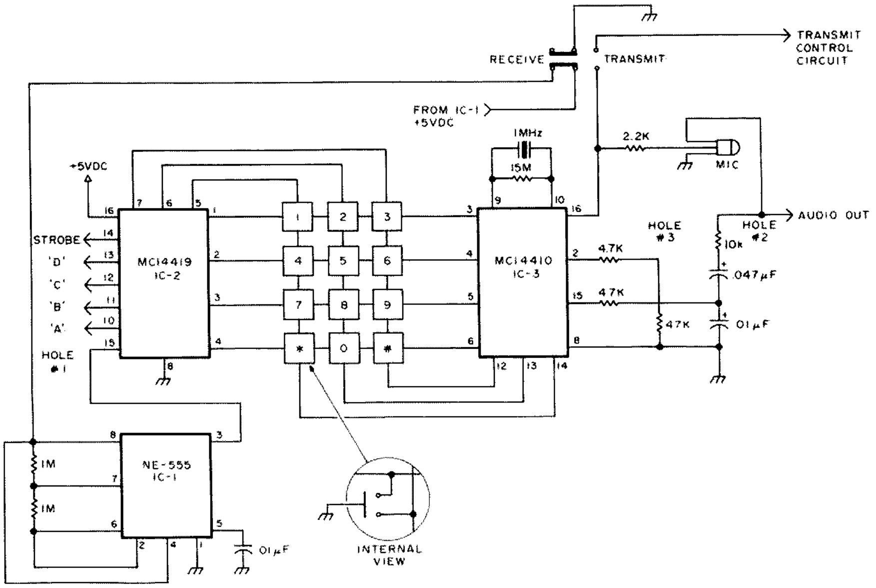


Fig. 2. 2036-MB MicBoard schematic.

sockets on this board. Install the sockets or directly install the chips. Install 220-Ohm, ¼-Watt resistor R9 to make the decimal point connection. Capacitor C1 is only installed if triple or double digiting is encountered when you key in a number. The value of this capacitor is dependent on whether or not the SN74LS298 chips match. The capacitor should be somewhere in the range of 100 uF to 470 pF. If desired, SN74LS48 BCD-to-seven-segment decoder/drivers may be employed instead of the 9368s, by running 2k pull-up resistors to the LEDs. When using the SN74LS48 chips, pin 3 of the decoder/driver should be clipped off, as the lamp test function is not used. (To test all lamps, just key in four eights in a row.) Using the pull-up resistors in this fashion makes for a rough time when you take the decoder/driver chips out and does not accommodate my scanner option board. (See Fig. 8 for pinouts on both chip styles.) From the synthesizer circuit board, remove all of the pull-up resistors associated with the thumbwheel switches: R401-409 and R411-413. Make a small solder bridge with a piece of wire at the scan bridge to pin 10 of IC7 if you are *not* using the scan option on the 2036-DB.

Resolder the wires from the thumbwheel switches to their corresponding display drivers. For the MHz, use IC8 pin 7. This is BCD "A", which goes to synthesizer circuit board pin A1. IC8 pin 1 is BCD "B", which goes to synthesizer pin A2, and so forth. IC9 is used for the hundreds of kilohertz and IC10 is used for the tens of kilohertz. IC11 remains to display the one-kilohertz digit. Remove the wiring from the 0/5-kHz switch completely. Put in the 0/5-kHz wire to the corresponding location on the 2036-DB. You will have to make a small five-wire bundle, eight inches long, out of the wires in the microphone cable to make the strobe and the BCD connections from the microphone cable to the 2036-DB. This wire bundle does not have to be shielded, but should be run under the volume and mode switches.

Install the 25-uF, 25-V dc and .01-uF capacitors on both outputs of the 7805 regulators. Connect the rear 7805 to the +5B power hole and the front 7805 to the +5A power hole. Install the ground wire connection to the 2036-DB at this time. The common-cathode LEDs that you choose can be socketed. Align all four sockets on a flat surface and "super glue" them together. Install the 2036-DB and, with a pencil, mark on the board the width of the display window opening. Remove the board and "super glue" the four sockets in the center of the marked display opening and to the rear of the board as far as possible. Keeping the sockets to the rear of the board will prevent the LEDs from scratching the red plastic lens. Remove the pins not used by the LEDs. Wiring from the sockets to the board should be accomplished by using wire-wrap.

Checkout

After I completed all connections and reassembly, I tested my modifica-

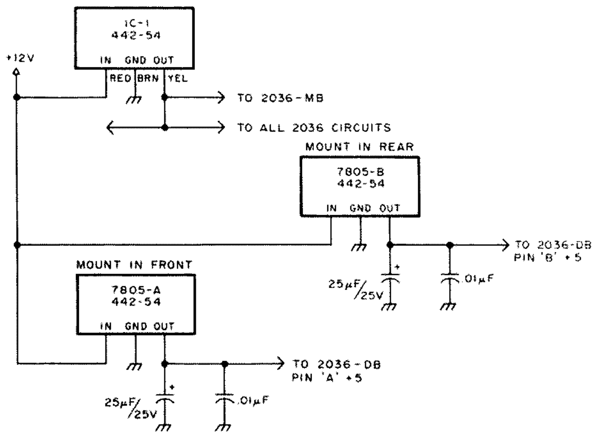


Fig. 3. 7805 voltage regulator schematic.

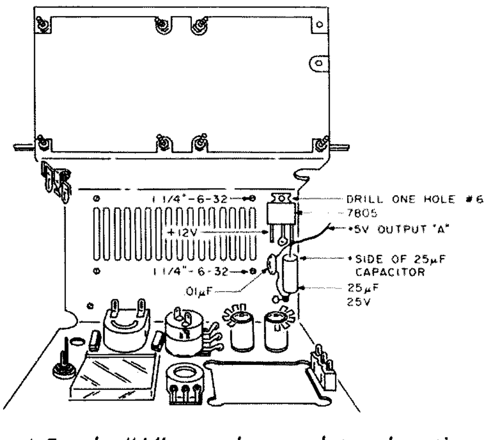


Fig. 4. +5-volt "A" supply regulator location inside speaker area.

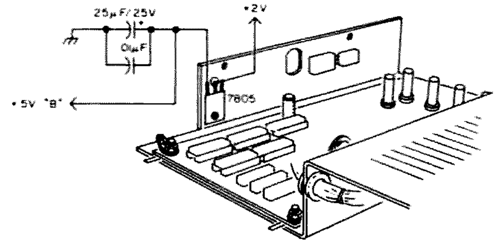


Fig. 5. +5-volt "B" supply regulator location inside transmitter area.

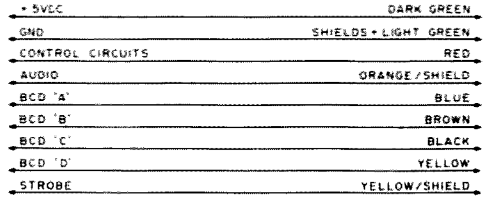


Fig. 7. Corresponding signal-to-cable colors used in the Radio Shack 24-conductor microphone cable. The end with the connectors should be placed in the Micoder.

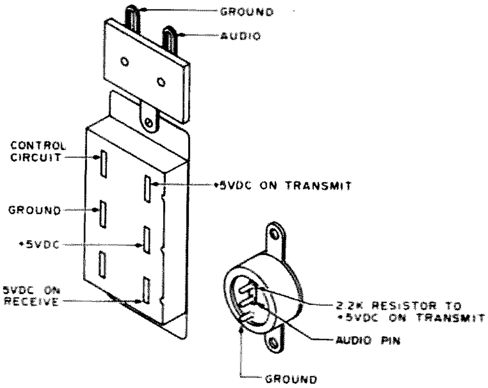
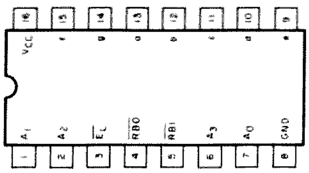
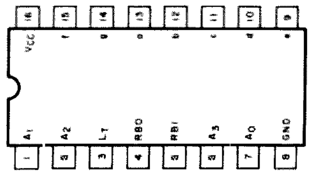


Fig. 6. Inside view of mic element and switch, showing the correct points for signal placement.



A_0,A_1,A_2,A_3	Address (data) inputs
$\overline{E_L}$	Latch enable (active low) input
$\overline{RBI}$	Ripple blanking (active low) input
$\overline{RBO}$	Ripple blanking (active low) output
a,b,c,d,e,f,g	(active high) outputs



A_0,A_1,A_2,A_3	Address (data) inputs
L_T	Lamp test
RBI	Ripple blanking input
RBO	Ripple blanking output
a,b,c,d,e,f,g	Outputs

Fig. 8. Seven-segment decoder/drivers. Either device may be used, although 2k pull-up resistors will be needed with the SN74LS48s.

tion. I started with the 2036-MB. With power on, the display should show random numbers and sometimes letters. I checked pin 8 of the NE555 for +5 V dc, and also pin 16 of MC14419 for +5 V dc. If this checks out, you may assume pin 3 of the 555 is generating a clock pulse. This pulse is used to generate the keypad strobe upon depression of a keypad number. The # and * are considered invalid digits, and, therefore, they will not generate a bit pattern when the operator selects a frequency. After depressing a valid digit, I looked for a short strobe pulse, one that goes from low to high and back to low. The BCD digit will be on the output lines as long as you hold your finger on the pad. Keypad data is fed to IC7 upon receipt of a keypad strobe pulse. It is then shifted in or out to the next stages, IC6, and so on. For IC7, which is the kHz digit, the BCD signals are sent to a BCD-to-decimal converter (IC3). This will send a logic one out if the BCD input is between zero and four, and a logic zero will be sent if it is between five and nine. IC2 inverts the signals which are then sent to a five-input NOR gate for the final 0/5-kHz output. A logic zero equals zero kHz and a logic one equals a 5-kHz signal.

Audio generated by the keypad-to-tone integrator MC14410 is coupled directly to the audio input line. In most units with this completed modification, the transmitter deviation needed to be lowered. It is advisable to check your deviation and set it to not more than 5 kHz.

To display the operating frequency of 146.820 MHz, simply touch in the digit sequence 6, 8, 2, 0 on the keypad. The same is true for 147.855 MHz; the digit sequence would be 7, 8, 5, 5. When the push-to-talk

Required Parts

Quantity	Type	Description	Source	Price
2	7805	+ 5-volt regulator	Radio Shack	$1.29
1	W-1878	24-conductor Mic cable used on One-Hander™**	Radio Shack	$6.95
1	EK-2036	Touchtone kit	Data-Signal*	$13.50 + postage
4	443-694	Fairchild 9368 LED driver	Heathkit	$2.50 ea.
4	SN74LS298	Quad 2-input multiplexer	Hamilton-Avnet	$2.00 ea.
1	MC14419	2 of 8 BCD encoder	Hamilton-Avnet	$3.00
1	SN74LS260	5-input NOR	Hamilton-Avnet	$ .50
1	NE555	Timer	Hamilton-Avnet	$ .40
1	443-807	SN74LS42 BCD-to-decimal	Heathkit	$1.00
1	SN74LS04	Hex inverter	Hamilton-Avnet	$ .40
2		25-uF, 25-V dc capacitors		
4	FND-357	Common-cathode 7-segment LEDs	Fairchild	
1		Red plastic lens	Radio Shack	
2		1-megohm ¼-Watt resistors		
1		.01-uF disc capacitor		
1		220-Ohm ¼-Watt resistor		
1		1k ¼-Watt resistor		
1		Super Glue		

*Data-Signal, Inc., 2403 Commerce Lane, Albany GA 31707.

**Order at local Radio Shack with instructions for manager to order from: Radio Shack National Parts, 1801 South Beach, Ft. Worth TX 76105.

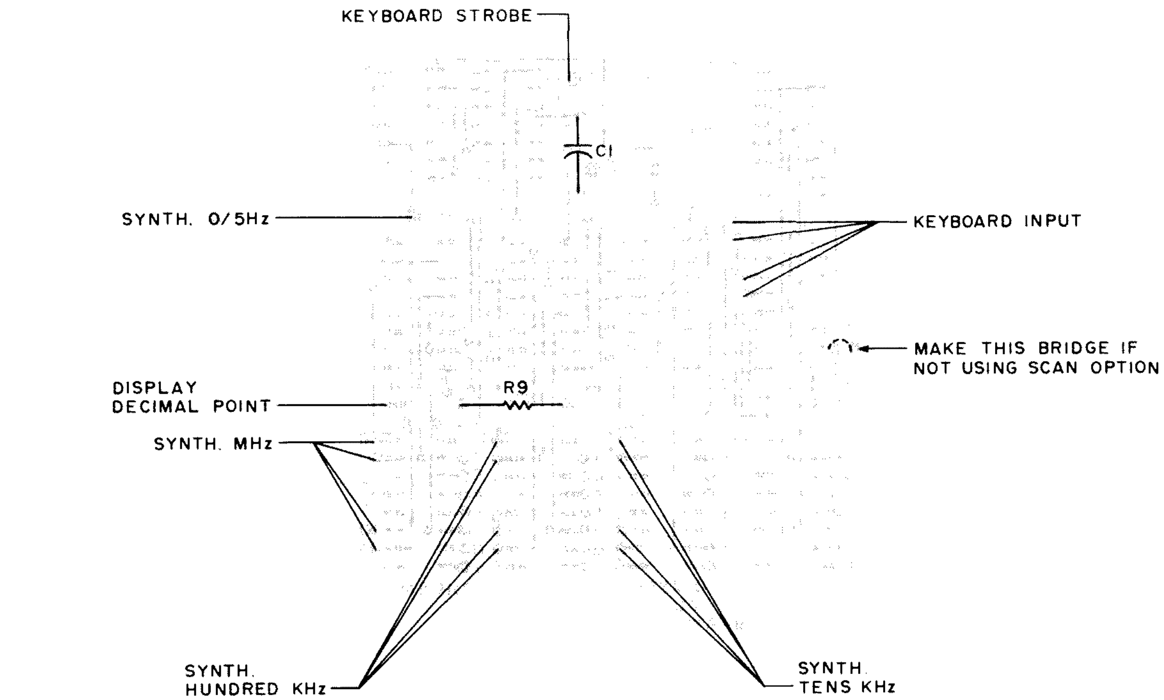
switch is depressed, the keypad is now a touchtone pad. Be careful not to hold your finger on a digit and then let go of the push-to-talk switch—you will find yourself on some other frequency.

Conclusion

This modification has been on my HW-2036 since April, 1978, and I appreciate the rig more each day. It works beautifully, and really is pleasing to the eye. The maximum overall cost for project parts should not exceed $65. The EK-2036 kit, which can be purchased from Data-Signal, Inc., includes a 1-MHz crystal, a MC14410 touchtone encoder, and assorted discrete components. There is another option board which allows the HW-2036 to scan any 1-MHz segment of the band and stop on any carrier. A small push-on only switch is added at one side of the microphone to cause scanning to continue. This works fine for those units that are not plagued by birdies at various divisions of one MHz.

The MicBoard (2036-MB) and Display Board (2036-DB) can be acquired by writing directly to me. These boards are double-sided and plated through. The price for two boards and an instruction booklet is $16.95. For the intrepid constructor, PC board layouts for the two boards are shown in Figs. 9 and 10.

My thanks to Jim Bell K4FUP for the accompanying photograph. ■



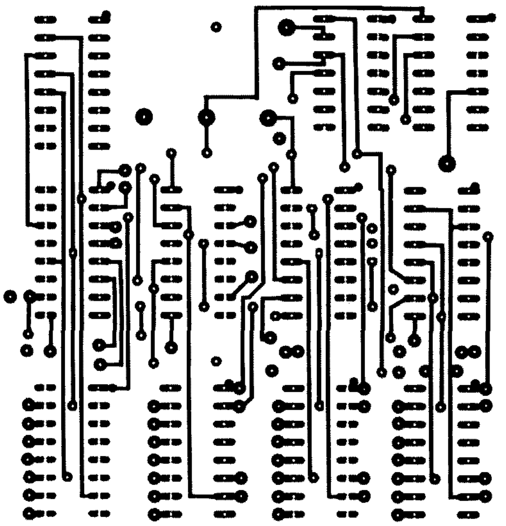
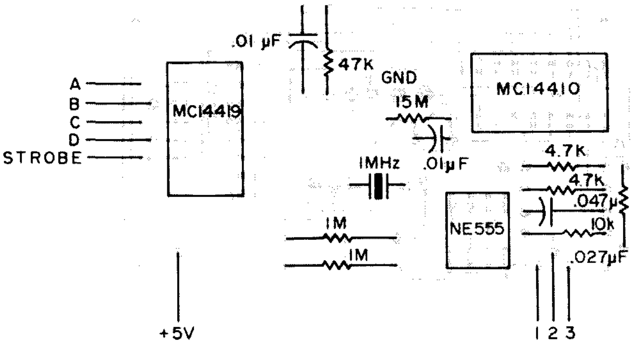
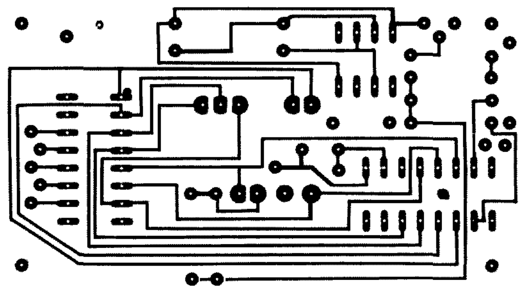


Fig. 9. PC board layout for the 2036-DB board. Top view shows components side; bottom view shows other side.

Fig. 10. PC board layout for the 2036-MB board. Left view shows component side; right view shows other side.





It's a Wattmeter . . . It's an Swr Bridge . . . It's Swattmeter!

—a super home-brew project

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1446 Hagen Lane
Rockledge FL 32955

One of my favorite pastimes in amateur radio is designing and building antennas for the HF spectrum. I have a 5-band trap vertical mounted 12" above ground, a ground plane vertical on the roof, a 10-meter "sloper" which is part of my TV guy-wire system, a 3-band inverted "vee," also part of the guy-wire system, and a couple of experimental 3/2-wavelength wires on the roof.

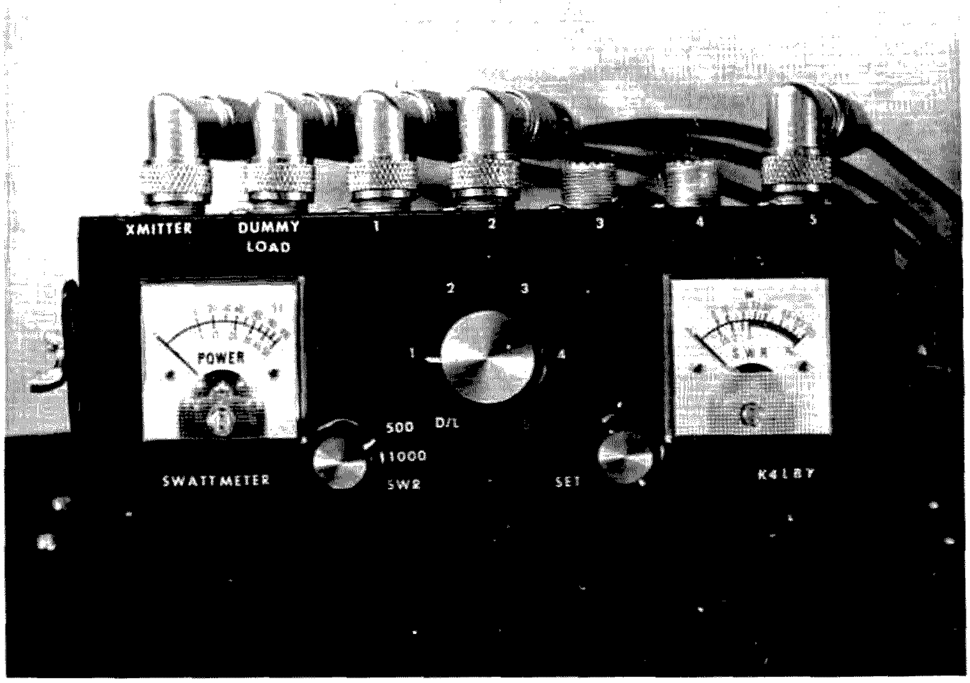


Photo A. The Swattmeter is mounted in station operating position. The meter on the left reads forward power. Reverse power and swr are shown on the right.

Now, I am working on a miniature quad, hoping I can find room to mount the thing. All this means that PL-259 coax connectors by the barrelful are coming into the shack. Of course, the only practical way to compare the relative performance of all these antennas is to use a husky coax switch so that I can readily go from one antenna to another during a QSO, and hopefully get some meaningful reports from the guy on the other end without making him wait until I disconnect and reconnect coax cables.

With this thought in mind, I recently acquired a B&W Model 595 coaxial switch which is a 6-position in-line model designed for wall or desk-top mounting. I preferred the in-line ar-

rangement to the axial configuration, in order to keep the thing from looking like an octopus squatting on the shelf.

Once I had the switch in hand, I started to think about all the other outboard stuff I had connected between my transceiver and the antennas. There was, of course, the low-pass filter, then an swr meter, and finally a borrowed power meter. Now, with the switch in place, the shack was beginning to resemble something out of Rube Goldberg. Besides the fact that it looked like a mess, did you ever have the need to determine just how long your transmission line is for matching purposes? Some of my antennas load best when the transmission line length is in multiples of 45'6" for RG-58/U. Outboard devices are handy, but just how much length does a switch like the B&W add, anyway? (I'll admit that the length added by any one outboard device is negligible, but I'm a nitpicker. And when you add two or three other gadgets, you start talking feet, not inches.)

Needless to say, the B&W came apart, and I discovered that the effective transmission line length was variable, depending on the position of the switch. Fig. 1 shows how the switch is wired as it comes from the factory.

When the switch is in positions 1 or 6, the effective length is the shortest, and in positions 3 and 4, the longest. As I said before, it probably does not mean much as a matter of practical fact, but what did matter was something else I noticed: There was a lot of wasted space in the guts of that switch! The space, in fact, looked tailor-made to contain a couple of meters and the necessary components for an swr/power bridge.

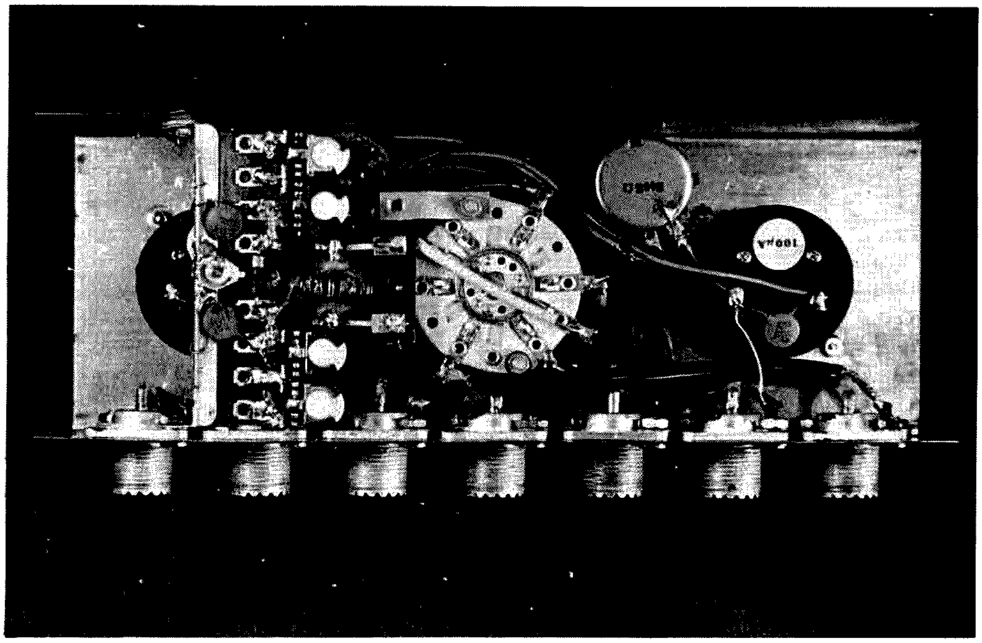


Photo B. An inside view of the Swattmeter. The SO-239 connector on the left is the input.

And so the Swattmeter was hatched, which is really what this article is about (I do ramble, don't I?). Line length forgotten for the moment, I took off after this new idea like a hound sniffin' grass, much to the exasperation of the XYL.

You might ask, why bother? Well, it's neater and results in less junk outboard from the transceiver. Besides, it looked like a challenge, and then there's that line-length factor . . .

Description and Criteria

The accompanying photographs pretty much show how the Swattmeter is constructed and what went into it. There is really nothing new in its design, but, rather, a circuit modification or two. The wattmeter portion of the Swattmeter uses the 100-uA dual meters cannibalized from the Swan model SWR-1. Also cannibalized from the Swan is the dual 10k potentiometer used for swr "set." What is different from the Swan meter is the toroid current transformer used as the directional coupler, rather than the transmission line-type coupler used in the Swan and similar inexpensive swr meters. I used the meters from the Swan because I had them, and they were already calibrated in terms of power and swr. Of course, any 100-uA meters may be used. The only criterion is that they fit into the space on either side of the switch.

Fig. 2 is the schematic of the Swattmeter. You will see that, with some exceptions, the circuit is similar to one described by Bruene in *QST* (April, 1959). The bridge circuit by Bruene uses a capacitive voltage divider and a current detector to provide two voltages proportional to the forward and reflected voltages or currents of the transmission line. See Fig. 3.

The circuit in Fig. 2 uses the stray capacitance between the current transformer and the line as part of the voltage divider. Most bridge designs try to eliminate stray capacitance so that a controlled amount can be used in the design. I figured, why fight it? I coudn't figure out how to shield everything in the confines of the B&W switch, and "if you can't lick 'em, join 'em!" The variable 6- to 20-pF ceramic trimmer of Fig. 2 is the other half of the voltage divider.

The design here uses a bifilar-wound current transformer in which the low impedance at the secondary is split into two equal parts. The center tap on the transformer is also part of the voltage sampling network (stray capacitance plus the 6- to 20-pF trimmer) so that the sum and difference voltages are available at the ends of the transformer secondary winding. With the values shown, the meter maintains its calibration to within 10 percent over the frequency range of 3 to 30 MHz—and probably from

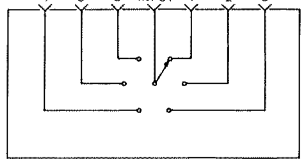


Fig. 1. Simplified wiring diagram, B&W Model 595 coaxial switch. Note: Automatic grounding (not shown) of all unused positions is incorporated.

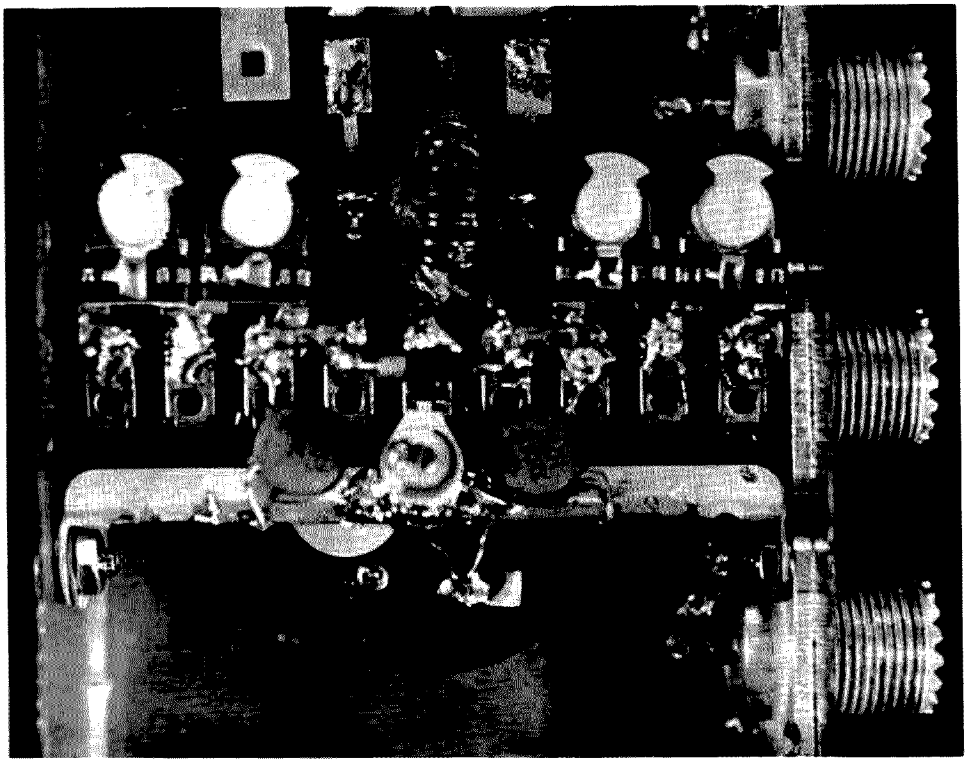
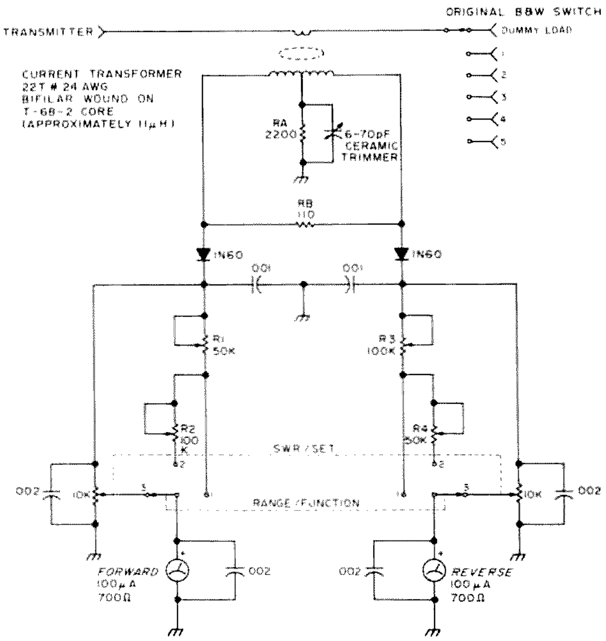


Photo C. A closeup view of nine-lug terminal strip and current transformer. The input SO-239 connector is on the lower right.

1 to 50 MHz, although I have used only the former. The degree of isolation between forward and reverse readings into a matched dummy load is excellent (estimated to be between 20 and 30 dB). I can pump nearly 500 Watts of rf into a 50-Ohm dummy load through the Swattmeter with nary an indication of reverse power.



RANGE/FUNCTION

POSITION	FWD	REV
1	500W	100W
2	1000W	1000W
3	SWR SET	SWR

Fig. 2. Swattmeter schematic.

A three-position switch is used as a function/range selector allowing for two power ranges and an SWR position. Position 1 of the switch allows forward power measurement of 500 Watts and reverse power of 100 Watts. Position 2 reads 1000 Watts forward and 1000 Watts reverse, and position 3 is for standard swr measurements using the "set" control variable potentiometer to calibrate the left-hand meter in the conventional manner. Swr is then read directly from the right-hand meter. Alternatively, the "swr set" potentiometer dial also can be calibrated in Watts if desired. When the function switch is set at swr and the pot is wide open, maximum sensitivity (both forward and reverse) is less than 5 Watts full scale.

The wattmeter can be made more sensitive by increasing the number of turns on the toroid. This causes the inter-turn capacitance to increase, however, and causes the response to fall at high frequencies. Consequently, the directivity also falls. The values of R_A and R_B were determined experimentally and can vary by 10%. R_B should have a value of 150 Ohms if the Swattmeter is to be used predominately with 72-Ohm cable. The values shown are good for 50- to 53-Ohm coax.

The 1N60 diodes need to be matched for both forward and reverse resistance. They should be within 5% if possible, with the forward resistance more important than the reverse.

A word here about bypass capacitors is in order. Use good quality ceramic capacitors rated at 1000 volts. Some ceramic capacitors act as fine inductors, especially at the higher frequencies, and can cause all sorts of spurious readings. This is particularly important in the confined space available in the B&W switch body, with all that rf bounding around inside. With good capacitors, noninductive resistors, and the layout shown, you should have no problems.

Construction

Assuming you have all the parts handy, the first step is to *completely* disassemble the B&W switch. I removed even the SO-239 coax connectors by drilling out the rivets in order to allow ground lugs to be mounted, one at each connector. The reason for this will be evident later on (remember the original line-length problem). Besides, the paint job on the 595 didn't please me, and I wanted to refinish the thing once I got the meter and control holes drilled.

The layout is tight but

workable, and depends pretty much on the size of your meters and other components. The meters I used mount in a 1½-inch diameter hole (which was convenient, since I happened to have a Greenlee punch just the right size). Needless to say, but I'll say it anyway, *check all dimensions carefully*. You get only one chance for proper clearances.

Once all the holes are drilled, the original finish can be removed (your option) with lacquer thinner, and the unit primed and refinished. I used Walsco Collins Instrument charcoal gray wrinkle varnish which comes in a convenient spray can.

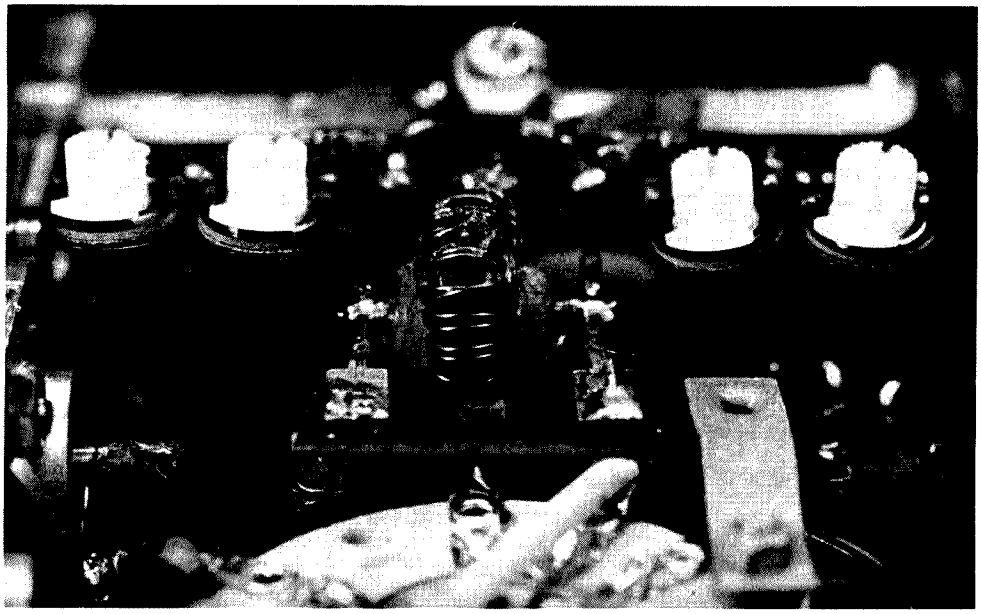


Photo D. Detailed view of the two-lug terminal strip and current transformer.

Once the paint is dry, you may wish to apply the panel markings before the components are mounted. It is easier if you know what you want and where you want it. Dry-mount lettering is easy to apply even to wrinkle finish, but should be sprayed afterwards with a clear finish to protect the lettering. I usually do it the hard way, and put the markings on last just in case I want to change something at the last minute.

The SO-239 coaxial chassis connectors should be mounted using 6-32 hardware with lock washers and a ground lug for each connector. Make sure there is no paint on the inside of the case, which may cause a poor metal-to-metal contact. Mount all the other components as shown in the photos, except for the nine-lug terminal strip. (It will be mounted after the switch has been wired.)

First, after all the hardware is secure, wire the coax switch. The input to the switch is now the first SO-239 connector on the left. This was done to allow room for the current transformer. All output connectors were wired to the switch in a clockwise direction using 5" lengths of RG-58C/U, which is more flexible than the others. The outer conductor of each length of coax is grounded to its respective SO-239 ground lug, but stripped back out of the way on the end which connects to the switch. This provides for shielded leads *all the same length* within the Swattmeter (I told you we would get back to that) and enables the switch-wiring to be routed easily out of the way of the other components. The effective transmission line length of the switch when wired in this manner is approximately 1 foot in all positions, give or take an inch.

Don't forget that the B&W switch actually has two decks, one of which grounds all unused positions. In the original switch, this second deck was grounded at the switch at a lug on the switch spacer. I preferred to eliminate that lug and ground the second deck to the nearest SO-239 ground lug.

The input side of the switch uses a 3" length of RG-58C/U, prepared as above and fastened to the input SO-239 in the same manner as the other cables. The exception is the other end, which goes to one lug of a two-lug terminal strip as shown in the photo. The second lug of the terminal strip is wired with bare wire to the input terminal of the switch.

You may have to improvise a little with this two-lug terminal strip, which is used to hold the toroid transformer. I found mine in my junk box and it was a perfect fit.

As you can see in the photos, the current transformer is slipped over a short piece of RG-8/U center conductor and the stripped ends of the RG-8/U are then soldered to the two-lug terminal strip. Fig. 4 illustrates a little more clearly how this is done. The physical configuration of the terminal strip lugs and the RG-8/U inner conductor acts as a half-turn loop, or primary, for the toroid. Actual dimensions are not critical, but the wiring to and from the terminal strip lugs should be soldered at the base rivet of each lug and *not* where the RG-8/U center conductor is soldered. The toroid is held in place by a few dabs of silicone cement.

The current transformer is wound on a T-68-2 (red) core which is rated for use between 1 and 30 MHz. Cut two pieces of no. 24 enameled wire about 60 cm (24") long. Put two ends together in a vise and twist until you have about 1 twist per cm (2½ twists per inch). Wind 22 turns on the toroid, leaving about 2½ cm (1") out of the toroid on both ends of the

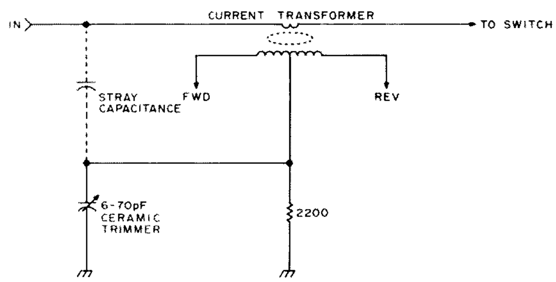


Fig. 3. Capacitive voltage divider with current transformer.

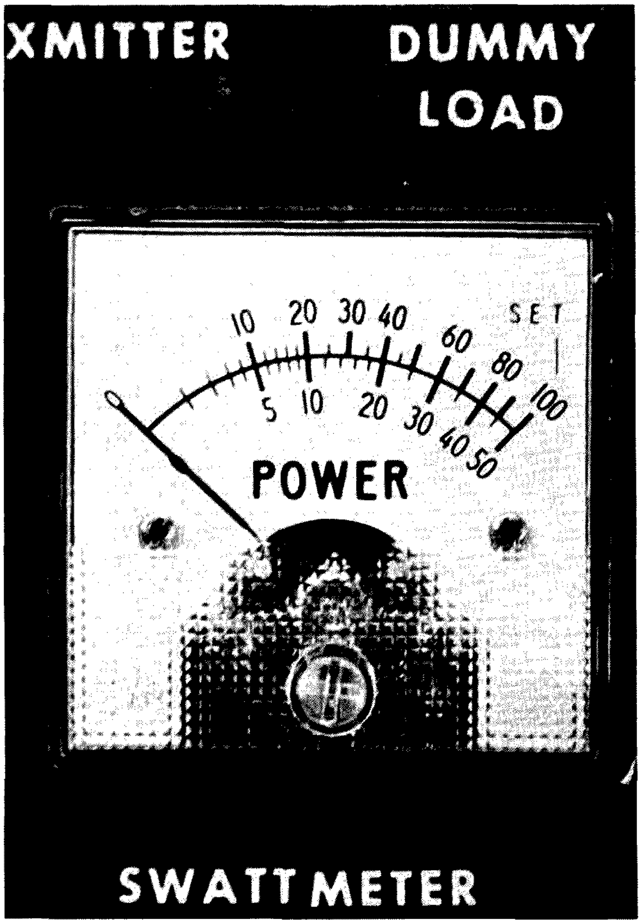


Photo E. Calibration of forward power meter.

winding. The turns should be close-wound around the inner circumference of the core, and evenly spaced along the outer circumference.

Carefully remove all the enamel back towards the toroid, select a wire from each end of the winding, and test with an ohmmeter to find two wires that do not show continuity. Connect these two wires together and hold with a drop of solder. This is the center tap. Check for continuity on the two remaining wires. The result is two bifilar windings in series, with a center tap, or 44 total turns. Total inductance is approximately 11 uH.

The toroid coil should then be slipped over a short length of RG-8/U coax with the outer insulation and braid removed, and mounted and soldered to

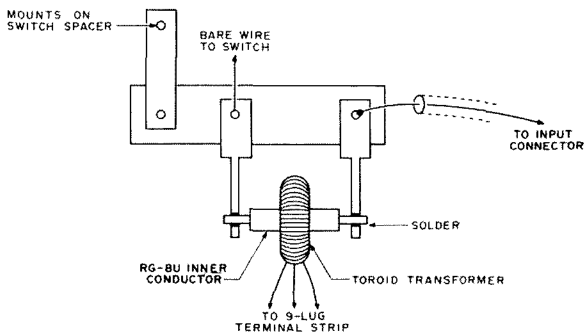


Fig. 4. Mounting the current transformer.

the two-lug terminal strip as described above.

After the toroid is in place, the rest of the Swattmeter wiring is conventional. Wire the hard-to-reach items first, such as the meter bypass capacitors and leads, which are located under the seven-lug terminal strip once it is installed. I used a series 3000, nine-lug terminal strip with a cadmium-plated steel mounting base for point-to-point wiring (available from Allied/Radio Shack). I did consider a PC board, but decided against it since the wiring is so simple. Also, the steel mounting base of the terminal strip makes a fine balanced ground point, as you can see in the photos.

The mounting holes on the terminal strip are bent at right angles away from the lugs. One side is mounted under the bottom nut holding the first (input) SO-239 connector. The other side is secured with 6-32 hardware through a hole drilled in the front of the enclosure. *Use lock washers between the terminal strip mounting holes and the steel enclosure/SO-239 connector,* as well as under each nut.

The center lug of the nine-lug terminal strip is the junction or tie point for the toroid center tap. The 2.2k resistor should be mounted on the underside of the terminal strip, using short leads. Use the metal base of the terminal strip as the ground point. Similarly, the 6- to 70-pF ceramic trimmer capacitor is mounted on the top side of the terminal strip. Again, use the metal base of the terminal strip just opposite of the center lug as a ground point for the capacitor.

Do not connect the two outer wires of the toroid until all other wiring is completed. You will have to determine by trial which lead is forward and which is reverse.

Use short leads for all bypass capacitors, and ground at the closest point possible. *Do not add additional capacitors.* They aren't needed and could make problems. Route all wires from and to the nine-lug terminal strip *under* the terminal strip away from the toroid. Make the layout as uniform and symmetrical as possible. The last components to be soldered in place should be the trimpots used to calibrate the two power positions of the function switch. Fig. 5 and the photos show the location of these trimpots.

I used the miniature pots available at Lafayette because they were the smallest I could get my hands on inexpensively. I cut off the center connector of each pot, and made a solder bridge from the remaining part of the center lug to one side of the pot to conserve space. All four pots are held in place with solder. Forget the old adage of a "good mechanical connection." "Solder is enough," is my motto.

Setup and Calibration

Assuming that all other wiring is complete, tack-solder the two remaining toroid wires to the terminals as shown in Fig. 5. You have a 50/50 chance of getting it right the first time, but Murphy's Law is still in effect, so don't count on it.

Now comes the "smoke" test. Hook up the input connector to an rf source of at least 5 Watts and a 50-Ohm dummy load to one of the output connectors. *Make sure the Swattmeter switch is in the appropriate position* or else there will be smoke, and it won't be coming from the power meter! (Don't ask me how I know!)

Set your rf source, transmitter, or transceiver

on 10 meters and the Swattmeter function switch to SWR. Run the swr meter "set" pot up full clockwise, and key the transmitter. *A lot of power is neither needed nor desired at this point.* Use a rf output level that you can comfortably maintain for a period of time without worrying about your finals sagging.

If all has gone well, the forward power meter (on the left) should register, and the reflected power meter may or may not register. Carefully and slowly, adjust the 6- to 70-pF trimmer capacitor and watch the meters for results. If the toroid is connected correctly, the reading on the reflected power meter should null out. If the null is experienced on the forward side, reverse the toroid connections and try again. Use minimum power and try to hit the null square in the middle. You will find that the null is fairly sharp on 10 meters, but gets broader as the frequency is reduced. Not to worry. Once balanced at 28 MHz, the bridge is okay at all other frequencies.

At this point the bridge is balanced, and all we have to do is calibrate the two power positions. If you have used meters which are calibrated at 0-100 uA, calibration for power will be nonlinear because the meter samples voltage, whereas power is proportional to voltage squared. Table 1 shows the relationship between a 0-100 linear meter scale and power. Two power ranges are shown: 0-50 Watts and 0-100 Watts. The meters I used were already calibrated in terms of power and swr (from the Swan SWR-1), and the power ranges were calculated to match the existing scales.

If you have to use meters calibrated at 0-100 uA, you can use Table 1 to determine actual power and swr, or you can remake the linear scales using dry-transfer press-on lettering. It isn't really all that difficult. Calibration is a heck of a lot less difficult if the meter scales read power instead of microamperes.

There are at least three ways to calibrate the Swattmeter. In each case, the wattmeter is calibrated by feeding power through the meter into a dummy load. It also is possible to infer calibration by measuring the dc output of the forward detector, which can be measured with a high-impedance dc voltmeter (more on this later). In all cases except the last, the reflected power meter is calibrated by reversing the external connections to the coaxial line.

The first method is to beg or borrow another wattmeter to use as a calibrated reference. Simply connect the borrowed meter in series with the power meter between your transmitter and dummy load. Set the range switch to 0-500 Watts and crank up your transmitter for a 10-Watt output as indicated by the borrowed meter. Adjust R1 for a 10-Watt indication on the 0-50 scale of the power meter. Move the range switch to 0-1000 Watts and adjust R2 for a 10-Watt reading on the 0-100 scale. Reverse the coaxial connections to the Swattmeter and calibrate for reflected power in the same manner, using R3 first for the 0-100-Watt position, and R4 for the 0-1000-Watt position.

The second method requires an rf voltmeter and measuring the power dissipated in the dummy load by measuring the rf voltage across the load. However, most rf probes designed for use with com-

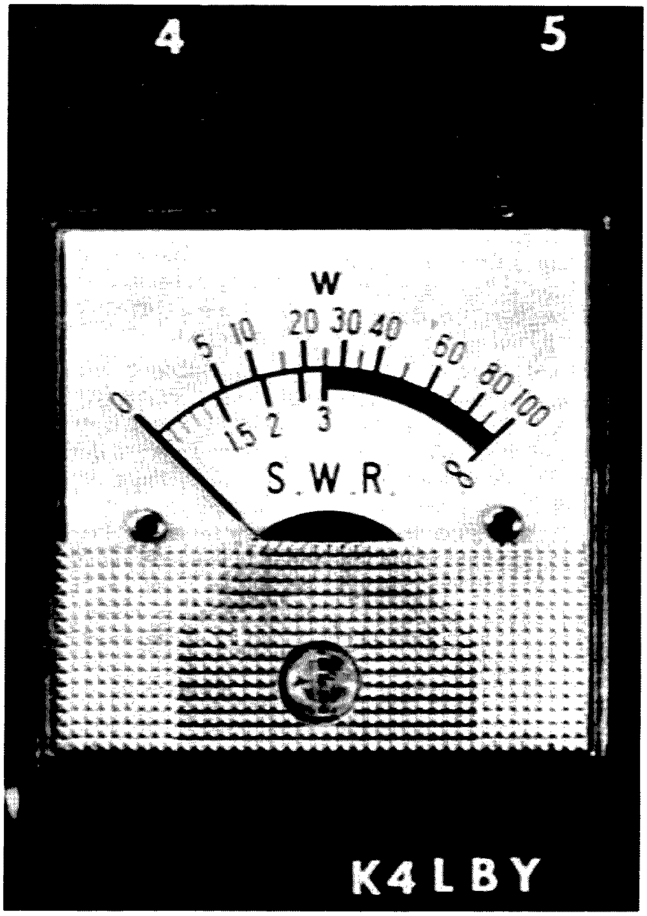


Photo F. Calibration of reverse power and swr meter.

mercial VTVMs are strictly limited. The reason is that the peak reverse voltage appearing across the probe diode will exceed the diode breakdown rating for a peak rf power of much over 10 Watts. (Ten Watts rf across a 50-Ohm dummy load will produce about 22.4 volts dc.) Fortunately, all we need is one bench mark if we assume the wattmeter to be reasonably linear; and a 10-Watt bench mark is as good as any.

An alternative is to use a voltage divider, say 10:1, in front of the diode detector, but that messes up the total load since the voltage divider then appears in parallel with the 50-Ohm dummy load. You can do it if you want to recalculate the load, for example, but it really isn't necessary. The Swattmeter isn't meant to replace a really

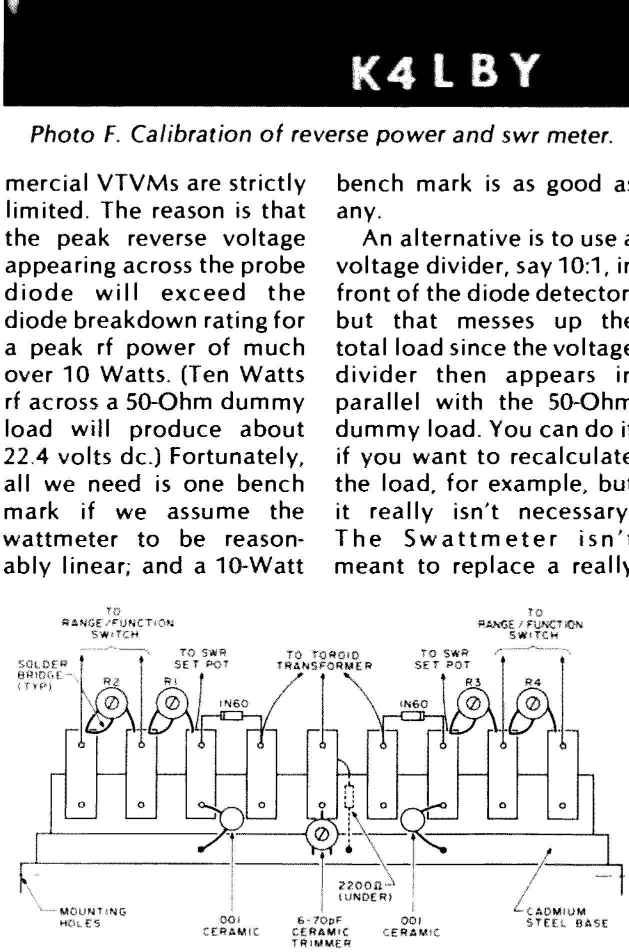


Fig. 5. Wiring diagram, nine-lug terminal strip.

good high-accuracy wattmeter in the first place.

The procedure using the second method of calibration is the same as outlined above, using a second wattmeter. The reference, however, is your VTVM rather than the borrowed wattmeter. Connect your VTVM with the rf probe across the 50-Ohm dummy load. (It won't hurt to measure the actual resistance of the dummy load first, since it may vary between 40 and 60 Ohms, especially if it has been well-used over a period of years. Even good quality resistors change value as they are heated and cooled periodically.) Adjust your transmitter drive to produce a 22.4-volt reading on your VTVM representing 10 Watts of rf, and proceed as above to adjust trim pots R1 through R4. Use a very short coax jumper between the Swattmeter and the dummy load for best results. If your dummy load resistance is off by more than 10% (45-55 Ohms), use Ohm's Law to recalculate the proper voltage for 10 Watts of rf.

The third method that can be used reasonably to calibrate the Swattmeter is to infer the peak line voltage from the dc output of the forward detector, which can be measured with a high impedance dc voltmeter. If you have examined the Swattmeter schematic closely, you will have noticed that the 10k Ohm "Swr Set" controls act as load resistors for the two diodes for all positions of the range selector switch. This loads the diodes on the most linear portion of their response curve, and the calibrating resistors, R1 through R4, plus their respective 100 uA meters, act as simple dc voltmeters measuring the voltages across each 10k control.

No, Virginia, you can't use the Swattmeter meters for self-calibration, but you can calculate the voltage to be expected across the 10k "Swr Set" controls for a given rf power level through the wattmeter. Not wishing to bore you with the math involved, I have shown in Table 2 this relationship for the Swattmeter as constructed.

From Table 2, you will see that 10 Watts of rf produces 0.66 volts at the output of the forward detector (or at the reverse detector if the input/output rf leads are reversed). For 100 Watts, the voltage should be 2.3, for 500 Watts, 5.2 volts, and for 1000 Watts, 7.5 volts. Assuming that you have built a nearly exact copy of the Swattmeter, simply hook up a dc source across both "Swr Set" potentiometers, along with an accurate VTVM or DVM (no rf needed). Set the range selector switch to 500/100 and the dc source to 2.3 V. Adjust R1 and R3 for a 100 Watt reading on both meters. Next, set the range selector to 1000/100 and adjust R2 and R4 for a 100-Watt indication. Run your dc source up to 7.5 volts and check both meters for 1000-Watt indications.

You may have to jockey R1 through R4 a little for compromise readings using the voltages given in Fig. 6. The readings will vary a little because of the load produced by the 100-uA meter movement, but don't worry too much about it. Remember, the Swattmeter is not intended to be a precision instrument—just a handy combination gadget convenient for tuning up and practical as a performance monitor for your station.

Once the calibration is complete, put the back on and install it in a handy location. I installed mine (as you can see from the photos) on a swivel mount, using M-359 angle adapters to keep the coax neat.

Potential Problems

When first constructed, the Swattmeter was erratic on some frequencies—the cause being poor ceramic bypass capacitors. If you experience power peaks, and know it's not caused by your transmitter, replace the capacitors. Another problem experienced was a negative swr indication at very low power levels! This was caused by slightly unmatched diodes which "turned on" at different voltages. If this happens to you, either increase the power level to get each diode turned on or rematch your diodes.

Speaking of diodes, it is possible (although I've never experienced it) that the diodes in any directional wattmeter are likely to produce harmonics of the applied frequency. Change the diodes if you suspect this is happening.

As I said before, Murphy's Law is still in effect, and you could run into some different problems. I have covered all those that I experienced.

Conclusion

My Swattmeter is a comfort when I'm on the air. I can tune up the rig into a dummy load using very little power, switch to whatever antenna I want to use, and load the finals in just a few seconds. It is reassuring to know your finals are putting out just about what they should, and that there is minimum reflected power on the line.

Variations are possible, if you don't like the design or if it doesn't fill your need. You can leave out the range switch and simply calibrate the "Swr Set" control for various power levels. You can eliminate, on the other hand, the swr function and simply have a forward and reflected wattmeter. You even can eliminate both controls, and replace them with fixed-value components for a "one range" Swattmeter. Different power ranges are easy also—just adjust R1 through R4 for wattever (pun intended) full scale power level you desire. And there are still more. . . let me see, now. If I put a 20-dB coupler in there, maybe I can come up with a spare receiver tap. Then there is the possibility of adding another diode and a capacitor and an op amp to read peak power. . . no, on the other hand, I guess the XYL wouldn't stand for it! ■

Power, Watts	0-100 Meter Reading
1000/500	100
900/450	95
800/400	89
700/350	84
600/300	78
500/250	71
400/200	63
300/150	55
250/125	50
200/100	45
100/50	32
50/25	22
25/12.5	16
20/10	14

Swr	0-100 Meter Reading
1:3	50
1:2	34
1:1.5	20

Table 1. Meter scale calibration.

Power, Watts	Forward Detector Dc Output
1000	7.5 V
900	7.0 V
800	6.6 V
700	6.2 V
600	5.7 V
500	5.2 V
400	4.7 V
300	4.0 V
200	3.3 V
100	2.3 V
50	1.6 V
10	0.66 V

Table 2. Forward detector dc-output vs. power.

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The Double-Sawbuck QRM Annihilator

—3-IC circuit yields perfect CW

Having been a ham for almost 13 years, I guess you could say that I am set in my ways in some areas. One of these just happens to be CW. I do not work much CW, but when I do, I like to have a strong clear signal to do it with. This little circuit can give you just that.

I like projects that use components that are easily obtainable and not too expensive. All parts here can be obtained from your nearby Radio Shack for less than $10, as well as a copy of their book, *Integrated Circuits, Volume 3, Projects* ($1.50), which helped me to understand the 567 better.

Overall Description

Basically, what this circuit does is take a CW signal from your receiver via the phones jack, and output to you via speaker or headphones a clear, uncluttered CW signal. It will work with very weak signals that are almost impossible to copy. It has an extremely narrow bandwidth so that it can easily separate two very close signals, especially when you are trying to copy the weaker of the two. If someone has a poor-sounding signal (chirp), you will never know it. It will receive RTTY, and you can tape a good signal off the air for practice later. It requires very little power, less than a Watt, so you can use an ac supply—or a small battery will do.

Circuit Description

See Fig. 1 as you read the following description. Audio enters pin 3 of the 567 via coupling capacitor C1. The 567 is a tone decoder which outputs a negative-going signal from 5 volts to 0 volts. The particular frequency that is able to activate the output depends upon a combination of R1 and C3. The center frequency can be determined by the equation: center frequency = 1.1/R1 x C3.

I used a center frequency of 2300 Hz. C2 is called the low-pass filter, and it determines the bandwidth that the 567 will pass at the center frequency. C4 is called the output filter, and it attenuates frequencies that lie outside the desired band of frequencies.

Normally, pin 8 of the 567 is high. When you tune across a CW signal so that

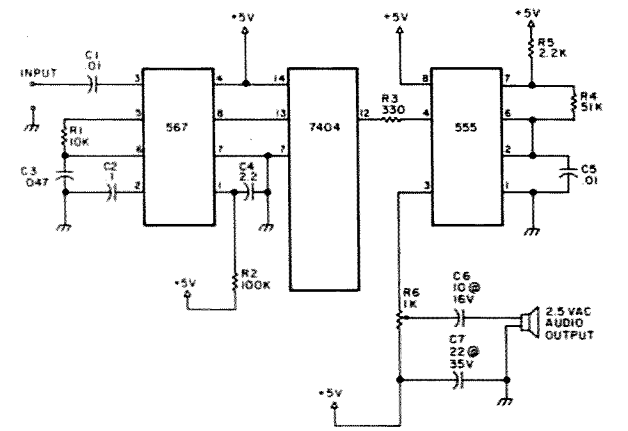

Fig. 1. Schematic diagram of CW circuit. R6 is a Bourns 3339P-1-102 PC board pot. Capacitor values are in microfarads; resistor values are in Ohms. The 555 and 567 are mini-DIP chips.

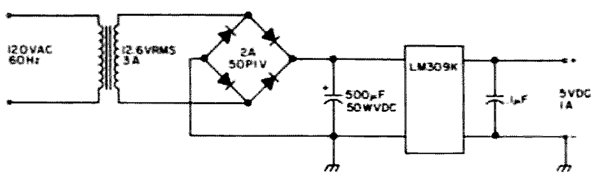

Fig. 2. 5 volts at 1 Amp dc power supply.

it generates the proper tone, pin 8 will go to zero with each dot or dash. So you end up with negative-going CW!

The signal enters the 7404, a hex inverter, at pin 13, and leaves at pin 12 as a positive-going CW signal.

From here, the signal enters the 555 at pin 4.

Data for the 555 can be obtained from *The Linear Control Circuits Data Book*, published by Texas Instruments. The 555 can be set up to run in many different modes. Here it is used to produce a tone every time it sees an input at pin 4. The frequency of this tone is determined by the equation: frequency = 1.44/C5(R5 + 2R4).

So, by changing the values of the components such as R4, you can vary the tone of the output in case you do not like my tone! You could even make R4 a pot, but I did not, to keep the cost low.

The 555 outputs the tone at pin 3, and its volume to your speaker is controlled by R6. Capacitor C7 was used as a filter because I used a 5-volt power supply. If you use a battery, it will not be necessary. And that is it; from the speaker comes uncrowded, clear CW!

Fig. 2 shows a simple 5-volt power supply if you do not already have one.

Summary

You will find that the circuit has a very narrow bandwidth so you have to be exactly at the correct "spot" to get an output. I have enjoyed using this circuit for a couple of months now, and, who knows, it might relight the CW flame in you, now that you do not have to listen to everyone on the band at once! ■

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Center Insulator for your Next Antenna

—do it yourself with PVC

Here is a scheme for a center insulator for your dipole or center-fed antenna that does the job beautifully and is inexpensive and easy to make.

The parts are of the ½-inch, heavy-duty, schedule 40 PVC plastic variety, and should be available at your local plumbing supply or large hardware store. Try to obtain parts that are grey in color, as the ultraviolet radiation from the sun is harder on the white. Painting the white PVC with a dark enamel will help here. The strain relief fitting may require a trip to your local electrical supply store. My fitting is a Ralco brand made of cast aluminum which cost 89 cents. This fitting cost less than a pair of coax fittings and is waterproof to boot. Taking the fitting apart will show you how it works much more easily than I can describe, so I won't go into that. Fittings are available that will accept the larger RG-8 size coax also, but I use 58C/U, with which the ¼-inch hole in the rubber grommet works nicely.

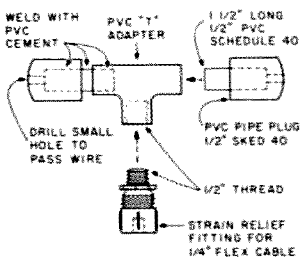

Fig. 1. Details of center insulator.

Run the element wires though their respective end cap holes and tie an overhand knot about 1 inch from the end of each wire. (Hope you use stranded flexible insulated wire, hi.) Pass the coax through the strain relief fitting and out the unglued end of the "T". Strip 2 inches of the jacket off the coax and separate the shield and center conductor. Strip ½ inch of insulation off the dipole ends and make the connection to the coax. Tape up the connections, and then carefully pull the works back into the center of the "T" and complete assembly.

Tighten the compression ring on the strain relief, and you're all set. If desired, before final assembly, the inside of the T-plug caps can be filled with wax, caulking compound, duct seal, etc., for additional protection against moisture through the end holes. You will find the completed project very strong, professional looking, and easily capable of doing its job. It can be tied to a supporting structure with nylon or poly rope, and you can be assured of good insulation and lasting performance. ■

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Another Approach to Repeater Control

—uses 7516 chip for low parts count

Over the last couple of years, I have written several articles using the 567 type of IC tone decoder. If you have used these decoders, you probably have discovered that, while they do the job, they have many limitations. They are very sensitive to input level, the decoding bandwidth changes with the input level, and there is bounce or ringing on the output. In order to function well in a complete 16-tone DTMF (touch-tone™) decoding system, the 567s require a lot of special effort, not the least of which is the addition of an agc amplifier.

Our local repeater organization is in the process of upgrading our control system and some of the first things on the list to be replaced were several 567-based DTMF decoders. We reviewed the specifications on several new monolithic tone decoders that have come on the market in the last couple of years. After reviewing the specifications, we decided on the Telenetics decoder which, although expensive (over $100), has several very attractive features, not the least of which is single-supply operation. Telenetics markets a system which consists of two ICs, a tone decoder, and an address selector, either of which is a stand-alone device which can be used without the other. Before proceeding with this article, I would like to acknowledge the help of Jay Hein WB7DQN, who did most of the initial logic layout.

Decoder

A very simplified block diagram of the 7516 decoder is shown in Fig. 1.

To briefly go through the decoder, it has an input audio amplifier which will accept either balanced or unbalanced inputs. The amplifier output feeds low- and high-pass bandsplitting filters which separate the high- and low-group DTMF tone-group ranges. The output of the filters then goes into a limiter. That output then drives an envelope detector and the digit decoder. The envelope detectors provide an input to the decoder portion which tells the decoder if valid dual tones are present. The decoder, through a digital counting scheme, decodes the tones and then provides either a one-of-sixteen logic output or a BCD-coded output, depending upon what the user selects. One thing I didn't mention earlier is a speech detector circuit which prevents false decoding with speech-type waveforms. The device also has several test points brought out which allow checking of device operation. In addition to the test points, a 10-kHz clock signal is brought out. This signal is required by the address selector. The specified operating range of the device is 8 to 28 volts, which adds to the versatility.

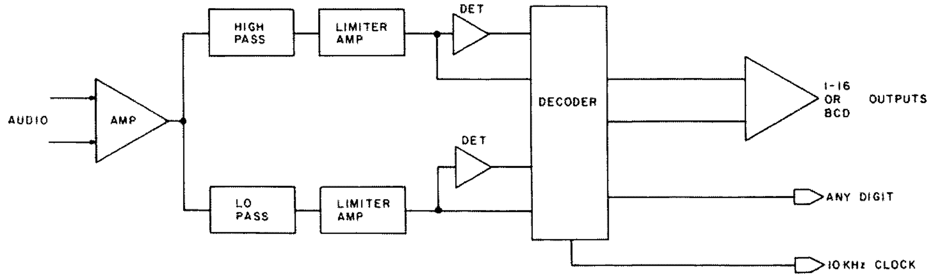

Fig. 1. Simplified block diagram of the Telenetics 7516 tone decoder. We obtained these and the address selectors direct from Telenetics, Inc, 4120 Birch St., Newport Beach CA 92660.

Address Selector

The 7511 address selector does just what its name suggests, i.e., recognizes an address. The length of the address to be recognized is user-selectable to lengths of 2, 3, 4, 7, or 10 digits. The chip requires a 10-kHz clock which can be provided directly from the 7516 tone decoder. This signal is used for internal timing. The selector provides either a positive- or a negative-going logic signal when the correct address is decoded, and the length of this output can be user-selected for 3, 5, or 9 seconds. The ingenious people who designed this circuit also provided for recognizing invalid digits through use of an "ANY DIGIT" output from the decoder or by resetting if too much time is taken in the digit selection. One minor drawback is the input voltage range; the maximum on the address selector is about 17 volts. This

normally won't present a problem.

Control Decoder

Now that I have introduced you to the device we are using, let's take a look at the complete repeater control system we designed around these devices. I divided the system up into blocks which are a little easier to describe. The first of these blocks is the control decoder, the heart of the system. The decoder is shown in Fig. 2.

The connections to the decoder and address selector are very straightforward and come straight from the Telenetics applications notes. The 12 (I didn't use all 16) digit outputs go to pads where they can be jumpered to the digit inputs of the address selector. In addition to these pads, I also ran the digit outputs out to the outside world so that the system can easily be expanded.

There is a 10-kHz clock output from the decoder (mentioned earlier) that is needed by the address selector. I also ran this line to the outside so that additional address selectors could be added at a future date. In order to ignore wrong addresses, the "ANY" line must also be connected. This line provides a pulse for each digit decoded by the decoder.

Pads also have to be provided for the selection of the address length and the address-selector output duration. The selection of 1-of-16 instead of BCD outputs I have shown hardwired, since that was the way our application went.

We used the low-going output of the selector ($\overline{Q}$) to trigger a 555 timer, which in turn puts out an enable signal to the rest of the function decode logic and will hold it for more than the time available from the selector. The # digit is fed through U13A and is used to reset the enable timer if desired. The other input to U13A serves as an inhibit to the control process. If this line is high, it will prevent enabling of the function-selection gates.

Two sections of U13 are cross-connected as a flip-flop and run off the decoded 8 and 9 digits to provide on/off toggling of the selected function.

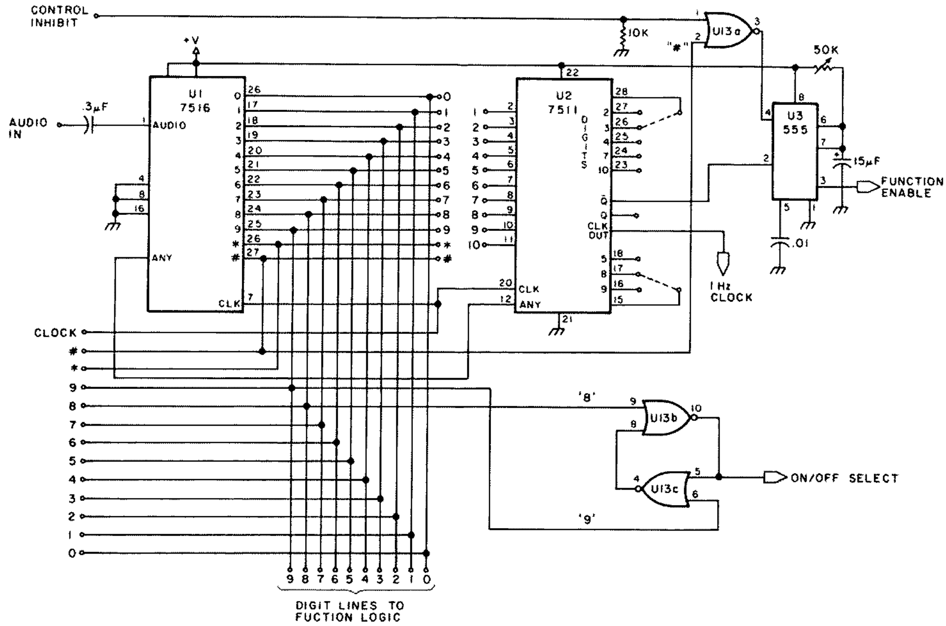

*Fig. 2. Schematic diagram of the decoder section of the complete control system. In this and the following schematics, the arrowheads indicate connections contained on the printed circuit board, while circles indicate those lines which go off the circuit board. The * is available but not used.*

Control Logic

The next section, illustrated in Fig. 3, recognizes that a valid address and control command have been sent and then provides an appropriate latched logic output to the outside world. In the case of the 6 and 7 functions, the logic in our system is hard-wired for timer disable and repeater disable, respectively.

The first digit normally sent would be an 8 or 9 to set the on/off flip-flop condition. The on/off flip-flop output line controls the D inputs to the flip-flops in U6, 7, 8, and 9. Now, if any of the flip-flops are clocked by the action of U4 or U5, their outputs will follow the state of the D input and set or reset the desired function.

In order to illustrate the operation this far, let's

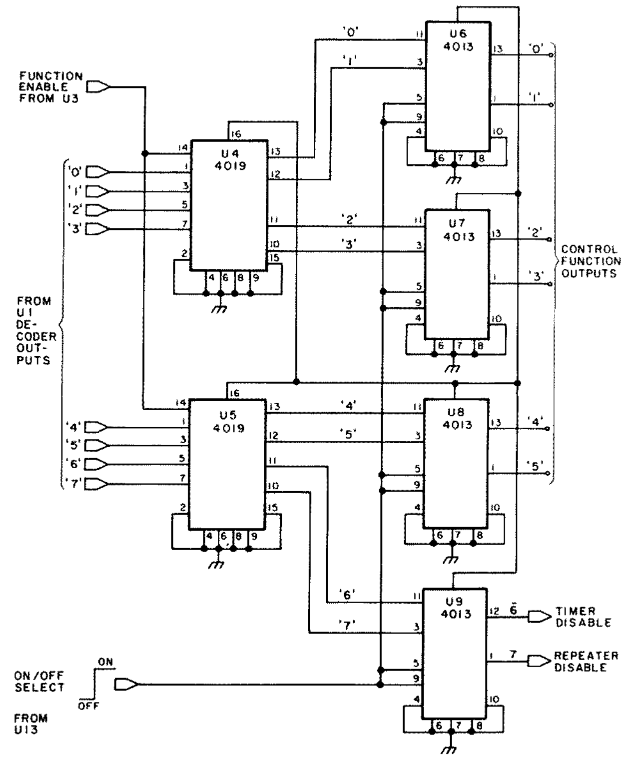

Fig. 3. Schematic diagram of the function decoder section of the control decoder. The control functions 0 through 5 go off the board for whatever auxiliary use may be needed.

assume that the correct address has been selected. U3 will then provide a high on the function enable line for about 5-10 seconds. This high will let the appropriate control-digit pulses through to the rest of the logic. If the next digit to follow the address was, for example, a 0, U4 would pass the high through to U6, where, if pins 5 and 9 were high, it would cause a latched high on the 0 function output. If the 0 had already been high and pins 5 and 9 were low, the output would have been reset to low.

As mentioned earlier, the 6 function is hard-wired for repeater disable and the 7 function is wired for timer disable. I made no attempt to buffer the CMOS outputs because of printed wiring board space limitations and because I thought it would put some restraints on the versatility of the board.

COR/Timer

The last section contains the COR, drop-out delay timer, time-out timer, and beep generator. The schematic for this section is shown in Fig. 4.

The PTT transistor is driven by U14A. One input of U14A is fed with a diode OR gate which allows either the time-out timer or the repeater disable signal from the control circuitry to inhibit the transmitter PTT. The other side of U14A is fed from U14B, which allows PTT operation from an external IDer, a second receiver, or from the internal COR switch.

The primary receiver COR circuit requires a signal keyed to ground when the COR is active. This signal activates timers U15A and U15B. U15A then activates the PTT; the setting of the 50k pot on this IC will determine the amount of time the PTT will stay on after the COR has shut off (drop-out delay). Timer U15B acts in the same manner except that it controls the time out timer. U15B also triggers a beep generator comprised of U16A and B on its falling edge. This provides a short beep when the timer is reset. In order for this function to work properly, the drop-out delay must be longer than the time-out timer time.

A typical setup for this would be to set U15A for about 2 seconds and U15B for about 1 to 1½ seconds. Thus the beep would be heard (and the timer reset) about 1 second before the carrier drops. There is a 50k pot on the beep timer which sets the duration of the beep tone.

One last connection to describe: The line marked COR inhibit, if taken to ground, will prevent the timers of U15 from operating. This effectively precludes PTT operation from the COR. This line was added as an afterthought to add to the possible methods of control. The last but not least section of this functional block is the time-out timer. I neglected to mention that the 7511 address selector also provides an output which is the clock input divided by 10,000, which, for the normal 10-kHz clock input, provides a one Hz output. By simply counting this output, time functions such as time-out can easily be accomplished.

The time-out circuit then simply consists of a chain of presettable counters which count down the 1-Hz clock. The first counter, U10, is hard-wired as a divide-by-10 to give a 10-second output. The second two counters, U11 and U12, are provided with strapping pads to allow programming of the desired time out in increments of 10 seconds. The output of U13D is also fed back to U10, where it stops the counting function, thereby holding the counter in its present state and holding the PTT off. U14 resets the whole timer chain when the COR signal is removed.

Operation

In the last section, I tried to tell you how this thing worked; however, its use is somewhat complicated, so I will try to explain it in some detail. Using the system requires two basic

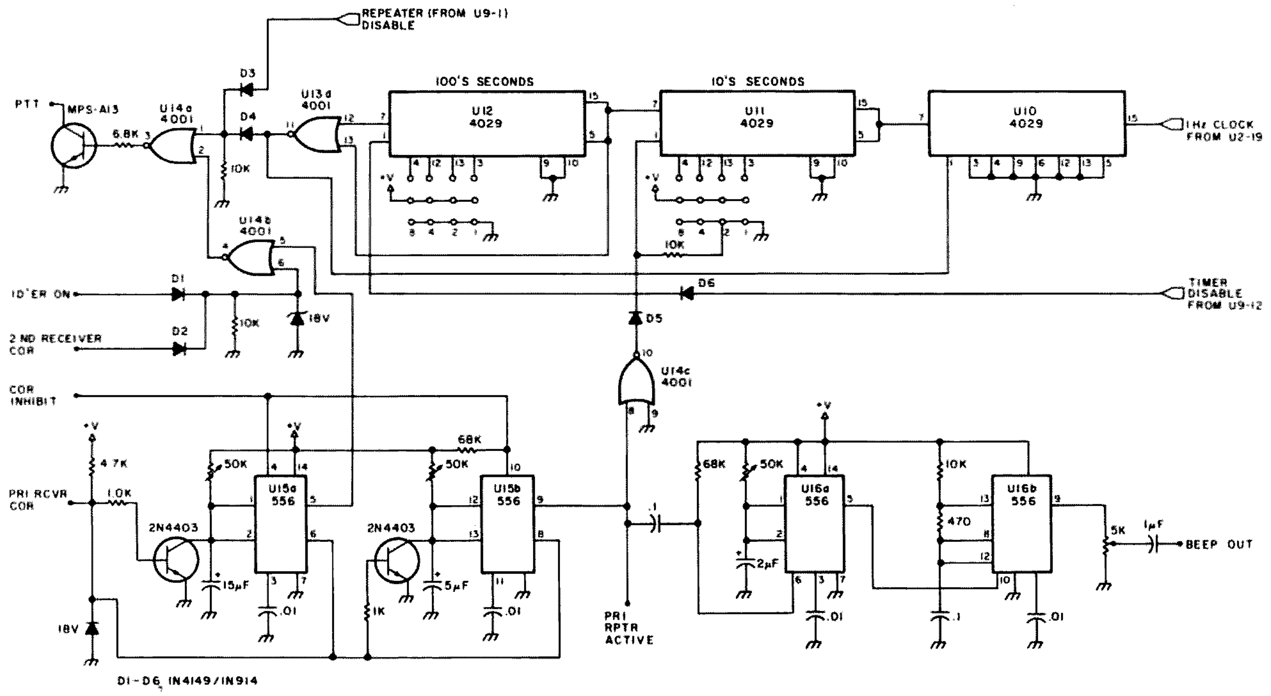

Fig. 4. Schematic diagram of the COR and timer sections of the control system. Note that the repeater disable and timer disable signals come directly from the function decoding logic (Fig. 3).

stages: initial setup and interconnection/adjustment.

Initial setup involves making some decisions and then strapping the options according to your decisions. The first decision is the length of the control address. This can be 2, 3, 4, 7, or 10 digits long. This option is set by installing a jumper between pin 28 of U2 and one of the following pins of U2: 27, 26, 25, 24, or 23.

The second decision, once the length of the address is decided, is what the actual address will be. I think this can best be explained by example. Let's say you selected an address length of three digits (U2, pin 28 to U2, pin 26) and an address of 9-4-2. Pin 2 of U2 is the first digit input, pin 3 the second digit input, and so forth to 10 (max.). Now, you would strap the first digit (pin 2, U2) to the nine digit output of U1, which appears at pin 25. Next, connect U2, pin 3 to the four-digit output (U1-20), and finally U2-4 to U1-18 (the two output). Your decoder system will now respond to an address of 9-4-2. Taking longer than about five seconds between digits or sending a digit out of sequence will cause the selector to reset and reject the address.

The last jumper you have to install on the address selector is the one which determines how long the output will stay active after a valid address is decoded. By jumpering U2, pin 15 to U2, pin 16, 17, or 18, you can select 9, 3, or 5 seconds. The printed circuit board being offered by the ARA* is hard-wired for a three-second time.

One last comment regarding the decoder: It can be jumpered for BCD outputs instead of one-of-sixteen as was done here. To do this, you have to reverse the states of pins 15 and 16. I don't want to go into any more detail since it is a whole different mode of operation.

The selection of time-out requires installation of jumpers also. The jumpers on U11 set increments of 10 seconds and the jumpers of U12 set multiples of 100 seconds. Both are programmed by jumpering the appropriate bit high or low in a BCD code for the digit desired. For example, if you want a three-minute timer, which is 180 seconds, you would program U11 to an 8 and U12 to a 1. To do this, we connect pin 4 of U11 and pin 3 of U12 to +V and then ground pins 12, 13, and 3 of U11 and pins 4, 12, and 13 of U12. This is now all of the jumpers required. The remaining adjustments should be made once the board is installed.

The primary connections to the controller are shown in Table 1.

Each of the function outputs is a latched CMOS-compatible signal which can be used, with the proper buffering, to control a number of various functions.

Conclusion

There we have a complete repeater control system which provides control decode functions, primary repeater control, auxiliary control functions, COR/PTT functions, adjustable squelch tail length, adjustable time-out timer length, and time-out beeper. With some professional assistance, we got the entire circuit on one 4½ x 6 inch plug-in circuit card. The Arizona Repeater Association is going to be marketing the printed circuit boards for the control system along with a compatible CMOS identifier printed circuit board. As of this writing, only prototype boards were completed, so pricing was not available. For pricing and availability, either contact the ARA or me.

One last comment; I almost forgot. Not shown on the schematic but present on our PC boards and highly recommended are .01 uF capacitors on the supply pins of each IC and 18-volt zener diodes on input lines for spike protection. ■

*Arizona Repeater Association, Suite 4000, Valley Center, Phoenix AZ 85073.

Signal	Description
PRI RCVR COR	An input line that is keyed to ground when the primary receiver is active.
COR INHIBIT	A normally open input line. A ground on this line will inhibit operation of the COR/PTT.
PTT	A transistor switch output keyed to ground and capable of about 200 mA. If anything other than a transistor circuit is to be keyed, it should be through a relay.
IDer ON	A high (+V) on this input line from the IDer will keep the PTT keyed while the ID is being sent.
2ND RCVR COR	Provides input capability for a second (link) receiver to operate the PTT. Note that this and ID both bypass the time-out timer.
BEEP OUT	Adjustable audio output signal which can be fed into the transmitter mic input.
AUDIO INPUT	This is the control audio Input which may come from a control line or from another receiver. Not normally fed from repeater receiver.
CONTROL INHIB	This input, normally open, will inhibit the control decoding process if a high is placed on it.

Table 1. Primary connections to the controller.

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Yes, You <u>Can</u> Build this Synthesizer!

—keep your crystal rig

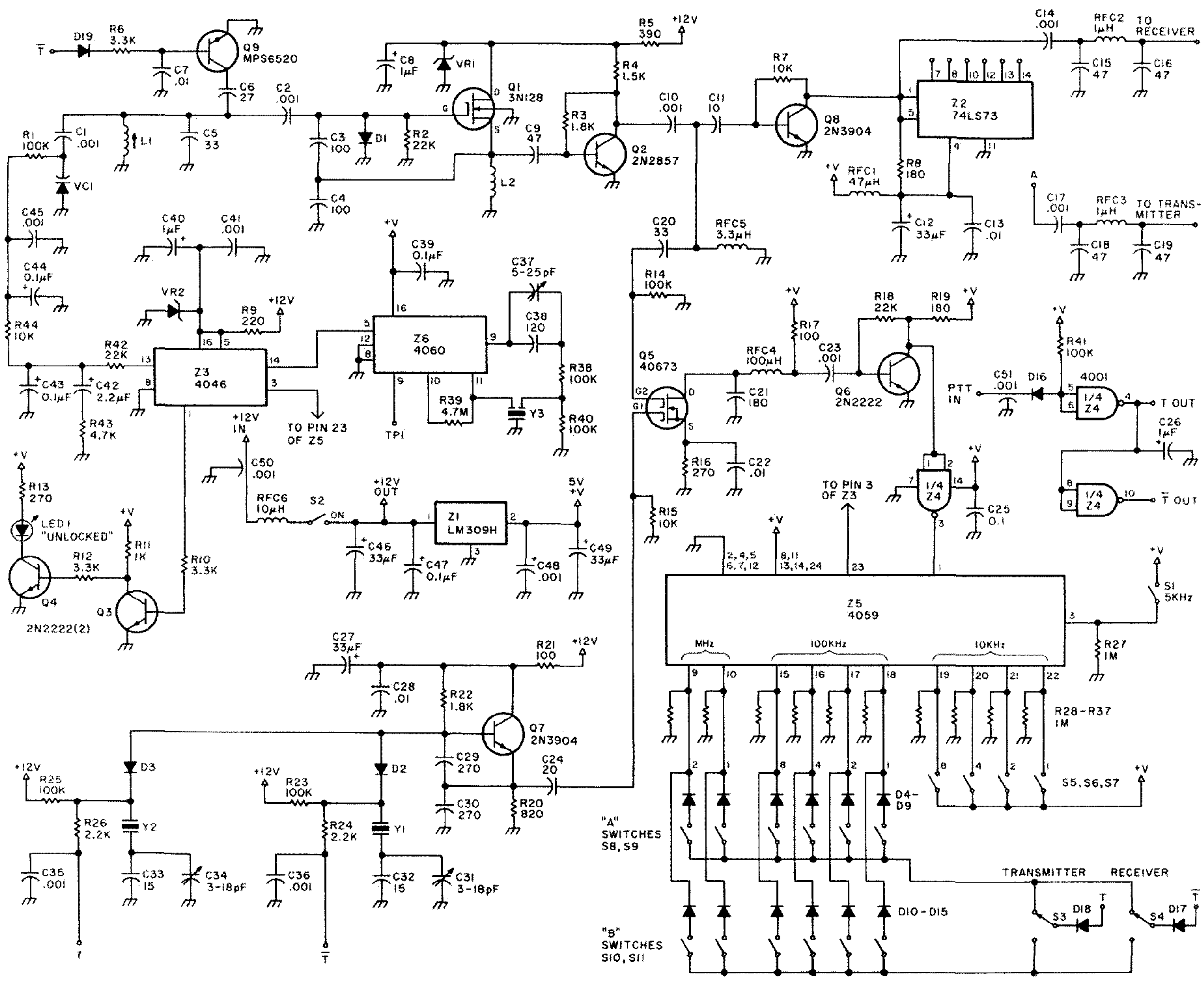
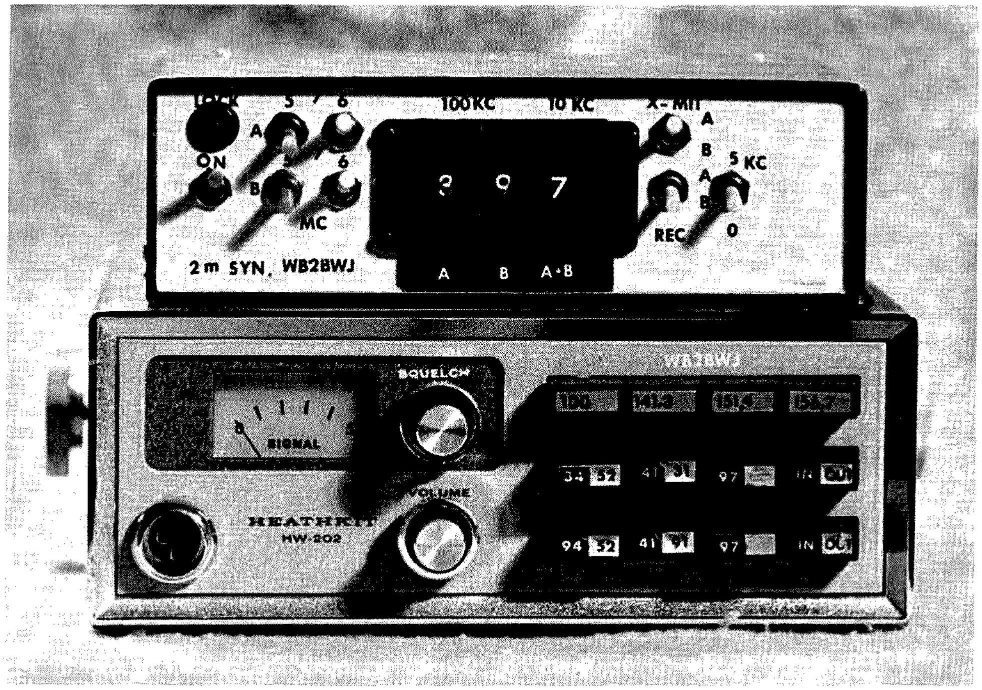


Fig. 1. 2m synthesizer schematic diagram.



A low-cost, low-power, compact two meter synthesizer can now be built due to recent developments in COSMOS technology. The synthesizer covers 144-148 MHz and can be adapted to almost any rig simply by programming the output divider and using the proper crystals in the beat oscillator. Any repeater offset can be generated, as the receive and transmit frequencies are independently set in 5-kHz steps. The unit uses a total of six integrated circuits and draws about 60 mA at 12 volts. My unit is interfaced with a Heathkit® HW-202.

See Fig. 1. Q1, along with its associated components, forms a vco which has an output in the 22-25-MHz region depending upon what the voltage on VC1 is and if Q9 is turned on or off. Q2 is a buffer amplifier which is connected to one gate of mixer Q5. The other gate of Q5 is connected to Q7, which is the beat oscillator that also oscillates in the 22-25-MHz range depending on which crystal is switched into its base. The output of Q5 contains the sum and difference frequencies of the two signals present at its gates. RFC4 and C21 form a filter which allows the difference frequency to pass on to Q6 which shapes and level-shifts the signal so that it is CMOS compatible.

The first gate of Z4 acts as a buffer to drive Z5, which is a divide-by-N divider. The divider is connected to divide by 800 plus twice the switch settings, and then plus one if the 5-kHz switch is on. These switches are labeled as to what decade of the frequency they determine. The output of the divider goes to the input of Z3, which is a phase comparator. The other input of Z3 goes to Z6, an oscillator /binary divider, whose output is 833.333 Hz. This is the reference frequency. The output of Z3 is connected to a low-pass filter whose output goes to varactor VC1.

Let us now trace a complete cycle of the loop (see Fig. 2). Suppose we want to transmit on 146.940 MHz, and we set the switches as such. Our divider divides by 800 + 2(294) = 1388. Suppose that the vco is free-running at 24.00 MHz. This mixes with the 23.3333-MHz transmit crystal to give an output of .6667 MHz. This is divided by 1388 to give 480.3 Hz. This is compared to the 833.333-Hz reference, and the 4046 raises the voltage to VC1 to increase the frequency of the vco. When the vco has an output of 146.940 MHz/6 which is 24.490 MHz, the loop will

For 24-MHz crystals, connect point A (C17) to pins 1 and 5.
For 12-MHz crystals, connect pin 13 to A.
For 8-MHz crystals, connect pin 8 to pin 14, pin 7 to 12, pin 10 to 13, and pin 14 to A.
For 6-MHz crystals, connect pins 7, 10, and 12, all tied together, and pin 8 to A.

Table 1. Programming chart for Z2. All of these connections are made directly to the socket pads of Z2.

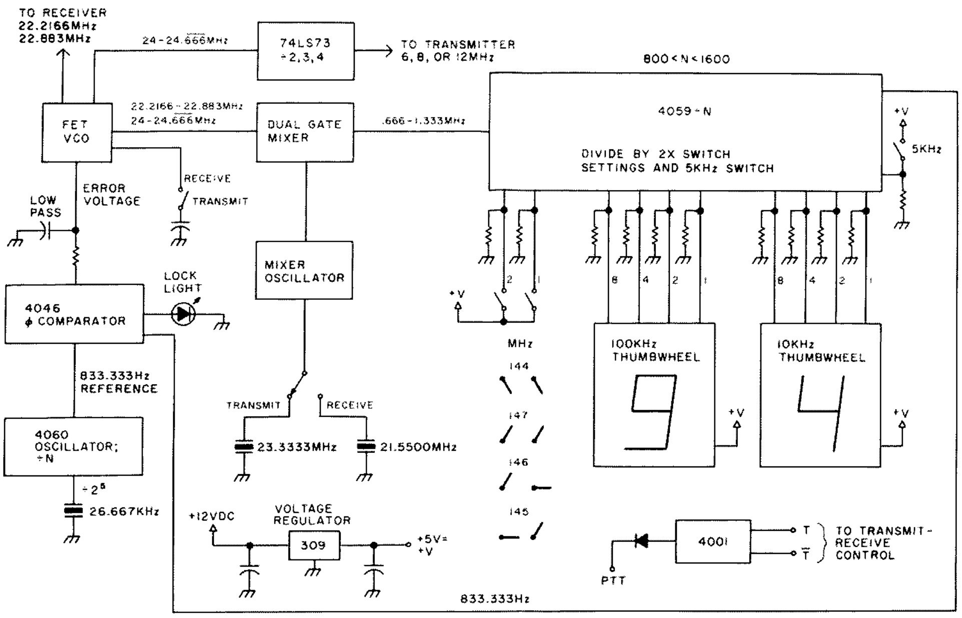


Fig. 2. 2m synthesizer block diagram.

lock since (24.490 − 23.333)/1388 equals 833.333 Hz.

The 4046 will adjust its output voltage so that the two inputs are identical in phase and frequency. Q3, Q4, LED 1, and associated components form an indicator that lights when the synthesizer is unlocked. This indication

Parts List

Resistors—all ¼-Watt, five percent

R1, R14, R23, R25, R38, R40, R41	100k
R2, R18, R42	22k
R22, R3	1.8k
R4	1.5k
R7, R15, R44	10k
R13, R16,	270 Ohms
R43	4.7k
R6, R10, R12	3.3k
R17, R21, and one in radio	100 Ohms
R20	820 Ohms
R24, R26	2.2k
R27-R37	1 megohm
R39	4.7 megohms
R9	220 Ohms
R5	390 Ohms
R8, R19	180 Ohms
R11	1k

Capacitors—all disc ceramic, unless otherwise noted

C1, C2, C10, C14, C17, C23, C35, C36, C41, C45, C48 and two in radio	0.001 uF
C50, C51	0.001-uF feedthroughs
C3, C4	100-pF silver mica
C9, C15, C16, C18, C19	47 pF
C12, C27, C46, C49	33-uF tantalum
C7, C22, C28	0.01 uF
C42	2.2-uF tantalum
C43, C44	0.1-uF tantalum
C13, C25, C39, C47	0.1 uF
C24	20 pF
C29, C30	270-pF silver mica
C32, C33	15-pF silver mica
C8, C26, C40	1-uF tantalum
C38	120-pF silver mica
C5	33-pF silver mica
C20	33 pF
C21	180 pF
C6	27-pF silver mica
C11	10 pF
C31, C34, C37	5-30-pF subminiature trimmers

RF chokes and coils

RFC1	47 μH
RFC2, RFC3	1 μH
RFC4	100 μH
RFC5	3.3 μH
RFC6	10 μH
L1	¼-inch slug-tuned form wound with 8 turns of #22 wire
L2	20 turns #30 wire on Amidon #73-801 ferrite bead

Semiconductors

Z1	LM309H
Z2	74LS73
Z3	4046
Z4	4001
Z5	4059
Z6	4060
Q1	3N128
Q3, Q4, Q6	2N2222
Q5	40673 or HEP F2004
Q7, Q8	2N3904
Q9	MPS6520 or HEP S0009
Q2	2N2857
VC1	HEP R2503 varactor
D1-D19	1N914 diodes
LED1	any type red LED
VR1, VR2	5.1-volt ½-Watt zener diode

Crystals

Y1	23.3333-MHz, Heath #404-586*
Y2	21.5500-MHz, Heath #404-584*
Y3	26.667-kHz, Statek type SX-1H

Switches

S5, S6, S7	10-position BCD switches with endplates
S3, S4	SPDT toggle switches
S1, S2, S8, S9, S10, S11	SPST toggle switches

*International crystal cat #435274

Miscellaneous

2 RCA phone plugs and jacks
RG-174/U miniature 50-Ohm coax
Amidon #64-101 ferrite beads

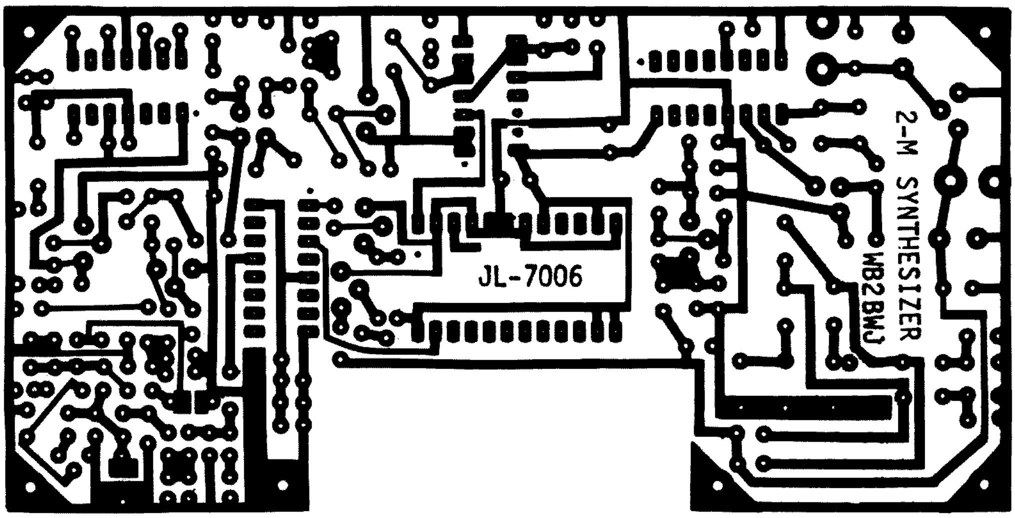


Fig. 3. PC board layout.

is useful when initially tuning the synthesizer, and warns the operator not to transmit if the loop becomes unlocked due to component failure, etc.

The second and third gates of Z4 generate two signals: T and $\overline{T}$ (pronounced not T). T is high in transmit and low in receive, and $\overline{T}$ is its complement. These signals switch between Y1 and Y2, select which set of frequency switches is connected to the 4059, and turn Q9 on and off, which places C6 in parallel with the vco tank to lower its frequency range in the receive mode. Q8 is a buffer stage which isolates the vco from the output circuitry.

Before the signal from Q8 goes to the receiver, it is passed through the low-pass filter composed of C14, C15, C16, and RFC2. This passes the 24-MHz rf, but keeps the VHF rf from the transceiver from getting into the synthesizer. Q8 is also connected to Z2, which is a quad flip-flop. By connecting the pins of Z2, as shown in the programming chart, Table 1, the chip can divide the 24-MHz signal by 2, 3, or 4, giving a 12-, 8-, or 6-MHz output. The transmitter's signal also goes through a low-pass filter.

Z1 is a five-volt regulator which supplies power to most of the circuit. Some parts of the circuit require 12 volts, and this is obtained at C46. In the HW-202, I take the supply voltage off the 11-volt regulated line within the radio.

Parts layout is fairly critical, and it is recommended that the PC board layout shown in Figs. 3 and 4 be used. Keep all leads as short as possible and mount Y3 and Z1 flush to the board. The use of IC sockets is encouraged. Resistors R28-37 and diodes D4-15, D17, and D18 are not mounted on the board but directly on the switches concerned. C50 and C51 are .001-uF feedthroughs mounted directly to the metal cabinet enclosing the synthesizer. RFC6 is not mounted on the board but is connected directly to feedthrough capacitor C50. RCA-type jacks are used for the receiver and transmitter output connectors. RG-174/U, 50-Ohm miniature coax is used to connect the receiver and transmitter output from the boards to their respective low-pass filters and jacks. The low-pass filters are assembled around the jacks. There are several jumpers that are connected to the bottom of the board (Table 2). They are noted on the parts placement diagram as J1, J2, etc. For example, a jumper must be connected from one point labeled J1 to another point labeled J1. Some jumpers go to more than one place. For example, there is a J4a, b, and c. This means that J4a goes to J4b and J4b goes to J4c. All jumpers are RG-174/U coax, and provision is made at each point for the shield to be soldered to

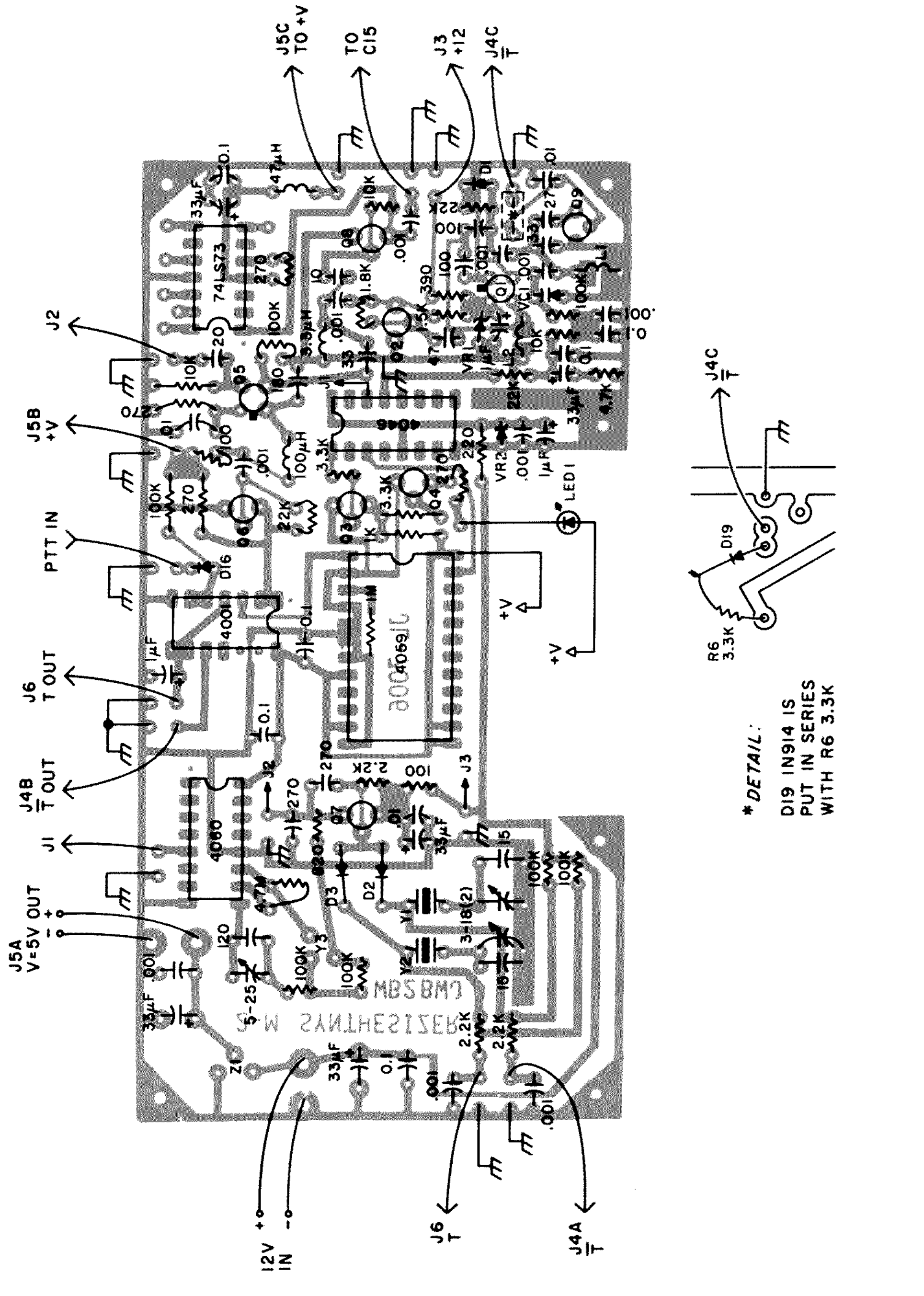
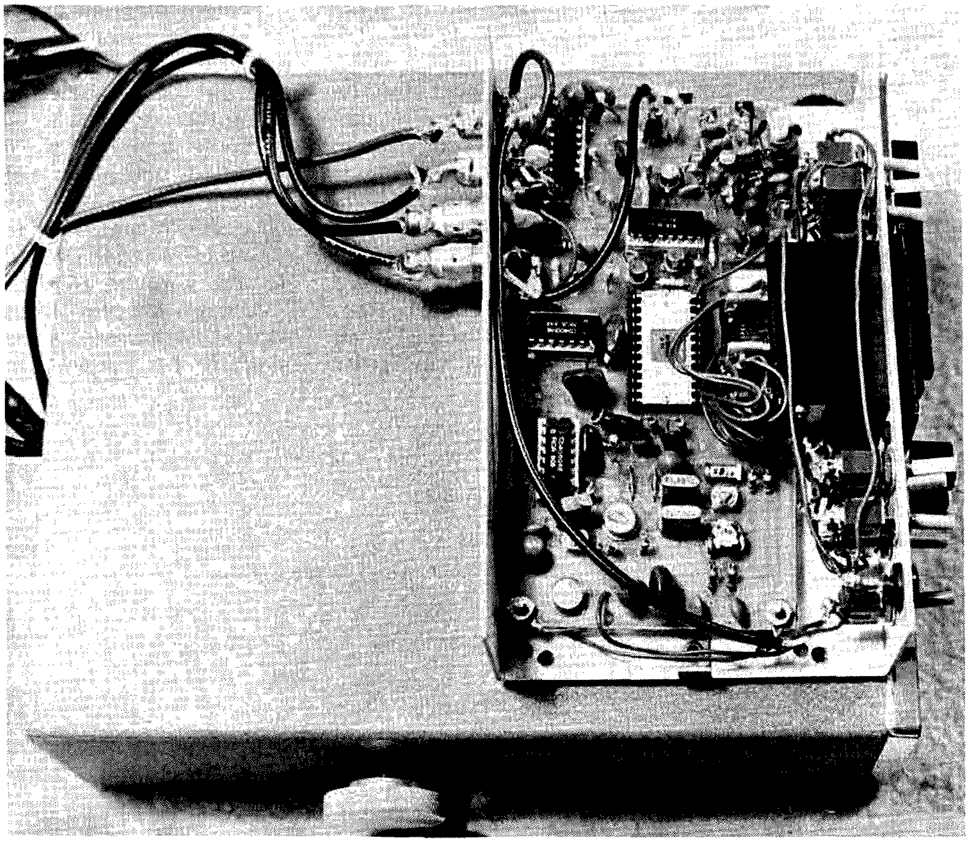


Fig. 4. Component placement.



ground. Table 3 shows the cable lengths.

The switching arrangement I used (Fig. 5) was designed to keep the number of thumbwheel switches to a minimum. The arrangement consists of two sets of switches, one labeled A and the other B. S8 and S9 are SPST switches that comprise the MHz selection for the A set. Placing both switches down (turning them off) sets the MHz to 144, S9 up (S8 down) is 145, S8 up (S9 down) is 146, and both up is 147. S10 and S11 work in a similar fashion for the B set. S5 is a thumbwheel switch that selects the 100-kHz step for A; S6 does this for B. S7 is another thumbwheel that sets the 10-kHz step for both A and B. S1 selects whether or not 5-kHz step is used. S3 and S4 select whether or not the A or B setting will be used for transmit or receive.

As an example, if we want to go on 146.34/146.94 with A selecting the transmit frequency and B selecting the receive frequency, we set S8 and S10 to on, S5 to 3, S6 to 9, S7 to 4, S3 to A, and S4 to B. To go on simplex on 146.34, say, to monitor the input, we set S4 to A. To go simplex on 146.94, we set S3 and S4 to B. To go on reverse 146.94/146.34, we set S3 to B and S4 to A. With this method of switching, most common repeater pairings can be obtained. If a more sophisticated system is desired, an automatic offset[1] could be built in, or a keyboard-type entry system[2] could be used. The important thing to note is that the synthesizer only requires the BCD code of the desired frequency—no look-up table is needed.

Mount all of the parts on the board in the following order: sockets, resistors, capacitors, chokes, transistors and diodes, crystals, and jumpers. Before inserting the IC chips, apply 12 volts to the unit and check for the proper supply voltages at the IC sockets. After turning the supply off, insert all of the IC chips. Turn the unit on again and the unlocked light should come on. The first signal to check on the unit is pin 14 of Z3. There should be a 5-volt peak-to-peak square wave at a frequency of 833.333 Hz. With an accurate frequency counter, preferably set to measure the period, adjust C37 until the frequency, or period, is as stated. This adjustment could also be made by looking at pin 9 of Z6 and setting C37 for a frequency here of 26.6666 kHz. Connect the positive lead of a VTVM or FET VOM to the lead of R1 farthest from VC1. The voltage here probably will be either near zero volts or near 10 volts, either of which represents an unlocked condition. With the synthesizer in the receive mode, set the frequency select switches to 147.995 MHz and adjust the tuning slug on L1 until the voltage reads approximately four volts. The unlocked light should now be extinguished. Change the frequency select switches to 144.000 MHz and check to see if the light is still extinguished. Simulate the transmit mode by grounding the PTT line on the synthesizer and check to see that the synthesizer locks over the same frequency range in transmit. The voltages at R1 should be within 0.5 volts of one another for the same frequency on transmit and receive.

Trim L1 until the tuning range is correct. Any con-

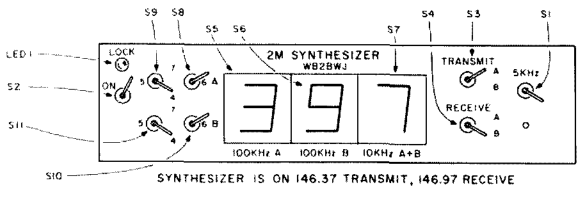


Fig. 5. Switch arrangement.

1. Cable J1 from pin 5 of Z6 to pin 14 of Z3; this is the divide-by-N out.
2. Cable J2 from C24 to R20; this is the beat oscillator-to-mixer line.
3. A Cable from J4a to J4b and one from J4b to J4c; this is the T̄ line.
4. Cable J3 from R5 to +12 volts at R21; this is the +12-volt line.
5. A cable from J5a to J5b and J5b to J5c; these are +5-volt connections.
6. Cable J6; this is the T line.

Table 2. List of required jumpered connections. Use RG-174/U coax.

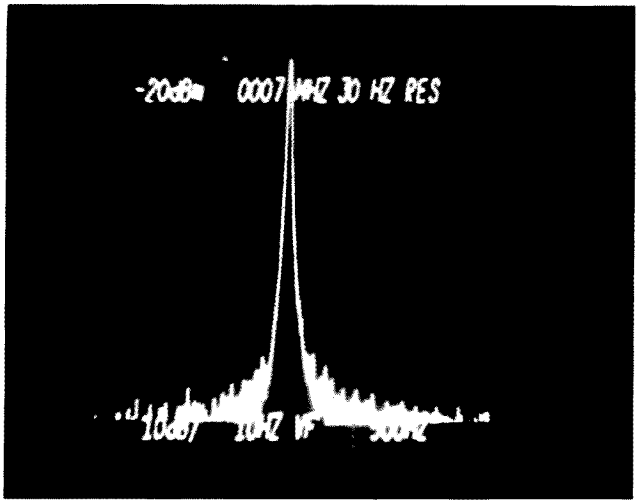


Photo A.

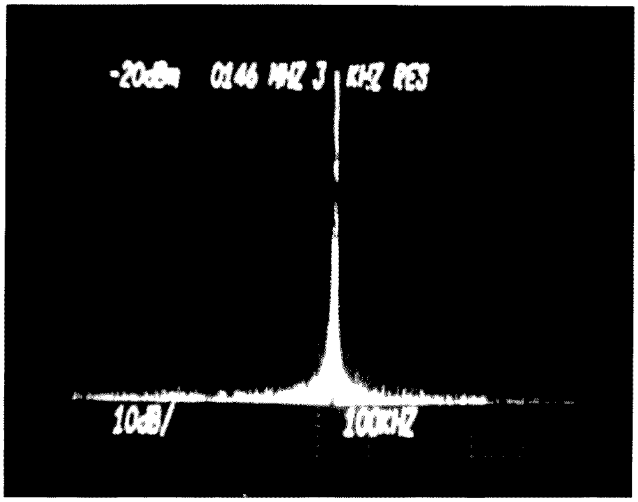


Photo B.

stant flickering of the unlocked light indicates an unstable condition, and the transceiver should be keyed only if the light is fully extinguished. A brief flash of the light when setting the frequency select switches, or when keying the transceiver, is just an indication that the synthesizer has become unlocked momentarily while changing frequency.

With the PTT line open (receive mode), connect a frequency counter to the receiver output jack and set the frequency select switches to 146.000 MHz. Adjust C34 until the counter reads 22.5500 MHz. Ground the PTT line (transmit mode) and adjust C31 until the counter reads 24.3333 MHz. It should be noted that the reading of 22.5500 MHz in the receive mode assumes that Y2 is 21.5500 MHz, which is the proper crystal for a 10.7-MHz i-f. For any other i-f, the counter should read (24.3333 − i-f/6). This completes the calibration of the synthesizer.

The unit should be built in a metal box with a cover that makes good electrical contact all around its perimeter. This prevents rf from getting into the synthesizer from the transceiver. Connecting leads to the transceiver should be made with RG-174/U. The first step in interfacing the synthesizer to the transceiver is to select Y2. Its value depends on the i-f frequency of your transceiver. For a radio with a 10.7-MHz i-f and receive crystals in the 45-MHz region, Y2 will be (23.3333 − 10.7/6) = 21.5500 MHz. For other i-fs, (23.3333 − i-f/6) will give the value for Y2. Even though the transceiver takes 45-MHz crystals and 22-23 MHz comes from the synthesizer, the receiver's oscillator and multiplication circuits do the proper multiplication. Receivers using 15- or 22-MHz crystals will also work with this scheme.

Connect the receiver output coax to the transceiver at an unused receiver crystal socket. Use a .001-uF capacitor to couple into the socket (Fig. 6).

The transmitter output coax from the synthesizer also goes to an unused crystal socket, but a 100-Ohm resistor and a .001-uF capacitor are connected as shown in Fig. 7. The resistor assures smooth operation of Z2. A ferrite bead is placed as shown to act as a choke which keeps the VHF rf from entering the synthesizer.

The PTT input line should go to a line in the transceiver that is open or has at least +5 volts on it during receive and is grounded during transmit. This line will most probably be the PTT line from the microphone to the relay. The +12-volt input line can go to the same place from which the transceiver gets power, but if it is at all possible, connect it to some source of regulated and hash-filtered power within the rig. A ferrite bead should be placed at the ends of the coax on both the PTT and +12-volt connections. See Fig. 8.

The most difficult part of interfacing the synthesizer to a particular transceiver is keeping stray rf from the transceiver from getting into the synthesizer. This problem will be noticed when your audio is reported as sounding bassy or distorted. A very severe case of rf leakage will cause the unlocked light to glow on transmit. A less severe case will cause the aforementioned bassy audio.

Cable	Length (inches)
J1	3½
J2	3¼
J3	4¼
J4ab	3½
J4bc	4½
J5ab	3½
J5bc	2½
J6	3½

Table 3. Cable lengths (RG-174/U).

If you have this problem, listen to yourself on a nearby receiver. Disconnect the receiver's coax at the synthesizer while transmitting, to see if the audio clears up. If it does, then this is the path of leakage. Try more ferrite beads or an additional low-pass filter in series with the other one. To check if the rf is leaking through the power supply line, temporarily run the synthesizer off a 12-volt battery and see if the audio clears up. If it does, try more ferrite beads or a larger value for RFC6. To check if the rf is leaking through the PTT line, disconnect it from the synthesizer and simply short the PTT input to ground. If the audio clears up, try more ferrite beads or another bypass capacitor. If none of these remedies seems to cure the problem, then the transmit

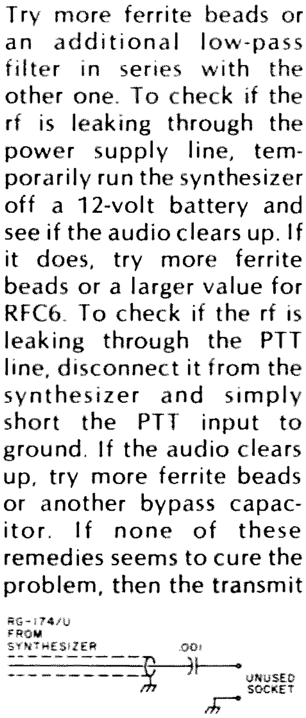


Fig. 6.

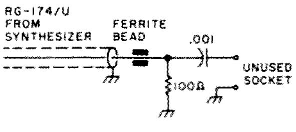


Fig. 7.

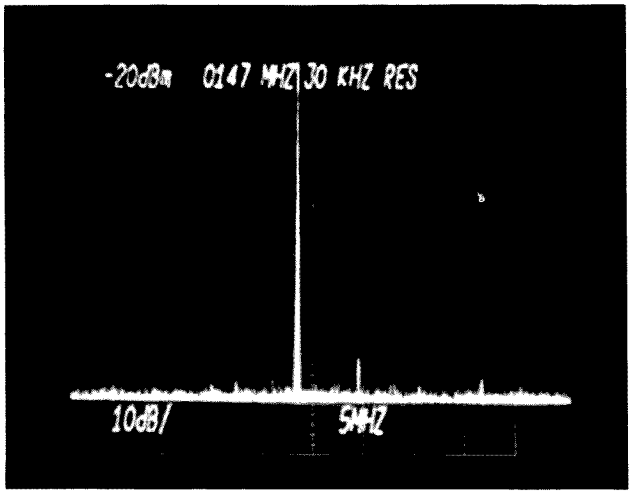


Photo C.

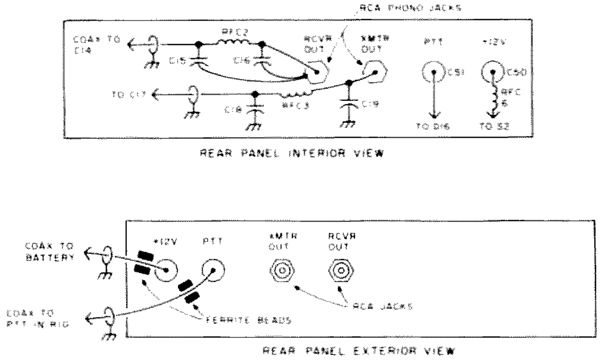


Fig. 8. Rear panel connections.

coax is probably the path of coupling, and additional ferrite beads or another low-pass filter probably will fix it.

Photo A is a spectrum analyzer photograph of the 6-MHz output of the synthesizer being sent to my transmitter. The analyzer is set for a 30-Hz resolution, 500 Hz per division, and a 10-Hz video filter in place. The vertical is calibrated at 10 dB per division. The signal is very clean; there is no sign of the 833.333-Hz reference sidebands, and the noise is 60 dB down. Photo B is the output of my transceiver with the synthesizer set at 146.000 MHz. The analyzer is set for 3-kHz resolution, 100 kHz per division, and 10 dB per division vertically. There are no close-in spurs within 60 dB. Photo C is also the output of my transceiver, but the resolution is 30 kHz, and every division now represents 5 MHz. The strongest spur is at about 154 MHz, but it is 60 dB down, complying fully with the latest FCC regulations for spurious output.

In conclusion, this synthesizer is performing very well on my HW-202. It is a versatile design and it leaves room for many additions that people may want to incorporate. ■

References

1. "Automatic Repeater Offsets," Bruce McNair N2YK, *73*, November, 1978, p. 82.
2. "A Practical 2m Synthesizer," Michael I. Cohen WA3SYI, *73*, September, 1977, p. 146.

Reader Service—see page 211

Analog Telemetry Techniques

—while designed for biomedical signals, these circuits work with any analog data

WARNING: Use or sale of this or similar devices is restricted under Federal Law to physicians or on their orders. No attempt should be made to diagnose or treat patients without medical supervision.

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The use of OSCAR to transmit human electrocardiograms (ECG—or EKG, after the German spelling), and the article in the February, 1978, issue of *73 Magazine* ("Inexpensive EKG Encoder" by WA3AJR), indicate interest in the transmission of analog data. The techniques needed to transmit the human ECG are also useful for transmitting almost any form of analog data signal in which the repetition rate is low and all frequency components fall into the "under 500 Hz" range. In this article, we will examine such circuits from the viewpoint of the human ECG and certain other physiological signals, but the information can be applied to other problems as well.

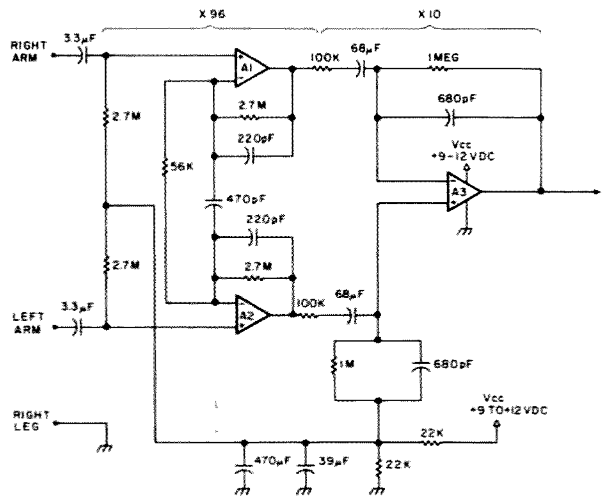

Fig. 1. Typical ECG preamplifier.

The ECG Preamplifier

The peak amplitudes in the ECG waveform are on the order of 1 or 2 millivolts, and significant frequency components exist in the 0.05- to 100-Hertz range. Electronic amplifiers used in professional diagnostic ECG equipment will have this AHA-recommended frequency response, while equipment used exclusively for monitoring usually has a frequency response of 0.05 to 40 or 50 Hertz (depending upon manufacturer).

ECG preamplifiers usually are differential types so that their inherent rejection of common mode signals can be used to eliminate 60-Hertz interference.

Additionally, ECG preamps must be capacitor-coupled to prevent drift due to changes in the *electrode-offset potential* that exists between the electrode and the patient's skin. The electrolytic skin surface reacts with the metallic electrode to form a battery that produces upwards of a volt or more.

Fig. 1 shows the circuit for an ECG preamplifier used in a battery-operated radio telemetry transmitter. This circuit operates from a single 9- to 12-volt dc power source, although, in most non-portable applications, it could easily be redesigned to take advantage of the operational amplifier's bipolar power supply terminals.

The circuit in Fig. 1 is basically an ac-coupled version of the classic instrumentation amplifer, and has a voltage gain of approximately 1000 (see "Op-Amp Encyclopedia"

by K4IPV, *73 Magazine,* February, 1978).

Under specific sets of circumstances, ac mains-powered equipment can be hazardous to connect to some patients, so modern ECG preamplifiers use isolated designs. In most cases, the output of a preamplifier such as in Fig. 1 will be used to amplitude-modulate an oscillator operating in the 30- to 100-kHz range (see Fig. 2). The preamplifier will be on an isolated portion of the printed circuit board, along with the amplitude-modulator and a floating rectifier-filter that creates a dc power supply from the 50-kHz signal. Alternatively, some use separate dc-to-dc converters that do essentially the same thing from a separate oscillator.

The situations that create a hazardous environment for patients do not ordinarily exist outside of the hospital/medical environment, but experimenters and science-fairists who might want to use these techniques are advised *not* to connect people to *any* mains-powered equipment. The use of battery power provides the same isolation as used in professional equipment, but only if the entire apparatus is battery operated.

Transmission Encoders

Some portable units do not encode the ECG waveform at all before transmission, and are called direct-FM telemetry systems. In this type of transmitter, the output of a preamplifier such as in Fig. 1 is applied directly to a varactor-modulated crystal oscillator. In one popular brand, the oscillator operates at 12 to 14 MHz and is multiplied into the 174- to 215-MHz region with the final deviation being 75 kHz or so.

Other models first encode the ECG waveform in the form of a frequency-modulated audio carrier that can be transmitted over a wire or radio communications channel. This method is called FM/FM telemetry. The encoder consists of a voltage-to-frequency converter, or voltage-controlled oscillator (vco), that uses the ECG signal as its control or input voltage. The output of the vco is then applied to an ordinary FM transmitter.

Fig. 3(a) shows a circuit for an ECG encoder that was originally designed at the National Institutes of Health (NIH)[1] in Bethesda MD, for use in telephone call-in cardiac pacemaker-surveillance systems.[2] The circuit was built into the case of a modem (modulator/demodulator used in computer systems), and was issued to patients. The box had a pair of telephone earpiece cups so that the tone could be transmitted down the line. The patient would phone in to the pacemaker clinic once a week, where an analog recording of the waveform was made, and certain computer measurements were taken. These were reviewed later by a cardiologist (an M.D.), who would decide whether or not to ask the patient to come in for a closer examination.

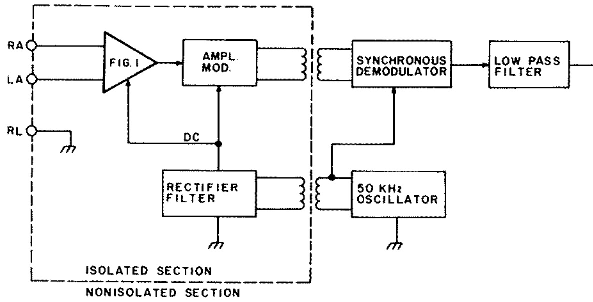

Fig. 2. Block diagram of an isolated ECG preamplifier.

The encoder in Fig. 3(a) uses four 741-family-operational amplifiers and a Motorola MC4024P vco chip that drives a loudspeaker in the modem box. Note that this device is filtered too heavily to provide diagnostic quality ECG recordings, but is sufficient for the limited purpose intended. For those who wish to use the circuit for a wider frequency-response system, some modification of the low- and high-pass filter sections is in order.

Gain is provided by amplifier A1, while A2 serves as the high- and low-pass filter section. The frequency response was limited intentionally so that interfering signals from the patient's skeletal muscles did not obscure the ECG waveform—a necessity because of the less-than-optimum situations in which recordings were attempted. The amplifier input lines were connected to a pair of 1.5-inch metal disk electrodes on the top surface of the modem box. This is not the best possible configuration, but is convenient for the home patient.

The 60-Hertz power mains will cause a tremendous interference signal to be present in nondifferential amplifiers and in those differential amplifiers in which the input balance cannot be maintained. To overcome this, a 60-Hz notch filter, A3 plus the cir-

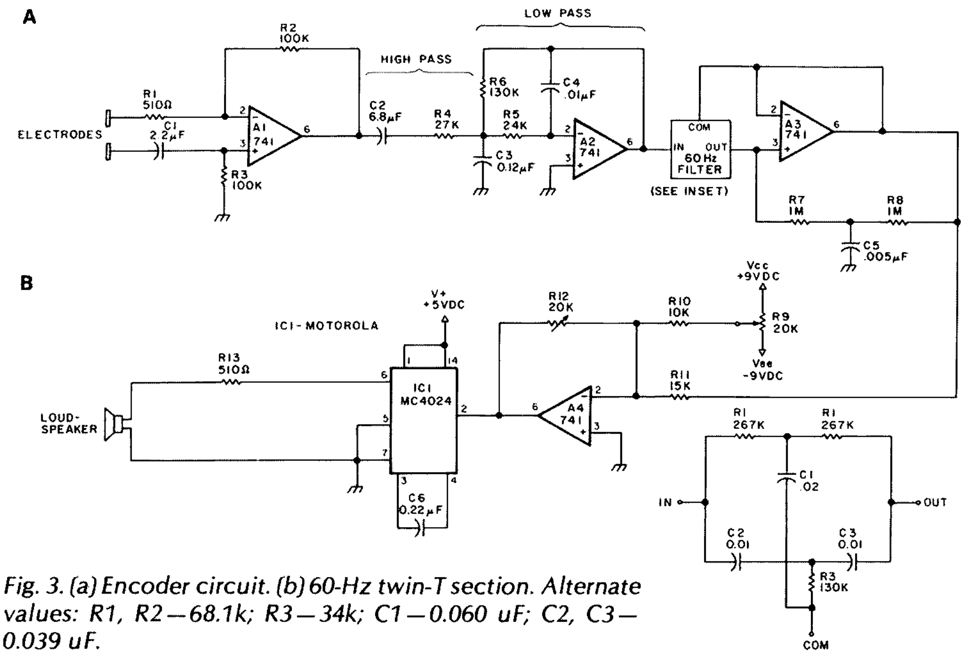

Fig. 3. (a) Encoder circuit. (b) 60-Hz twin-T section. Alternate values: R1, R2—68.1k; R3—34k; C1—0.060 uF; C2, C3—0.039 uF.

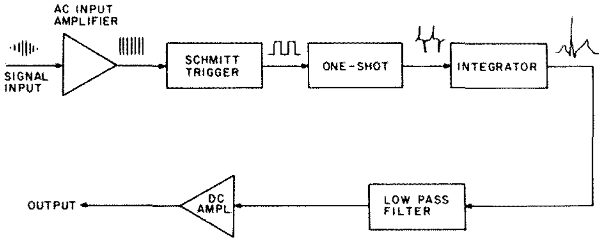

Fig. 4. Block diagram of a pulse-counting FM detector.

cuit in Fig. 3(b) is provided. A claim of 50-dB suppression is made, but we could verify only 18-23 dB.

Amplifier A4 serves as a level shifter between the ECG preamplifier and the MC4024P vco input. The output of the vco is fed to a loudspeaker for acoustical coupling to a telephone. Note that a series resistor is used between the speaker and the vco. This component is needed because the TTL output of the vco will be loaded too much by the low impedance typical of speakers.

The output of the vco in Fig. 3(a) is too high for most radio transmitter audio input stages, and the waveform consists of a chain of square waves. To overcome this problem, an attenuator/low-pass filter is needed between the vco output and the radio transmitter input connector.

Decoders

Neither the circuit of Fig. 3(a) nor the circuit presented in the February, 1978, issue of *73* is useful by itself, except to show that your heart can control the whistle of the modulation in the loudspeaker! Unless a decoder (i.e., FM demodulator) is provided, all these circuits can do is whistle at you in step with the ECG waveform!

The encoded signal is an audio-range (1 to 5 kHz) carrier that is frequency-modulated by the ECG waveform. Any phase-sensitive detection scheme could conceivably work, but two types are most commonly employed: phase-locked loops, and pulse-counting (also called digital) FM demodulators.

A number of technical papers have been written that show the use of low-cost PLL chips for ECG telemetry decoding, but, in my experience, these circuits have not been altogether satisfactory. It seems that many of the low-cost PLL chips do not recover rapidly enough following the ECG R-wave (the spike-like feature). This results in distortion of the waveform in an area that is of particular interest to the physician. Such circuits should, however, prove interesting to the hobbyist who can tolerate some distortion.

It is a little easier to use the pulse-counting detector of Fig. 4. The signal received from the radio loudspeaker or telephone line will probably be weak and noisy, so the first stage will be an amplifier and bandpass filter stage. It should have a bandwidth that is not much greater than the signal's frequency swing, i.e., 2x deviation. In most encoders, the deviation is 25 to 75 percent of the unmodulated carrier frequency.

The amplified audio-FM carrier is then squared in a Schmitt trigger circuit or other form of circuit that will produce output square waves from irregular input signals. The output of the Schmitt trigger is then differentiated to form spike pulses that are suitable for triggering a monostable multivibrator (one-shot).

The actual detector consists of the one-shot and an integrator stage. This arrangement is common not only in telemetry applications, but also in many industrial and scientific instruments, including FM-carrier tape recorders that record low frequency analog data on ordinary audio tape. This circuit produces a dc level that is proportional to the frequency or pulse-repetition rate of the input signal.

The one-shot produces an output pulse for each trigger pulse received at its input. The one-shot output pulses differ from the input pulses, however, in that they have a constant amplitude and duration (period). Only their repetition rate varies with the input frequency. As a result, the output of the integrator, which is a time-averaging circuit, is a dc level proportional only to frequency. Note that at least one high-quality hi-fi FM tuner uses this technique at 10.7 MHz to demodulate the FM i-f signal. The integrator is a form of low-pass filter, so the circuit is inherently low-noise.

A practical example of this type of detector is shown in Fig. 5(a). Note that this is not a clinically acceptable circuit, but it is able to produce results that are good enough for educational or experimental applications. Most serious experimenters wishing to transmit low-frequency human or animal physiological signals by radio or wire, or to store them on an audio tape, will be successful with this circuit.

An LM311 voltage comparator is the input signal conditioner. This circuit is connected as a zero-crossing detector and requires at least 200 mV of signal to operate reliably. Lower signals can be accommodated if IC1 is preceded with an operational amplifier gain stage.

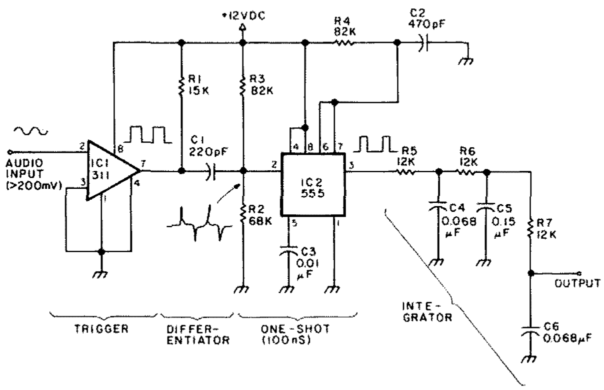

Fig. 5(a). Practical hobbyist decoder circuit.

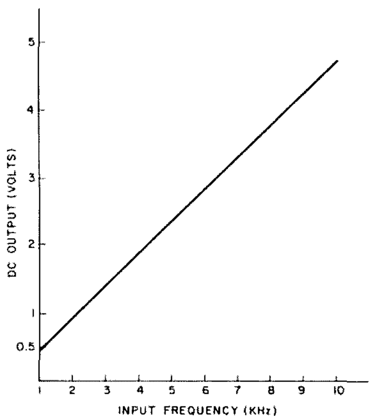

Fig. 5(b). Output voltage versus input frequency.

The square waves at the output of the LM311 are differentiated by C1-R2 to form spike pulses that will trigger the 555 one-shot stage (IC2). The 555 output pulses have a constant amplitude and duration, but their repetition rate varies with the input frequency.

The 555 pulses are integrated in a three-stage RC integrator. The output is taken across capacitor C6, and is a frequency-dependent dc potential. The graph showing input frequency versus dc voltage is shown in Fig. 5(b).

Does it work? I built a modulator using the A4/IC1 portion of Fig. 3(a) and used a function generator to drive its input. A triangle waveform of 2 Hz was selected because it approximates the frequency components of the ECG waveform. The output of the modulator was attenuated and then applied to the input of the circuit in Fig. 5(a). Fig. 5(c) shows the original input waveform from the function generator (upper trace) and the dc output of the decoder (lower trace). Note that the demodulated version shows some, but not much, loss of high frequencies in the waveform.

The vertical gain of the oscilloscope used was adjusted to show more clearly the two waveforms. The amplitude of the upper trace was several volts p-p, while that of the lower was approximately 80 mV p-p. An operational amplifier following the integrator would build this level up to whatever level is required.

Accessories

A qrs-beeper can be used by using the R-wave to trigger an audio oscillator. this is the "beep-beep" used to good effect in doctor TV shows. A popular method is to use the R-wave to fire a one-shot that drives one input of a NAND gate. The other input of the NAND gate is driven by a 1-kHz (or so) audio oscillator.

Alternatively, the output of the one-shot that is triggered by the R-wave can be connected to an LED to form a qrs-flasher. These circuits are shown in Fig. 6. In both cases, the noninverting input of the comparator might either be grounded, as in Fig. 5(a), or connected to a dc level that prevents the comparator from firing on noise impulses or, in most cases, the ECG T-wave.

The circuit of Fig. 5(a) is also useful to make a cardiotachometer (jargon for heart-rate meter) if the time constants are changed. The ECG waveform has a fundamental frequency of approximately 0.5 to 2 Hz, so it will not work properly with the 2-kHz values used when the decoder in Fig. 5(a) is used, but the same principle is used in the tachometer. (The same principle has been published many times as an auto tachometer, incidentally, again with suitable component value changes).

In the case of a cardiotach, the one-shot duration should be 25 to 50 ms, and the values of the integrator capacitors and resistors will probably have to be raised. The dc output meter can be calibrated in beats-per-minute. If you do not have a 1-Hz range function generator to calibrate this circuit, then use TTL or CMOS counter/dividers *a la* crystal calibrator circuits to divide the 60-Hz line from a 5-V ac filament transformer (*not* direct from the 115 V ac line!) down to 0.5, 1, and 2 Hz for calibration purposes. ■

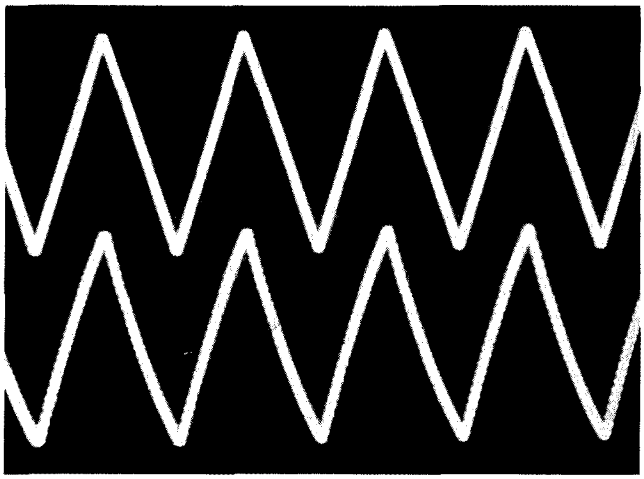

Fig. 5(c). Input (upper) and output (lower) waveforms.

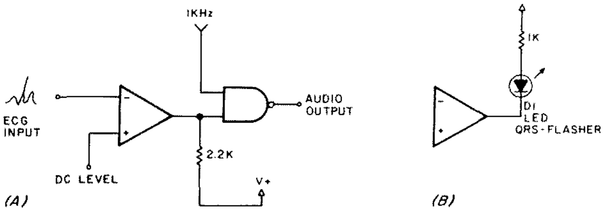

Fig. 6. (a) Qrs-beeper. (b) Qrs-flasher.

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2. Klingenmaier, C.H. *et al*, "A Method of Computer-Assisted Pacemaker Surveillance From a Patient's Home via Telephone," *Computers and Biomedical Research*, 6, pp. 327-335, 1973.

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The MICROSIZER: Computerized Frequency Control

—a synthesized vfo replacement for most HF rigs

The use of microcomputers in the operation of amateur radio stations has increased rapidly in the past year. Applications have ranged from simple Morse keyboards to complex antenna-tracking systems. One use that has been neglected is that of controlling the frequency of a transceiver with a microcomputer. Microcomputer frequency control is extremely useful and flexible, but has not been explored because of the incompatibility of analog vfos in transceivers with the digital output of the microcomputer. Now, however, it is possible to combine a handful of inexpensive digital ICs with a few discrete components on a single printed circuit board to form a 5.0-5.5-MHz frequency synthesizer. This unit can serve as a solid-state replacement for the mechanically-tuned vfos used in nearly every popular amateur HF transceiver. Because thumbwheel switches do not meet the amateur's requirements for casually scanning the bands, a convenient method of "tuning" the synthesizer is needed. The marriage between the computer and the radio was inevitable. This article presents a practical approach to building an HF synthesizer for your transceiver, plus some simple software to enable a 6800-based microcomputer to control it.

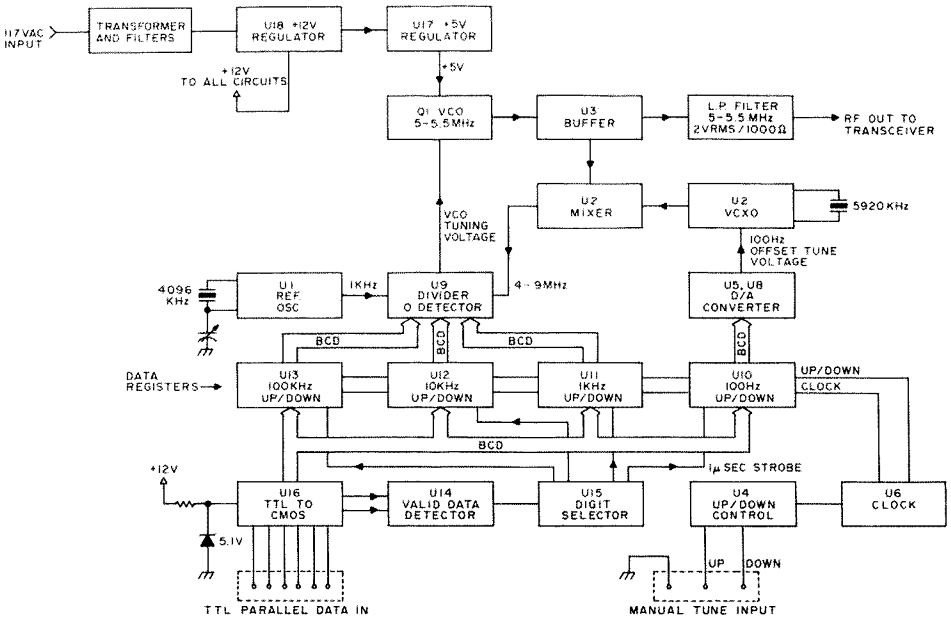
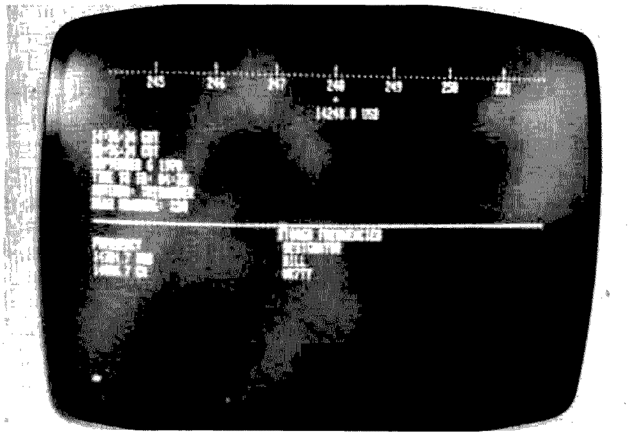


Fig. 1. Block diagram of the MICROSIZER. All parallel data bits are normally high between data words for at least 1 μs. Valid data should be held for a minimum of 4 μs. All digit values are BCD. Digit selector: 100 Hz = 00; 1 kHz = 10; 10 kHz = 01; 100 kHz = 11.

The Hardware

The MICROSIZER, as it is affectionately called, is a solid-state, digitally-synthesized remote vfo that will operate with virtually any HF transceiver. It tunes the popular 5.0-5.5 MHz vfo range in precise 100-Hz increments and can

MICROSIZER in operation at WA0QJI.



Simulated "dial" display.

be controlled by an 8-bit parallel interface port from any microcomputer. The frequency stability and signal purity are excellent, exceeding that of most analog vfos. When controlled by a computer, a CRT terminal is used for entering and displaying the operating frequency. Alternately, the MICROSIZER can be used by non-computer-equipped amateurs as a stand-alone remote vfo with fast or slow up/down tuning controlled by the station's keyer paddle. When operating without a computer, a digital readout in the transceiver is used to indicate the operating frequency. A dual paddle is preferred, offering a slow tuning rate of 500 Hz per second if either the up or down paddle is activated. If both paddles are closed simultaneously, the tuning rate increases to 20 kHz per second, with the tuning direction determined by which paddle was first closed.

Circuit Description

The MICROSIZER's circuitry consists mostly of CMOS ICs and is contained on a single-sided 4.8" × 5.3" PCB. The board has been designed for mounting in a Radio Shack Model 270-253 utility cabinet. Most of the parts are available directly from regular advertisers in *73 Magazine*. A PCB and some other selected parts can be supplied by sources listed in the parts list on page 82. Please note that the PCB layout printed here is copyrighted and reproduction by individuals for other than their private use is prohibited. Microcomputer interface or local control connections are through a 10-terminal connector on the rear panel. Other than an on/off switch, no controls are required on the front panel, making out-of-the-way placement convenient.

Circuit Operation

Refer to the block diagram in Fig. 1 and the schematic in Fig. 2 for the discussion to follow. The vco (voltage-controlled oscillator) operates directly at 5.0-5.5 MHz, using a high-Q varactor-tuned Colpitts circuit. The output of the vco drives the vco buffer, U3, and is then lowpass-filtered and applied to the transceiver. The output level is approximately 2.0 V rms across 1000 Ohms, a level compatible with the remote vfo input requirements of most transceivers. The output of the vco also drives a section of U3 used as a buffer, which is applied to mixer U2. Another input to the mixer is from the vcxo offset oscillator, U2, operating at approximately 5.9 MHz. The difference frequency from the mixer is in the 400 to 900 kHz range and is applied to U9, a Hughes HCTR-0320, containing a 3-stage programmable divider and a phase detector. The 100-, 10-, and 1-kHz BCD inputs to the programmable divider section of U9 determine the division ratio. The phase detector section of U9 compares the output of the divider with a 1.00000-kHz reference signal, converting any frequency or phase error to an error voltage to correct the frequency of the vco. The 1.00000-kHz reference signal is derived from a 4096-kHz oscillator and 12-stage binary divider, U1.

Thus, five hundred 1-kHz channels are produced over the 5.0-5.5 MHz range by varying the data to the programmable divider from 400 to 900. This data comes from 3 sections of a 4-section data register composed of U10 through U13. This register is a 4-decade up/down presettable counter with outputs from 0000 to 5000, corresponding to the five thousand 100-Hz channels. The output of the 100 kHz counter, U13, is modified by a section of U7 so that 4 is added to its output. Thus, the data presented to the programmable divider, U9, varies from 400 to 900 as the vco output varies from 5.5 to 5.0 MHz. The 100-Hz steps are produced by varying the frequency of the 5.9-MHz offset vcxo (voltage-controlled crystal oscillator) over a 900 Hz range in nine 100-Hz steps. This is accomplished by a digital-to-analog (D/A) converter (U8 and U18) controlled by BCD inputs from the 100-Hz section of the data register, U10. This scheme allows a lockup 10-times-faster than at least one commercially-available HF transceiver—without sacrificing frequency resolution. The data register can be clocked up or down at a fast or slow rate by circuits from U6 and U4. This is the mode of operation when microcomputer control is not used. The data register is automatically reset to 0000 each time power is applied to the MICROSIZER, preventing invalid BCD codes from upsetting U9. Microcomputer control is accomplished by utilizing outputs of a TTL-to-CMOS converter, U16, to program the BCD preset inputs of the data register. The two digit-select bits are also converted from TTL to CMOS levels by U16 and then decoded to one of four outputs by U15. U15 is enabled by a one-microsecond strobe pulse to load the data register with the BCD data present on bits 0-3 of the 8-bit inter-

face. As in the manually-tuned up/down mode, 0000 in the data register corresponds to an approximately 5.5-MHz vco output frequency. The 5.9 MHz offset vcxo is actually at 5.920 MHz so that 0000 will produce an operating frequency approximately 20 kHz below each amateur band, allowing plenty of margin for off-frequency heterodyne crystals in the transceiver. The software calibration routine adds a constant to the desired operating frequency to produce the "data frequency" that actually controls the MICROSIZER. Some transceivers, such as the Drake TR series, tune "backwards" on some bands, in which case 0000 would produce an operating frequency approximately 20 kHz above the high end of the normal tuning range of the vfo. This causes no major problems, because the operating frequency could be subtracted from a constant to produce the desired output data and tuning direction.

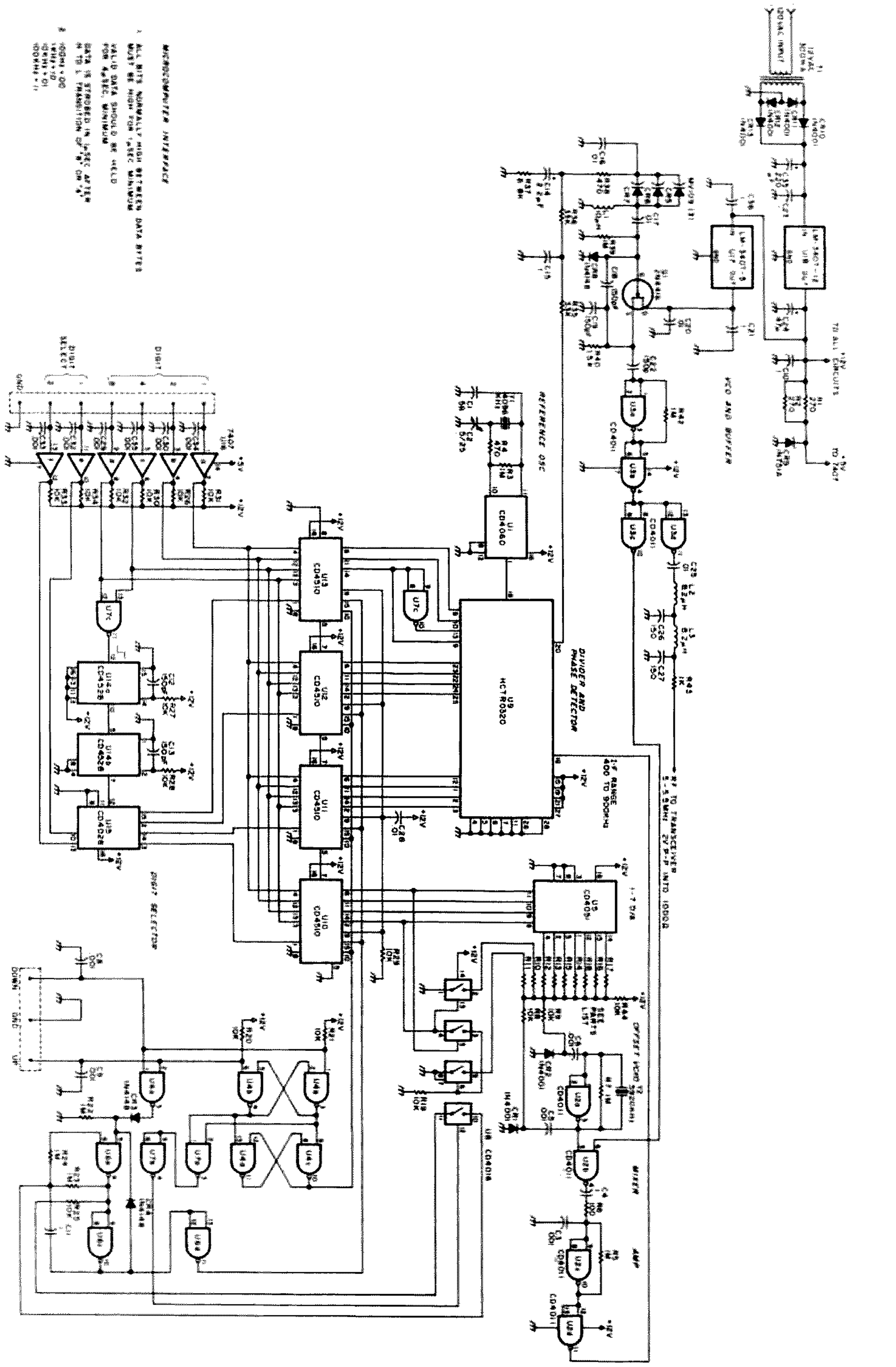


Fig. 2. Schematic of the MICROSIZER.

Power Supply

The vco operates from a regulated 5-volt source provided by a 3-terminal regulator, U17. The rest of the circuits operate from a separate 3-terminal 12-volt regulator. Five volts for the TTL-to-CMOS level converter is zener-regulated from the output of U18. Both 3-terminal regulators operate on 15 volts from the rectified and filtered output of a 12-volt transformer. A 10% variation in the ac line voltage causes no measurable shift in the output frequency. As is characteristic of all high-quality synthesizers, the frequency drift, even from a cold start, is very low, typically a few Hz. In the photograph of the spectrum of the MICROSIZER, note that the 1-kHz sampling sidebands are down more than 60 dB.

Possible Applications

The number of uses for a computer-controlled transceiver is limited only by the imagination. Here are a few seeds for thoughts. Many of you readers are programmers by profession and could develop these ideas more effectively than we.

Storage and Recall of Frequencies

Any of the 5000 channels in the basic 5.0-5.5 MHz range could be stored for instant recall by the computer. These frequencies could be catalogued as channel numbers, or with more meaningful designators (such as SSTV for 14.230 MHz or W1AW for 07.080 MHz). Some uses of this capability are:

1. Scanning selected frequencies for activity;
2. Split-frequency operation for DX;
3. Net operation and coordination.

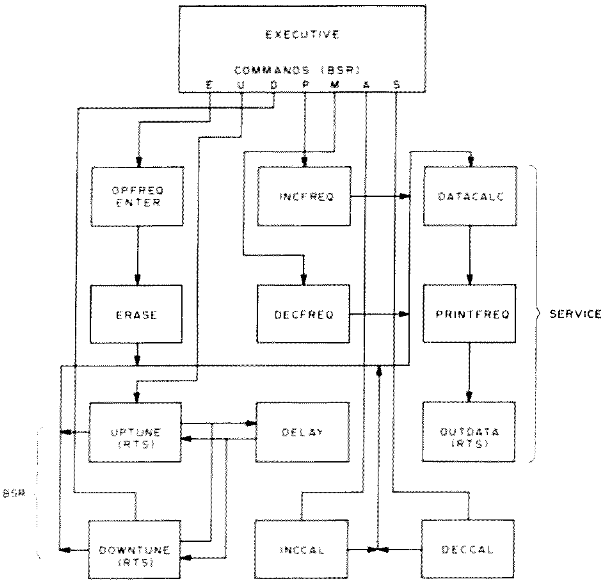
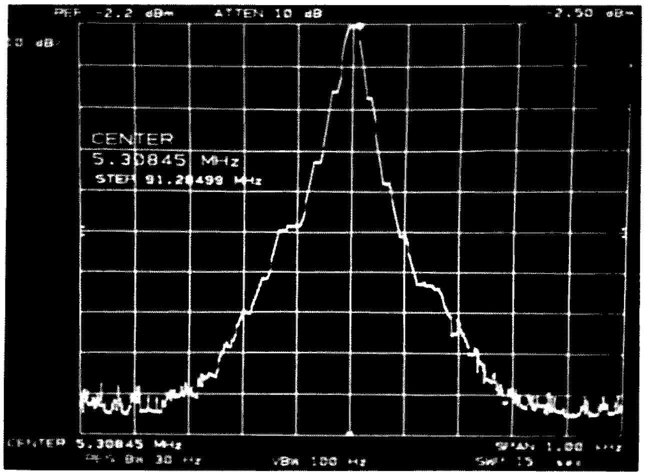


Fig. 3. Block diagram showing the functional arrangement of and linkage between the modules.



Spectrum analyzer photo of output.

Automatic Tuning

The transceiver could be swept automatically over any given band or band segment and at practically any tuning rate, ignoring undesired band segments. Out-of-band operation or operation on unauthorized frequencies can be detected by the tuning software, and an error message can be displayed to the operator. This would be especially useful during hectic contest or DX-chasing when the operator's attention sometimes strays. A similar frequency-recognization scheme could make the transceiver "hop over" foreign broadcast QRM on 40 meters or boring nets on 20 meters. With the computer's ability to decode CW, the times and frequencies of rare DX activity could be monitored and recorded continuously, especially during multiband single-operator DX contest operations.

Doppler Shift Correction For OSCAR-Relayed Signals

Using a variation of the automatic tuning mode, the transceiver could be tuned at the correct rate to track the Doppler shift of an OSCAR-relayed signal. Once a signal is initially tuned in, an OSCAR orbital prediction program and real-time clock in the microcomputer would determine the instantaneous Doppler shift and retune the receiver accordingly. The operator need only enter the geographic location of the transmitting station and the uplink and downlink bands.

Remote Control Operation

Virtually any microcomputer can be operated from a remote location by the addition of a simple modem and a remote terminal. This would permit

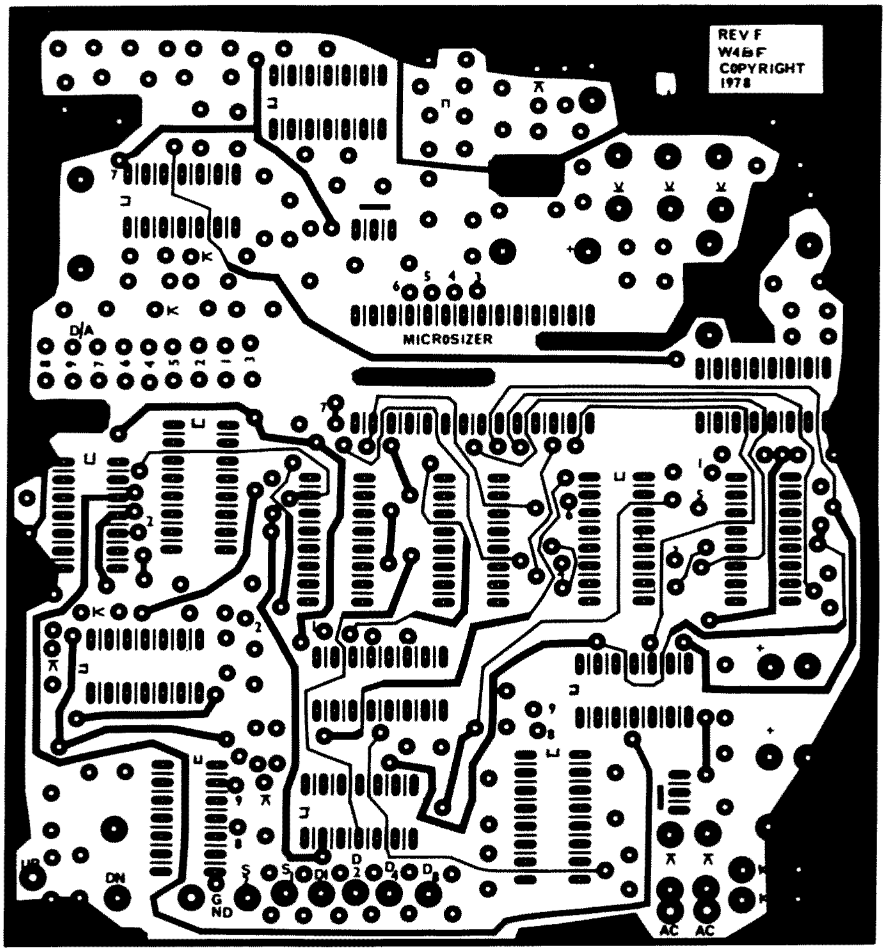


Fig. 4. Top view of PC board.

an operator to control the MICROSIZER and the other station functions from any location where an audio link could be established. The link could be either a telephone or radio system. Imagine operating your super DX station from your office telephone or through the local FM repeater! Unauthorized control of the system could be prevented by the use of classified "passwords" to limit computer access.

Improved Frequency Display

One common objection to digital readouts in conventional HF transceivers is the lack of visual "feel" when tuning. While tuning an analog dial, the operator can visually relate the operating frequency to other frequencies in the band. With a computer terminal serving as a display device, a simulated "dial" can be created with frequency calibrations and graticules moving left or right as the frequency changes. Some terminals even offer high-resolution color graphics, making possible some really "sexy" displays.

Some Software To Get You Started

OK, enough about our dreams. What have we really done? Well, desiring to develop some really useful software, but considering our lack of experience as programmers, we settled upon a few basic functions, which are:

1. Continuous CRT readout of the operating frequency;
2. Ability to tune continuously in 100-Hz steps;
3. Software correction for off-frequency heterodyne crystals;
4. Relocatable code;
5. Single 8-bit parallel interface.

This entire program was coded without the aid of an assembler, programming experience, or above average intelligence. Because each module of the program was developed and tested separately, this 500-byte program was only slightly more difficult to code than each of the short modules by itself. Our prime considerations obviously did not include fast program execution or ultra-efficient use of memory. An attempt was made to follow the basic guidelines of structured programming, but deviations were necessary because of the limitations of conditional branching in such a large program. Again, the program is modular in form, and branches between modules have been held to a minimum. The individual modules are simple enough for even the novice to understand. Each module may be modified to satisfy some special application requirement without disrupting the functions of the other modules. Because the program is relocatable, it should be easily integrated into any 6800 system having access to MIKBUG® or SWTBUG® routines and 520 bytes of RAM. Patches to other input-output routines will be very simple.

The Executive Routine (0030-007A)

The executive routine, as the name implies, is the master of this program. It monitors the system keyboard, decodes your commands, and calls upon the other modules of the program to perform various functions. Fig. 3 is a block diagram showing the functional arrangement of and linkage between the modules. Each module will be described in the text. The executive responds to the following commands: E—enter operating frequency; U—tune upward in frequency; D—tune downward in frequency; P—plus 100 Hz (single frequency step); M—minus 100 Hz (single frequency step); A—add 100 Hz to calibration offset; S—subtract 100 Hz from calibration offset.

Upon receiving an "E" command, the executive calls upon the "opfreq enter" module, which prompts with "FREQUENCY?" The operator enters six digits of frequency data. (Example: 142500.) Next, the "service" module adds this frequency data to the calibration offset (positive or negative), prints the operating fre-

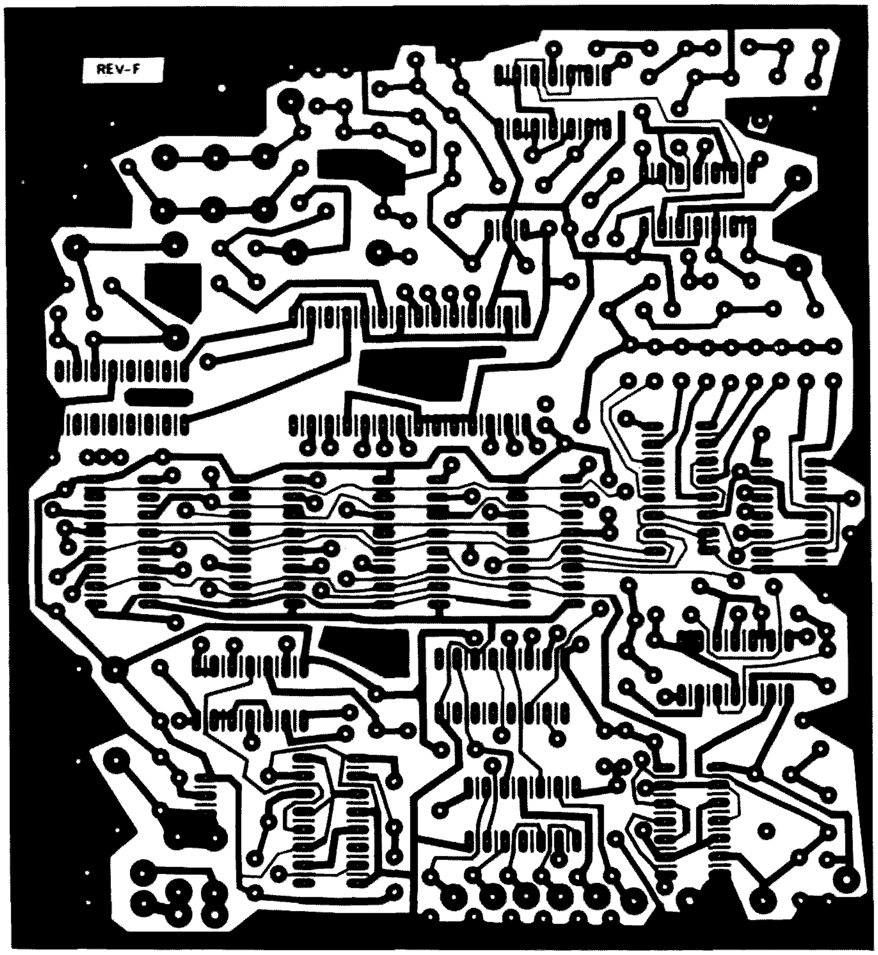


Fig. 5. Bottom view of PC board.

quency ("14250.0 kHz") on the CRT terminal, and outputs the frequency-controlling data to the frequency synthesizer sequentially through a single 8-bit parallel-output port.

A "U" command tells the executive to call upon the "uptune" module, a sort of "vice-executive" module, which in turn calls upon the "delay," "incfreq," and "service" modules repeatedly until any key is pressed, at which time program control is returned to the executive.

Similarly, on "D", the executive appoints "downtune," another vice-executive, to call the "delay," "decfreq," and "service" routines repeatedly until a key is pressed.

The "P" (plus 100 Hz) command tells the executive to call incfreq and service once only. The executive immediately resumes command of the program.

On "M" (minus 100 Hz), the executive calls decfreq and service, and resumes command.

On "A", the executive calls upon incal and service, and resumes command.

On "S", the executive calls upon decal and service, and resumes command.

Future plans include a much more powerful executive to control synthesizer, Morse transmit and receive, and QSO logging routines.

Erase Module (007B-0098)

The erase module, when called, erases the screen of a CRT terminal by outputting the proper ASCII control characters. This module also initializes the 6820 PIA of the synthesizer interface port.

Delay Module (00EB-00F4)

The delay module, called by the uptune and downtune "vice-executives," determines the tuning rate of the uptune and downtune modes of operation. The number of cycles of the delay loop, and therefore the time delay, is determined by the values of the two bytes of data stored at hex locations A022 and A023 of the system's 6810 scratchpad RAM. The maximum delay occurs when A022/A023 contain FFFF, allowing 65,536 loop cycles, for a delay of approximately 1.75 seconds.

Incfreq Module (0099-00B1)

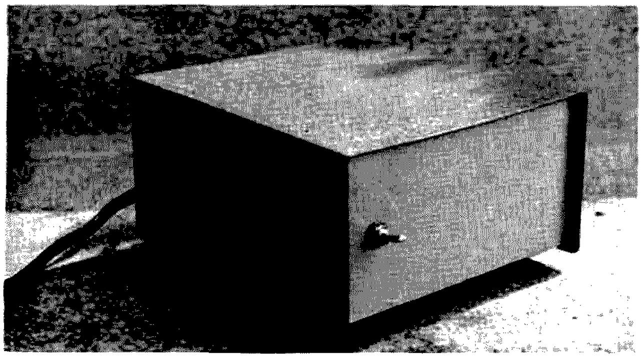
The incfreq module adds one (100 Hz) to the BCD frequency data stored at hex locations 0000-0005. A BRA command always routes the program flow to the service module.

Decfreq Module (00B2-00D2)

This module subtracts one (100 Hz) from the BCD frequency data stored at hex locations 0000-0005. A BRA command always routes the program flow to the service module.

Inccal Module (01D6-01EE)

Inccal adds one (100 Hz) to the BCD calibration offset data stored at hex locations 0007-000C. A BRA command always routes



MICROSIZER in cabinet.

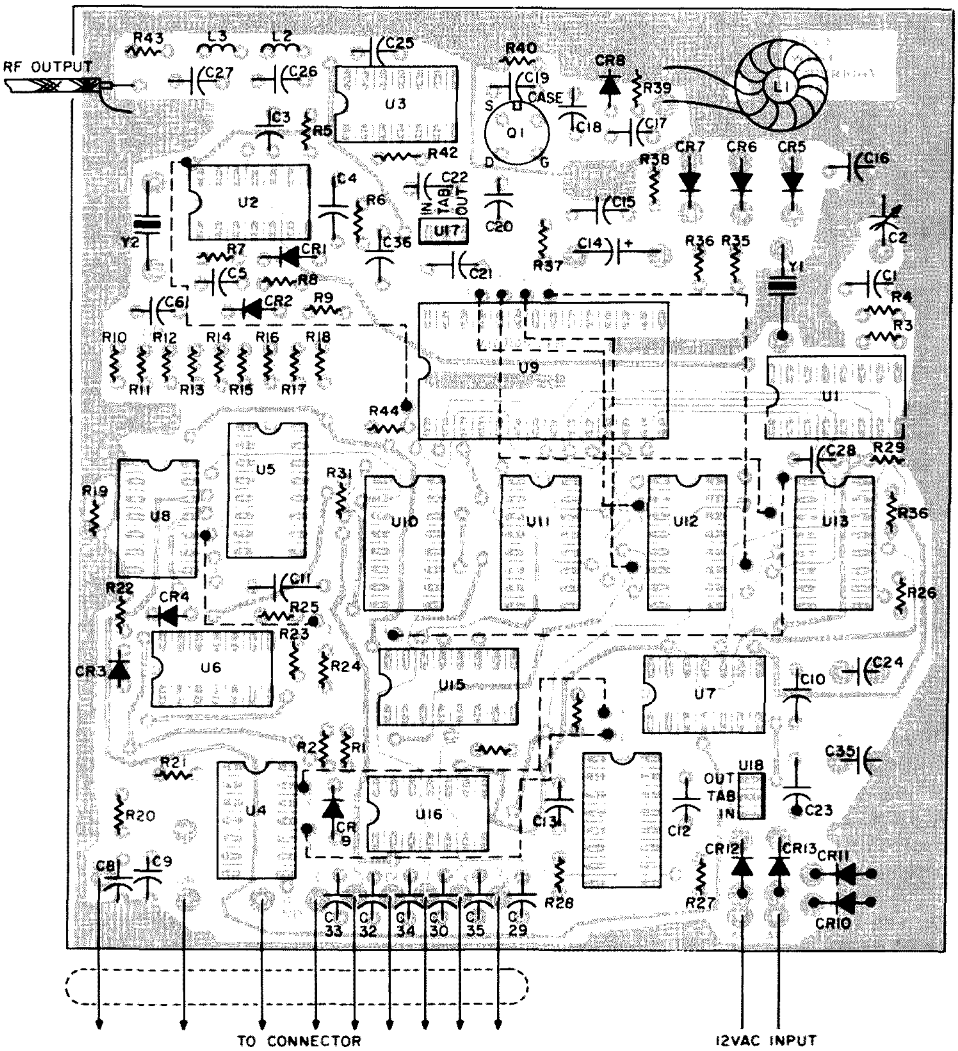


Fig. 6. Component layout of the MICROSIZER. Jumpers are shown with dotted lines.

```
DATA STORAGE MEMORY ALLOCATION

0000  30  "0"   (100 Hz)        Sample frequency of 14,205.0 KHz
0001  35  "5"                   and calibration offset of .7 KHz
0002  30  "0"
0003  32  "2"                 OPERATING FREQUENCY DATA
0004  34  "4"
0005  31  "1"   (10 MHz)
0006  DD  STOP CHARACTER

0007  07  "7"   (100 Hz)
0008  00  "0"
0009  00  "0"                 CALIBRATION OFFSET DATA
000A  00  "0"
000B  00  "0"
000C  00  "0"   (10 MHz)
000D  DD  STOP CHARACTER

000E  07  DIGIT 0 is "7" (100 Hz)
000F  15  DIGIT 1 is "5"
0010  20  DIGIT 2 is "0"                DATA FORMATTED FOR OUTPUT
0011  32  DIGIT 3 is "2" (100 KHz)
0012  DD  STOP CHARACTER

000E-001F UNUSED (RESERVED FOR FUTURE NEEDS)


0020  10  HOME
0021  20  SPACE
0022  20  SPACE
0023  46  "F"
0024  52  "R"
0025  45  "E"
0026  51  "Q"
0027  55  "U"
0028  45  "E"
0029  4E  "N"
002A  43  "C"
002B  59  "Y"
002C  3F  "?"
002D  20  SPACE
002E  20  SPACE
002F  DD  STOP CHARACTER

EXECUTIVE ROUTINE

0030  BD  E1AC  JSR INEEE      GET CHARACTER FROM KEYBOARD
0033  81  4D    CMPA #4D       M?
0035  27  2C    BEQ 0063       NO?
0037  81  50    CMPA #50       P?
0039  27  2C    BEQ 0067       NO?
003B  81  44    CMPA #44       D?
003D  27  38    BEQ 0077       NO?
003F  81  55    CMPA #55       U?
0041  27  30    BEQ 0073       NO?
0043  81  53    CMPA #53       S?
0045  27  24    BEQ 0069       NO?
0047  81  41    CMPA #41       A?
0049  27  24    BEQ 006F       NO?
004B  81  45    CMPA #45       E?
004D  27  10    BEQ 005F       NO?
004F  20  DF    BRA 0030       GET ANOTHER CHARACTER

0051-005E UNUSED (RESERVED FOR FUTURE COMMANDS)

005F  8D  70    BSR OPFREQ ENTER 00F5 (VIA BRANCH ISLAND 00D1)
0061  20  CD    BRA 0030           RETURN TO EXECUTIVE
0063  8D  4D    BSR DECFREQ 00B2
0065  20  C9    BRA 0030
0067  8D  30    BSR INCFREQ 0099
0069  20  C5    BRA 0030
006B  8D  62    BSR DECCAL 01EE (VIA 00CF)
006D  20  C1    BRA 0030
006F  8D  5C    BSR INCCAL 01D5 (VIA 00CD)
0071  20  BD    BRA 0030
0073  8D  5E    BSR UPTUNE 00D3
0075  20  B9    BRA 0030
0077  8D  66    BSR DOWNTUNE 00DF
0079  20  B5    BRA 0030
```

```
ERASE ROUTINE

007B  86  10    LDAA #10       HOME (CONTROL P)
007D  BD  E1D1  JSR OUTEEE
0080  86  16    LDAA #16       ERASE EOP (CONTROL V)
0082  BD  E1D1  JSR OUTEEE
0085  86  FF    LDAA #FF
0087  B7  8010  STAA 8010      INITIALIZE PIA-ESTABLISH ALL
008A  86  04    LDAA #04       8 LINES OF PORT A AS OUTPUTS.
008C  B7  8011  STAA 8011      (SWTPC I/O SLOT #4)
008F  01        NO OP
0090  01
0091  01
0092  01
0093  01
0094  01
0095  01
0096  01
0097  20  30    BRA SERVICE 0120 (VIA ISLAND 00C9)

INCFREQ ROUTINE

0099  FE  A020  LDX A020       FIND DATA
009C  A6  00    LDAA X 00      GET DATA
009E  81  DD    CMPA #DD       STOP CHARACTER?
00A0  27  0E    BEQ 00B0
00A2  84  0F    ANDA #0F
00A4  8B  01    ADDA #01       ADD ONE
00A6  19        DAA            DECIMAL ADJUST
00A7  A7  00    STAA X 00      REPLACE
00A9  81  09    CMPA #09
00AB  2F  03    BLE 00B0
00AD  08        INX            FIND NEXT DIGIT OF DATA
00AE  20  EC    BRA 009C
00B0  20  17    BRA SERVICE 012D (VIA ISLAND 00C9)

DECFREQ ROUTINE

00B2  FE  A020  LDX A020       (SEE INCFREQ)
00B5  A6  00    LDAA X 00
00B7  81  DD    CMPA #DD
00B9  27  0E    BEQ 00C9
00BB  84  0F    ANDA #0F
00BD  8B  09    ADDA #09       ADD NINE (SAME AS SUBTRACT ONE)
00BF  19        DAA
00C0  A7  00    STAA X 00
00C2  81  09    CMPA #09
00C4  2E  03    BGT 00C9
00C6  08        INX
00C7  20  EC    BRA 00B5
00C9  20  62    BRA SERVICE 012D (ALSO SERVES AS ISLAND)

ISLANDS
00CB  20  AE    BRA ERASE 007B
00CD  20  58    BRA 0127
00CF  20  58    BRA 0129
00D1  20  22    BRA 00F5

UPTUNE ROUTINE

00D3  8D  16    BSR DELAY 00EB
00D5  8D  C2    BSR INCFREQ 0099
00D7  B6  8004  LDAA 8004 (or address of input port used to
                          stop the tuning.)
00DA  81  FF    CMPA #FF        Compare fetched value to normal value.
00DC  27  F5    BEQ 00D3        Again.
00DE  39        RTS

DOWNTUNE ROUTINE

00DF  8D  0A    BSR DELAY 00EB
00E1  8D  0F    BSR DECFREQ 00B2
00E3  B6  8004  LDAA 8004  (see 00D7 of uptune.)
00E6  81  FF    CMPA #FF
00E8  27  F5    BEQ 00DF
00EA  39        RTS

DELAY ROUTINE

00EB  FE  A022  LDX A022  (Value at A022 sets delay.)
```

Program listing.

program flow to the service module.

Deccal Module (01EF-0207)

Deccal subtracts one (100 Hz) from the BCD calibration offset data stored at hex locations 0007-000C. A BRA command always routes program flow to the service module.

Opfreq Enter Module (00F5-012C)

The opfreq enter module utilizes the MIKBUG® / SWTBUG® OUTEEE routine to display "FREQUENCY?" on the top line of a CRT terminal. Next, using the monitor's INEEE routine, opfreq enter accepts six digits of frequency data, with the 10-MHz digit entered first, and the 100-Hz digit last. Opfreq enter does not accept decimal points or commas between the digits. The data entered is stored at hex locations 0000-0005, with the 100-Hz digit at 0000, and the 10-MHz digit at 0005.

Service Module (012D-01D5)

The service module is rather complex compared with the other modules of the program. For simplicity, this module was written and will be described as three separate modules that are unconditionally linked together. They are: datacalc, printfreq, and outdata.

Datacalc Module (012D-016D)

Datacalc takes the BCD operating frequency data at 0000-0005, adds to it the BCD calibration offset data at 0007-000C (positive or negative), formats this result for output to the frequency synthesizer, and stores it at 000E-0011.

Only four digits of data are required to drive the 05,000.0-05,500.0-kHz synthesizer, because the units (5) and tens (0) of MHz never change. Although the 5.0-5.5-MHz vfo of most HF transceivers tunes backwards, this reversal is handled by the hardware of the synthesizer. This software merely outputs the four least significant digits of the BCD operating frequency data, plus or minus any

```
00EE  09          DEX
00EF  01          NO OP
00F0  01          NO OP
00F1  01          NO OP
00F2  26  FA      BNE 00EE
00F4  39          RTS

OPFREQ ENTER ROUTINE

00F5  FE  A020    LDX A020          FIND DATA
00F8  A6  20      LDAA X 20         GET CHARACTER OF MSG
00FA  81  DD      CMPA #DD          STOP CHARACTER?
00FC  27  06      BEQ 0104          YES? BRANCH
00FE  BD  E1D1    JSR OUTEEE        NO? PRINT CHARACTER
0101  08          INX               NEXT CHARACTER
0102  20  F4      BRA 00F8

0104  FE  A020    LDX A020          FIND DATA STORAGE AREA
0107  BD  E1AC    JSR INEEE         GET 10 MHz DIGIT
010A  A7  05      STAA X 05         STORE IT
010C  BD  E1AC    JSR INEEE         1 MHz
010F  A7  04      STAA X 04         STORE
0111  BD  E1AC    JSR INEEE         100 KHz
0114  A7  03      STAA X 03         STORE
0116  BD  E1AC    JSR INEEE         10 KHz
0119  A7  02      STAA X 02         STORE
011B  BD  E1AC    JSR INEEE         1 KHz
011E  A7  01      STAA X 01         STORE
0120  BD  E1AC    JSR INEEE         100 Hz
0123  A7  00      STAA X 00         STORE LAST DIGIT
0125  20  A4      BRA 00CB          BRA SERVICE VIA ISLAND

0127  20  3D      BRA 0166          ISLAND
0129  20  3D      BRA 0168          ISLAND
012B  20  XX      BRA XXXX          SPARE ISLAND

DATACALC ROUTINE

012D  86  00      LDAA #00
012F  B7  A026    STAA A026         TEMPORARY STORAGE
0132  FE  A020    LDX A020          FIND DATA
0135  0C          CLC
0136  A6  00      LDAA X 00         GET OPFREQ DIGIT
0138  2B  23      BMI 0164          EXIT IF MINUS
013A  84  0F      ANDA #0F          AND MASK
013C  8A  40      ORAA #40
013E  E6  07      LDAB X 07         GET OFFSET DIGIT
0140  24  01      BCC 0143
0142  4C          INCA
0143  C4  0F      ANDB #0F
0145  CA  50      ORAB #50
0147  1B          ABA
0148  19          DAA
0149  84  0F      ANDA #0F
014B  BA  A026    ORAA A026
014E  A7  0E      STAA X 0E
0150  07          TPA
0151  F6  A026    LDAB A026
0154  CB  10      ADDB #10
0156  06          TAP
0157  F7  A026    STAB A026
015A  08          INX
015B  20  D9      BRA 0136
015D  86  DD      LDAA #DD          STOP CHARACTER
015F  FE  A020    LDX A020          FIND DATA STORAGE AREA
0162  A7  12      STAA X 12         PLACE STOP CHARACTER
0164  20  08      BRA SERVICE 016E

0166  20  6E      BRA 01D6          ISLAND
0168  20  4E      BRA 01B8          ISLAND
016A  20  C1      BRA 012D          ISLAND
016C  20  XX      BRA XXXX          SPARE ISLAND

PRINTFREQ ROUTINE

016E  FE  A020    LDX A020          FIND DATA
0171  86  10      LDAA #10          HOME
0173  BD  E1D1    JSR OUTEEE
0176  BD  E0CC    JSR OUTS          SPACE
0179  BD  E0CC    JSR OUTS
017C  A6  05      LDAA X 05         GET 10 MHz DATA
017E  BD  E06B    JSR OUTHR         PRINT RIGHT NYBBLE
0181  A6  04      LDAA X 04         1 MHz
0183  BD  E06B    JSR OUTHR         PRINT
0186  A6  03      LDAA X 03         100 KHz
0188  BD  E06B    JSR OUTHR         PRINT
018B  A6  02      LDAA X 02         10 KHz
018D  BD  E06B    JSR OUTHR         PRINT
0190  A6  01      LDAA X 01         1 KHz
0192  BD  E06B    JSR OUTHR         PRINT
0195  86  2E      LDAA #2E          PERIOD
0197  BD  E1D1    JSR OUTEEE        PRINT PERIOD
019A  A6  00      LDAA X 00         100 Hz
019C  BD  E06B    JSR OUTHR         PRINT
019F  BD  E0CC    JSR OUTS          SPACE
01A2  86  4B      LDAA #4B          ASCII K
01A4  BD  E1D1    JSR OUTEEE        PRINT K
01A7  86  48      LDAA #48          H
01A9  BD  E1D1    JSR OUTEEE        PRINT H
01AC  86  5A      LDAA #5A          Z
01AE  BD  E1D1    JSR OUTEEE        PRINT
01B1  BD  E0CC    JSR OUTS          SPACE
01B4  20  06      BRA 01BC          BRA OUTDATA

01B6  20  B2      BRA 016A          ISLAND
01B8  20  35      BRA 01EF          ISLAND
01BA  20  XX      BRA XXXX          SPARE ISLAND

OUTDATA ROUTINE

01BC  FE  A020    LDX A020          FIND DATA
01BF  A6  0E      LDAA X 0E         GET DATA BYTE TO OUTPUT
01C1  81  DD      CMPA #DD          STOP CHARACTER?
01C3  27  0B      BEQ 01D0          IF YES, EXIT
01C5  B7  8010    STAA 8010         OUTPUT DATA BYTE
01C8  4F          CLRA
01C9  08          INX
01CA  43          COMA
01CB  B7  8010    STAA 8010         SET ALL OUTPUT BITS HIGH
01CE  20  EF      BRA 01BF          REPEAT
01D0  4F          CLRA              EXIT
01D1  43          COMA
01D2  B7  8010    STAA 8010         SET OUTPUT BITS HIGH
01D5  39          RTS

INCCAL ROUTINE

01D6  FE  A020    LDX A020          FIND DATA
01D9  A6  07      LDAA X 07         GET DATA
01DB  81  DD      CMPA #DD          STOP CHARACTER?
01DD  27  0E      BEQ 01EC          YES? EXIT
01DF  84  0F      ANDA #0F          INCREMENT DATA
01E1  8B  01      ADDA #01
01E3  19          DAA
01E4  A7  07      STAA X 07         REPLACE DATA
01E6  81  09      CMPA #09
01E8  2F  03      BLE 01EC          EXIT IF LESS OR EQUAL ZERO
01EA  08          INX               POINT NEXT BYTE
01EB  20  EC      BRA 01D9          REPEAT
01ED  20  C7      BRA 01B6          SERVICE

DECCAL ROUTINE

01EF  FE  A020    LDX A020          FIND DATA
01F2  A6  07      LDAA X 07         (SEE INCCAL)
01F4  81  DD      CMPA #DD          STOP CHARACTER?
01F6  27  0E      BEQ 0206          YES? EXIT
01F8  84  0F      ANDA #0F
01FA  8B  09      ADDA #09          DECREMENT DATA BYTE
01FC  19          DAA
01FD  A7  07      STAA X 07         REPLACE DATA BYTE
01FF  81  09      CMPA #09
0201  2E  03      BGT 0206          EXIT IF GREATER THAN ZERO
0203  08          INX               POINT NEXT BYTE
0204  20  EC      BRA 01F2          REPEAT
0206  20  AE      BRA 01B6          ISLAND
```

calibration offset.

Printfreq Module (016E-01BB)

Printfreq, utilizing OUTEEE, displays the operating frequency data stored at hex locations 0000-0005 on the top line of the CRT terminal. The five most significant digits are output, then a decimal point, the last digit, and the letters "KHZ".

Outdata Module (01BC-01D5)

Outdata outputs the previously formatted BCD frequency control data stored at hex locations 000E-0011 to the 8-bit parallel-output port driving the frequency synthesizer.

Modifications

The uptune and downtune modules repeatedly monitor the system's control interface for the signal to stop tuning. An interesting alternative would be to monitor the parallel port connected to a tone detector used for CW receive programs. The program would stop tuning when a signal is found, and with a more powerful executive, jump to a CW receive routine. The address of the port to be monitored is stored at 00D8-00D9 and 00E4-00E5. The value of the "normal" byte found there is stored at 00D8 and 00E7 (no stop command or no signal). Any different value stops the uptune or downtune function and returns program control to the executive.

Construction

A full-size layout of the printed circuit board is shown in Figs. 4 and 5. Even with the double-sided board, it is still necessary to install 9 wire jumpers (number 26 wire) on the top of the board. Fig. 6 shows the jumper and component layout. Notice that the resistors are mounted vertically to conserve space. Plated-through holes are not used in the design, although if you make your own boards and have the facilities, you could do so. Our boards use "Z" wires to connect certain pads on the top and bottom sides. Fig. 7 shows the location for the "Z" wires, along with the method of installation. The cost savings of plated-through holes

C1,	56 pF mica
C12, 13, 18, 19, 22, 26, 27	150 pF mica
C2	5/25 trimmer
C3, 5, 6, 8, 29, 30, 31, 9, 32, 33, 34	.001 ceramic, 50 V
C16, 17, 20, 25, 28	.01 ceramic, 50 V
C4, 10, 11, 15, 21, 23, 36	.1 ceramic, 50 V
C24	.47 uF, 25 V electrolytic
C35	220 uF, 35 V electrolytic
C14	2.2 uF, 15 V electrolytic
R1, 2	270 Ω, ¼ Watt, 10%
R4, 38	470 Ω, ¼ Watt, 10%
R37	6.8k, ¼ Watt, 10%
R8, 9, 19, 20, 21, 25, 27, 28, 29, 30, 31, 32, 33, 34	10k, ¼ Watt, 10%
R43	1k, ¼ Watt, 10%
R3, 5, 7, 22, 23, 24, 39, 42	1 meg, ¼ Watt, 10%
R35, 36	33k, ¼ Watt, 10%
R10	4.7k, ¼ Watt, 10%
R11	33k, ¼ Watt, 10%
R12	5.6k, ¼ Watt, 10%
R13	6.8k, ¼ Watt, 10%
R14	12k, ¼ Watt, 10%
R15	10k, ¼ Watt, 10%
U1	CD4060
U2, 3, 7, 4, 6	CD4011
U5	CD4051
U8	CD4016
U9	HCTRO320
U14	CD4528
U15	CD4028
U16	7407
U17	LM340T-12
U18	LM340T-5
R16	33k, ¼ Watt ± 10%
R17	47k, ¼ Watt
R18	18k, ¼ Watt
R40	4.7k, ¼ Watt, ± 10%
R6	100 Ω ¼ Watt, ± 10%
L1	10 uH, 37T #26 on .5" T-50, mix #2 core (Palomar Engineers)
L2, 3	8.2 uH molded chokes
CR1, CR2, CR10, CR10, CR11, CR12, CR13	1N4001
CR9	1N751A 5.1 V zener
CR3, CR4, CR8	1N4148
CR5, CR6, CR7	MV109 varactor diode
Q1	2N4416
Y1	4096 crystal, 20 pF, HC/6
Y2	5920 crystal, 20 pF, HC/6
T1	12 V ac at 300 mA (Radio Shack)
	SPST toggle switch, line cord, cabinet (Radio Shack), phono jack, printed circuit board, RG-174 miniature coax

Parts Availability

The following parts are available from MICROSIZER, PO Box 44, Cedar Rapids IA 52404: Double-sided, drilled G-10 PCB, tin-plated, $17.00; MV109 diodes, .75 ea. Hughes HCTR-0320 is available from Coombs Associates, 1001 E. Touhy Ave., Des Plaines IL 60018, for $14.70.

more than offset the inconvenience of the "Z"-wire installation. The rf output is routed from the pad on the PCB through miniature coax to an rf connector (RCA phono) on the rear. The PCB is mounted by removing the sheet metal screws that hold the rubber feet on the cabinet and replacing them with 5/8" 4-40 screws. The PCB is spaced off the bottom of the cabinet by appropriate spacers (or just #4 nuts on the top and bottom side of the board). The power transformer is mounted on the rear panel, using hookup wire to connect it to the PCB. Since the transformer was designed for PCB mounting, it is necessary to carefully bend the terminals so that they will not short to the chassis. An SPST toggle switch and ½-Amp fuse and fuse holder complete the mounting effort.

The vco inductor, L1, is mounted to the PCB with an insulated washer and a 5/8" 4-40 screw. Due to the tolerances in permeability of the toroid core, the actual turns required may vary by 1 or 2—so use the number called for in the parts list and remove a few if it is found necessary in the tune-up section. The two crystals are mounted directly on the PCB—just remember to solder quickly, in order to avoid too much heat on the pins.

Test and Alignment—Computer-Controlled

This step is easiest if you have the tuning program keyed in and ready to present data to the parallel data port connected to the MICROSIZER.

Apply the 120 V ac power and check for +12 and +5 at the outputs of the two regulators. Connect a frequency counter to the rf output jack and enter a frequency of XX0000. (Note that the first two digits don't really matter to the MICROSIZER—they are only for the CRT readout to indicate the tens and units megahertz.) The MICROSIZER should respond with a frequency somewhere in the range of 5.517 MHz. The exact frequency depends upon the frequency of the 5920 mixer crystal. However, this is not at all critical since the "A" or "S" calibration commands will correct the data frequency so that the MICROSIZER supplies the exact frequency to the transceiver to make XX0000 be at the bottom edge of any band. Monitor pin 9 of U1, the reference oscillator, and adjust the trimmer for 4096.000 kHz. Check the voltage at the junction of R35 and C15 (control voltage to the vco) for 11 to 11.5 volts. If necessary, adjust the number of turns on L1 or their spacing until this voltage is achieved. Next enter data XX5000 and check that the output frequency moved down exactly 500 kHz. The vco tuning voltage at this point should be between 5 and 6 volts. If everything

has checked out so far, input various frequencies and check that the 100 kHz, 10 kz, 1 kHz, and 100 Hz data move the frequency as it should. At this point, you should be able to connect the MICROSIZER to your transceiver and successfully perform all of the software operations available. Notice that the lockup time between 100-Hz steps is very fast and smooth, and tuning up or down is just like using a vfo, except that it's all done by the computer. Now enter a frequency and watch the CRT display show a jump to the desired frequency, accurate to within 100 Hz, in less than 100 milliseconds. Try that with a regular vfo! ! !

100-Hz Adjustment

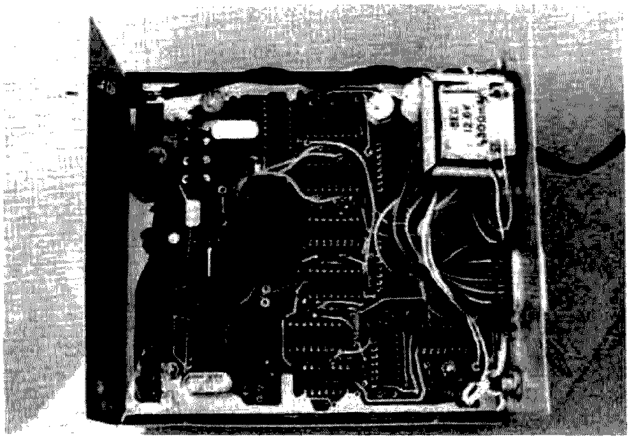
If your tests showed that the 100-Hz steps within a 1-kHz range were not accurate to within a few Hertz of the desired 100 Hz, some adjustment on the digital-to-analog converter may be necessary. The values for R10-R17 shown in the parts list may be juggled slightly to tailor the individual 5920 mixer crystal to the tuning diodes. Each 100-Hz step voltage is controlled by a single resistor, with the exception of the 900-Hz step, which is obtained by paralleling a resistor with the one used for the 800-Hz step. Table 1 shows the resistors and the 100-Hz steps that they control. If necessary, alter their values slightly—or, better yet, use a pot to determine the exact values, measure them, and replace each with a 1% unit.

Resistor	100-Hz Step Controlled
None	000
R17	100 Hz
R16	200 Hz
R18	300 Hz
R14	400 Hz
R15	500 Hz
R13	600 Hz
R12	700 Hz
R10	800 Hz
R11/R10	900 Hz

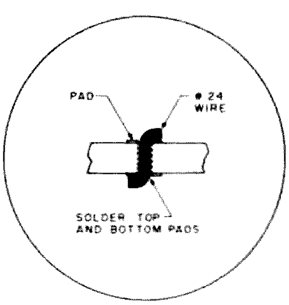
Table 1.

Test and Alignment—Manual Tuning Mode

If you don't have access to a computer to input data, you will probably need to measure the BCD output of the four data registers in order to determine their output to the divider chip and D/A converter. When the unit is first powered up, the registers should be all programmed with 0000, since C28 and R29 apply a 1-ms reset pulse when 5 volts first appears. Check that the output frequency is near 5.517 MHz, and zero the 1 kHz reference as described in the computer-controlled tune-up procedure. Now, ground the "up" tuning line, and the frequency should start changing in 100-Hz steps at a fairly slow rate. If the "down" line is simultaneously grounded, the tuning rate will increase. Momentarily remove power and reapply it to reset the counters to 0000; check



Interior view of MICROSIZER.



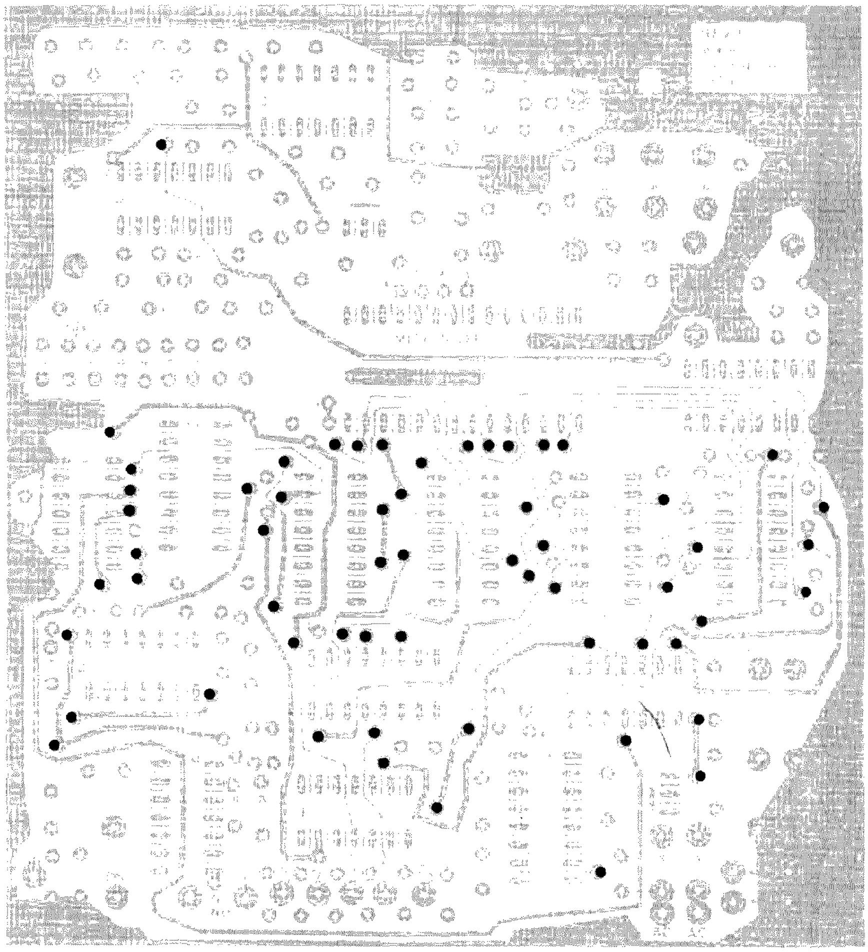


Fig. 7. "Z"-wire placement, along with method of installation.

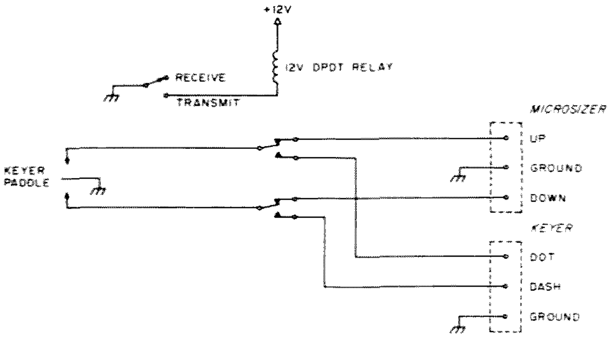


Fig. 8. Method for switching the keyer paddle between MICROSIZER tuning and keyer operation.

the vco tuning voltage as described in the computer-controlled tune-up procedure. Also, check the accuracy of the 100-Hz steps and vary the D/A converter resistors (R10-R17) if necessary. The tuning rate in the slow mode is controlled by C11; that in the fast mode is controlled by R25. They may be varied to adjust the tuning speed to suit your needs. If you are using your keyer paddle to tune, the simple circuit shown in Fig. 8 will permit it to tune the MICROSIZER in receive and operate the keyer in transmit.

Hopefully, this article will inspire radio amateurs to surrender the almighty tuning knob and discover the fascinating world of computerized "hamming." The possibilities are endless, and the cost of a computer is now less than that of a good transceiver. ■

CW Fans: Give Superior Selectivity to your Atlas Rig

—this mod uses an inexpensive MFJ filter

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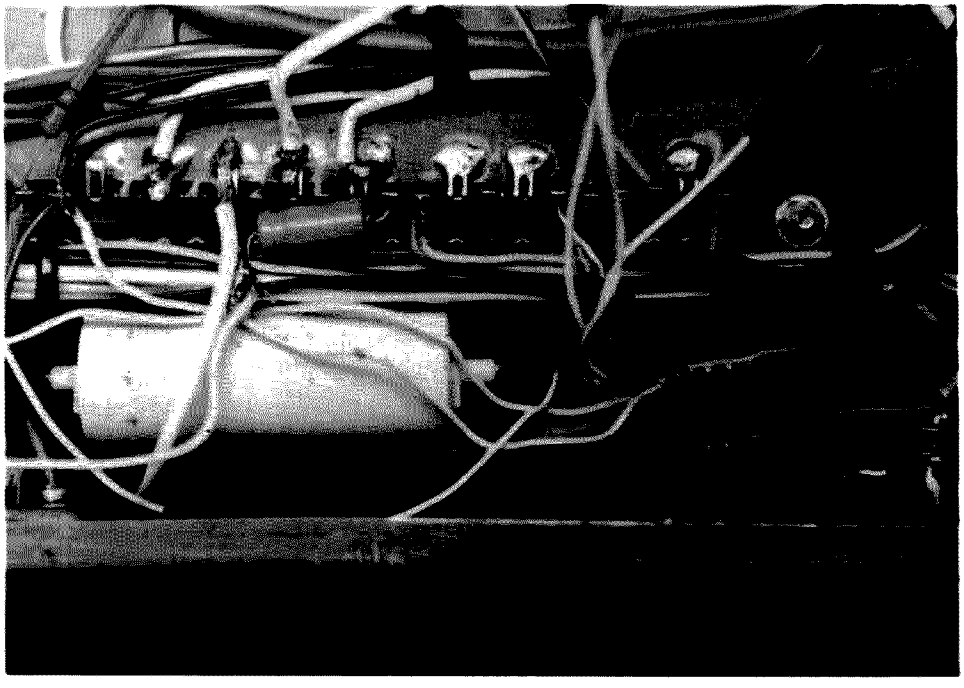
As have many other hams who enjoy the use of the great Atlas solid-state, no-tune-up rigs, I quickly discovered that while it was great for SSB, it lacked a little in CW reception ability. This simple modification will bring it around and make CW as enjoyable as sideband.

The Atlas rigs have a fine SSB i-f filter, but if you try to copy CW with this unit, you find that there is no original factory CW filter, nor any adjustments to narrow the i-f bandwidth. The problem of separating close CW signals by tone alone is difficult and frustrating, especially if you are a Tech trying to upgrade. (I finally got my Advanced using this rig on the Novice bands!)

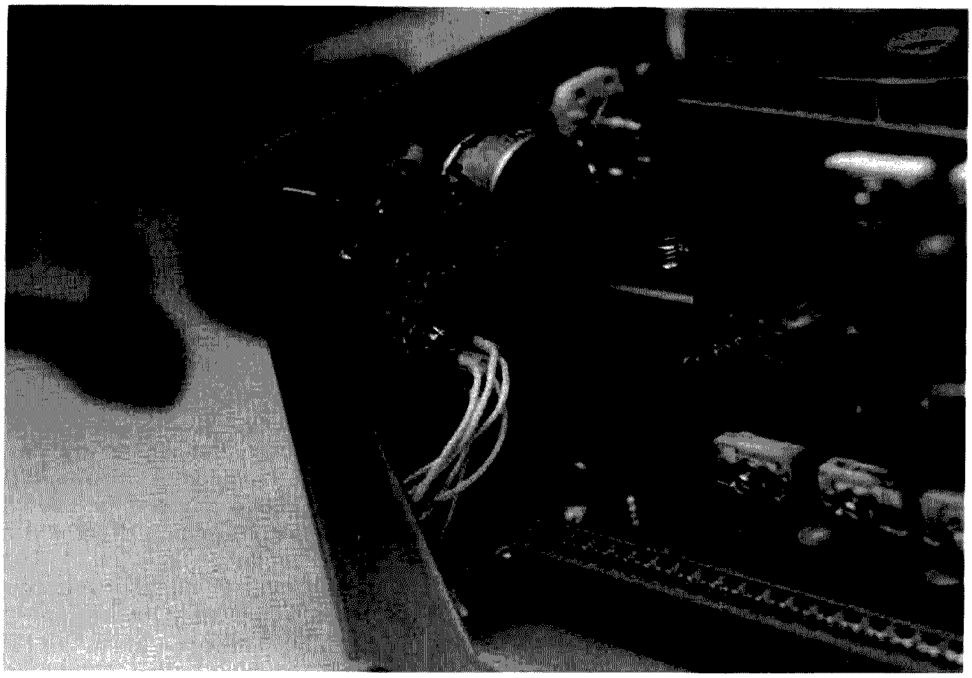
MFJ makes a dandy CW audio filter with a selectable bandpass which is centered at 750 Hz and which is also the CW offset of the Atlas, making it an ideal choice. While you could outboard the unit and keep buying 9-volt batteries for the filter, I found it could be placed easily inside the Atlas, deriving power and operational benefits from its location. While an audio filter is not as good as an i-f filter for CW, the performance of the hybrid unit when completed was more than adequate, and only the worst of QRM and zero-beating of signals could not be overcome. A more demanding CW operator would prefer the narrower i-f filter, but this works fine for most of us, and, since it can fit inside the rig, allows unimpeded mobile or portable operation.



Audio circuit connections, showing new wires and placement of the filter output capacitor (small electrolytic) in the center of the picture.

The MFJ filter, model CWF-2, like most MFJ products, comes in a small box and is powered by an internal 9-volt battery. Because of the small size and super compactness of the Atlas, there isn't much room inside for add-on goodies, but the MFJ fits.

The first step is to familiarize yourself with the operation of the MFJ filter. It employs a series of



Mounted bandwidth selector switch.

active audio filters using IC chips and matched components for a 750-Hz center frequency and a variable bandwidth of 180, 110, or 80 Hz. This allows easy copy without resorting to very low audio notes—nice in a non-CW rig—so you don't walk down the band, retuning to hear the other guy. The selectivity is chosen from a multi-position slide switch. The MFJ unit is designed for use either between audio stages or between the rig output and a headphone jack, supplied on the front of the MFJ box.

Modification Steps

1. To complete the conversion as pictured in the photos, follow these easy steps. No mechanical work is necessary unless you have the noise blanker option in your unit, in which case a single 3/8" hole is required.

The filter board is nestled between the speaker and the back wall of the chassis.

2. First, remove the screws holding the MFJ unit together. There are four, two on each side of the box.

3. Once the unit is open, you will see that the actual filter is contained on one PC board, held to the rear and bottom of the box with a rubber-like cement. Using an X-acto® or similar knife, carefully remove the PC board from the box. A wedging action between box and board is sufficient.

4. Remove the switches and headphone jack from the box by removing the four screws and a large nut holding the ¼" jack. The box should be set aside and all loose hardware stored in the bottom shell of the MFJ box.

5. Label or identify on the PC board each wire on the MFJ unit. There are two wires for power, + and −, audio in, and three audio out wires. The electrolytic capacitor attached to the multi-position switch is removed and saved for later use. After removal of the wires, the switches and connector can be remounted in the MFJ box. The box can be reassembled and set aside for other projects.

6. Remove both the top and bottom covers from the Atlas.

7. Remove the hole plug on the front panel below the NB (noise blanker) notation or, alternatively, drill a small (3/8") hole wherever you would like the bandwidth selector switch to go. A good spot is near the af/rf gain controls, positioned to allow as much room as possible for fingers to turn the knobs.

8. The switch selected for the rig shown in the photos was a Dale SP10T. A very small Alco or similar rotary with 4 positions is adequate. The Dale was in the ever-growing junk box. The type of switch used is the same as found on many HTs for frequency selec-

tion and is available from most parts houses, FM specialty houses, and ham stores. Spectronics (1009 Garfield, Oak Park IL 60304) has some for use on Motorola HTs for adding more frequencies. The cost is about $4.

9. Because the switch is really nestled in the rig, it is necessary to prewire the terminals. Five lengths of stranded no. 26 in your favorite colors, each about 14" long, will do nicely. Prepare the switch for insertion.

10. The PC board in the Atlas on the far right (facing front) is removed for insertion of the switch. This is the rf module, PC-100; or, if you have the noise blanker, find your hole and insert the switch as best you can.

11. The wires from the switch are routed to the front corner and down through the open space by the wafer selector switch to the underside of the Atlas. There is a channel in the rf cover over the vfo near the front lip which can serve as a cable raceway, or the wires can be run around the outside of the Atlas chassis over the audio board.

12. If you take the time and are neat, you can run the switch wires directly to the MFJ PC board. Or, use the wires attached to the MFJ unit and splice in midstream. Being naturally sloppy (according to the XYL), I chose to splice in midstream. The MFJ board slips between the speaker magnet and the rear connectors of the Atlas.

13. There is a red/white wire coming from the center terminal on the af level control which goes to the edge connector of the audio board in the Atlas. Remove the end attached to the edge connector. This is the input to the MFJ filter. This wire attaches to the #1 terminal (filter-bypass) position on the rotary switch. The audio input wire coming from the MFJ filter board is attached to the af level center terminal.

14. The output terminal on your selector switch is run to the vicinity of the edge connector and is connected to terminal 12 of the edge connector, using the electrolytic capacitor supplied with the filter (series connection).

15. The + power lead of the filter is connected to pin 21 of the edge connector.

16. The ground lead is attached to pin 18 of the edge connector.

17.The filter-select wires of the MFJ unit are connected to the terminals of the rotary switch in the order desired: 80, 110, 180, or 180, 110, 80 Hz.

18. The Atlas covers are replaced.

19. Turn on and enjoy!

Performance of the unit on the crowded 80- and 40-meter Novice bands was excellent. Needless to say, tuning the Atlas with the filter in the 80-Hz position makes for *fast* tuning. It was found that the 180-Hz mode was adequate for most work and tuning, and the 110-Hz mode was best for QRM-laden stations. The 80-Hz mode was something else, allowing you to hear the other stations chirp and drift with keying. You really can tell about vfo stability with the 80-Hz mode!

All in all, the unit performs very satisfactorily and makes a good SSB rig an even better all-rounder for those of us who only dabble in CW. The MFJ unit is currently priced at $29.95 and is available from a number of sources, including MFJ direct. ■

A Sensible CMOS TT Decoder

—presented by popular demand

C. Warren Andreason N6WA
PO Box 8306
Van Nuys CA 91409

Several years ago, *73 Magazine* published one of my articles titled "Autocall 76" (June, 1976). At that time, I offered printed circuit boards and the response was overwhelming. To make a long story shorter, over the time span, the circuit was redesigned using CMOS, and commercial printed circuit boards were developed.

While that circuit was intended for paging use, there were many letters asking how the circuit could be modified to work as a control circuit in a repeater with an on/off function. I designed a new circuit with a plug-in printed circuit board that meets this requirement.

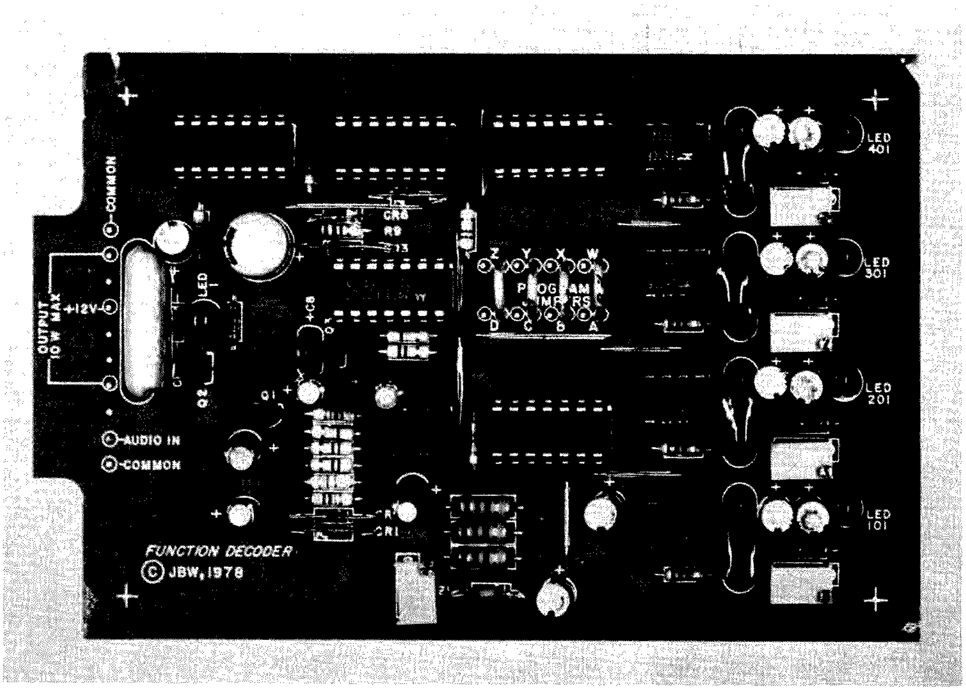


Photo of completed decoder.

This unit that is being presented is a totally self-contained single-function control board that requires only a 12- to 15-volt power source at about 100 mA and virtually any level of audio. The input is high impedance so it will not load or affect the audio line to which it is attached, and it adjusts its own input gain so that whatever audio input level is present is optimized for maximum performance. The output of this unit is in the form of a reed relay which can handle loads of up to 10 Watts. The relay contacts are isolated from all circuitry and may be used in any manner required. The circuit contains everything necessary for tuning and programming, without the need for test equipment. Once set up, the unit will respond to a four-digit touchtone™ code, latching the output relay, and releasing the relay upon reception of the proper and different four-digit off

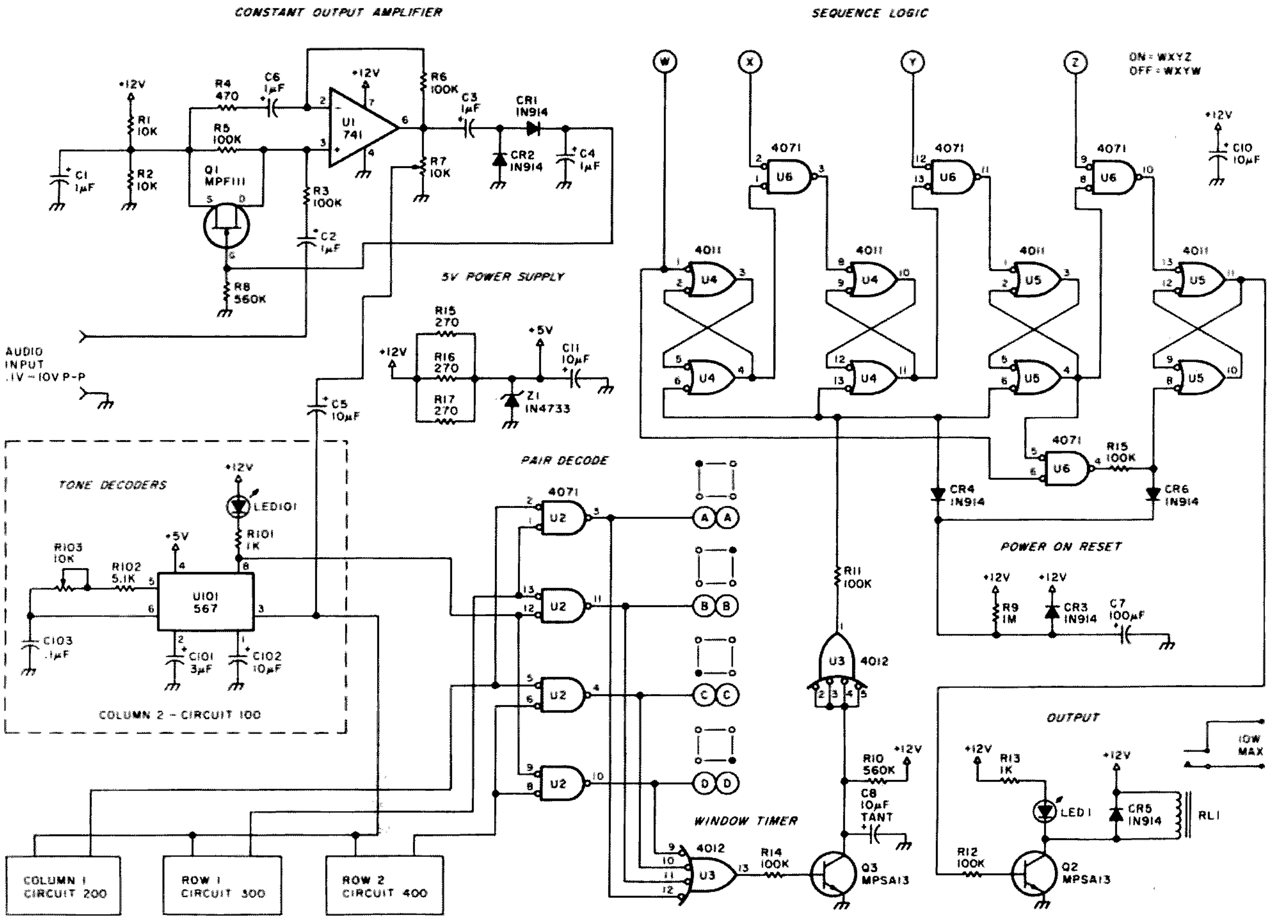


Fig. 1. Schematic of remote-control decoder. All resistors ¼ W, 5% unless otherwise stated. On all ICs, connect pin 14 to +12 volts and pin 7 to ground unless otherwise stated. Circuits 100, 200, 300, and 400 are identical except that part 101 becomes 201, etc.

code. This unit cannot be triggered by voices, yet will work even under the most trying conditions.

Circuit Description

See Fig. 1. The input stage of this function decoder is a self-adjusting automatic-leveling amplifier. It will take its input from any point which has audio available. The input impedance is on the order of 100k Ohms, so it will not load the audio line to which it is attached.

U1 forms a fixed-gain amplifier and the rectifier stage sampling the output produces a dc voltage level which is directly related to the output amplitude of the amplifier stage. This dc voltage is fed back to Q1, which turns on as the dc voltage goes in the positive direction. As the dc tries to go higher, the FET conducts more, shunting the input signal away from the amplifier input and not allowing the amplifier to produce any greater output.

In this way, the input stage regulates its gain to allow only small changes in the output, while the input may vary over a wide range.

The constant-level audio is fed to the inputs of circuits 100, 200, 300, and 400, which are tone decoders. Two of these circuits are tuned to column tones, and two to the rows. The desired decode tones are decided on and a touchtone dial (Fig. 2) is used to determine which columns and rows are needed. The leftmost column used will be referred to as column 1; column 2 is the rightmost. In a like manner, row 1 is the uppermost used row, and row 2 is the lowermost used row. Circuit 100 is tuned to the column 2 tone, circuit 200 to column 1 tone, circuit 300 to row 1 tone, and circuit 400 to row 2 tone.

These four decoded tones are fed into U2, (Fig. 1), which detects tone pairs and gives the digit-decode outputs. Output "A" would be row 1 and column 1; output "B" would be row 1 and column 2; output "C" would be row 2 and column 1; and output "D" would be row 2, column 2.

The decoded digits are fed to the W, X, Y, and Z inputs in the order in which the numbers are desired. An example would be the

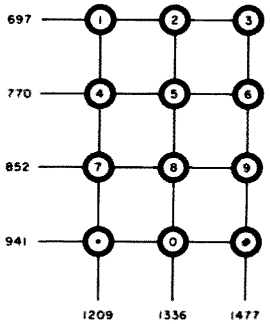


Fig. 2. Touchtone keypad showing row and column tones.

control number 1-3-7-9. 1 (column 1/row 1) output "A" goes to "W". 3 (column 2/row 1) output "B" would go to "X". 7 (column 1/row 2) output "C" would go to "Y". 9 (column 2/row 2) output "D" would to to "Z".

Anytime a digit is decoded, the output on pin

13 of U3 goes high, turning on Q3 and discharging C8. The low at C8 is inverted by the other half of U3, and is fed through R11 to the enable inputs of the sequence logic. As long as the enabling output from U3 is low, the sequence is held in a reset state, but the decoding of a digit and the subsequent discharge of C8 will enable the sequencing logic for a period determined by the charge time of C8.

If another proper digit is not received by the time C8 is charged by R10 (about 3 seconds), the logic is reset. As the proper sequence of digits is received, the flip-flops formed by U4 and U5 are set, in turn, until U5, pin 11, goes high with the proper decode of the fourth digit of the "on" code. When pin 11 is high, it drives the base of Q2, causing the transistor to conduct and relay RL1 to pull in. The relay will stay closed until the flip-flop driving Q2 is reset by the "off" code. The "off" code is the same as the "on" code except that the first digit of the code is also used as the fourth digit. If the code 1-3-7-9 were used as the "on" code, the "off" code would be 1-3-7-1.

LED1 in the collector of Q2 is a status light which allows the person looking at the board to know if the relay is energized. If the LED is lit, the relay is energized.

The network made up of C7, CR3, R9, CR4, CR6, R11, and R15 is used to provide power reset protection. In the event of a power failure, the unit will always come up in a mode where the relay is off (open contacts) when power is restored.

As mentioned earlier, this circuit is extremely effective and is in use in many repeaters, working as described. Some of the earlier units (based on the Autocall circuit with modifications for this task) have been on hilltops in repeaters and have been operating for several years without problems, so the circuit has been well proven.

In building this unit, it would be wise to select good temperature-stable components for operation in the area of the tone decoders. Resistors R102 and R103, and capacitor C103 must not change much if the tuning of the tone decoders is to remain stable. Show some care in handling and soldering of the CMOS logic, as I can attest to what a soldering iron with a leaky tip can do. If in doubt about your iron, ground the tip with a clip-lead near the handle. CMOS is great stuff but it cannot handle high voltage, even at extremely low current levels.

A final note of interest is that on the printed circuit card, the decoded digits, A, B, C, and D are brought out to a patch point and the sequencing logic inputs W, X, Y, and Z are also brought to the same point where convenient strapping is available for programming.

Professional PC boards and all components are available from CW Electronics (the author) as shown in the parts list.

Tuning—With Test Equipment

Provide an audio source and observe audio at pin 3 of any tone decoder on an oscilloscope. Adjust R7 until the audio peaks are about 200 mV. After deciding which tones to decode, connect a frequency counter which has a high-impedance input to pin 5 of each tone decoder (567), and, in turn, adjust each associated pot until the proper decode frequency is read as the vco idle frequency. This is done with no audio being fed into the unit.

Tuning—Without Test Equipment

Connect the audio input to a source of touchtones. Set R7 midrange and introduce the row 1 tone into the unit. This can be done by pushing two buttons of the touchtone pad simultaneously. Adjust pot R103 until the LED lights. Lower the adjustment of R7 until the LED goes out. Raise the adjustment of the R103 about 2 turns past the point where the LED lights again. Now, in a similar manner, provide the desired row or column tone, and adjust the other three tone decoders. R7 is set only once and just the tone decoders need adjusting. Make sure each tone pot is set in the center of the range, halfway between the drop-out points.

Jumpers

When all four decoders are set, decoded tone pairs will appear at outputs A, B, C, and D. Provide jumpers from A, B, C, and D to W, X, Y, and Z to obtain the desired order of decode, i.e., first digit to W, next to Y, and so on.■

Parts List

Item	# Req.	Description	Designation
741	1	Op amp	U1
4071	2	Quad OR	U2, U6
4012	1	Dual NAND	U3
4011	2	Quad NAND	U4, U5
567	4	Tone decoder	U101, U102, U103, U104
MPF111	1	FET	Q1
MPSA13	2	NPN transistor	Q2, Q3
LED	5	Light-emitting diode	LED 101, 201, 301, 401, LED 1
1N914	6	Signal diode	CR1, CR2, CR3, CR4, CR5, CR6
1N4733	1	Zener diode	Z1
270 Ohm	3	½-W, 5% resistor	R15, R16, R17
470 Ohm	1	¼-W, 5% resistor	R4
1k	5	¼-W, 5% resistor	R101, R201, R301, R401, R13
5.1k	4	¼-W, 5% resistor	R102, R202, R302, R402
10k	2	¼-W, 5% resistor	R1, R2
100k	7	¼-W, 5% resistor	R3, R6, R5, R12, R11, R14, R15
560k	2	¼-W, 5% resistor	R8, R10
1 Meg	1	¼-W, 5% resistor	R9
10k	5	Trimpot	R7, R103, R203, R303, R403
.1uF	4	Mylar™ capacitor	C103, C203, C303, C403
1 uF	5	Electrolytic capacitor	C1, C2, C3, C4, C6
3 uF	4	Electrolytic capacitor	C101, C201, C301, C401
10 uF	7	Electrolytic capacitor	C5, C7, C1, C102, C202, C302, C402
10 uF	1	Tantalum capacitor	C8
100 uF	1	Electrolytic capacitor	C7
Relay	1	RA31441121, Elec-trol	RL1
PCB	1	Printed circuit board	Available from CW Electronics, PO Box 8306, Van Nuys CA 91409. Full kit is \$42.00. Optional sockets for ICS 3.00. Optional edge connector 2.00.

DTMFR for your Repeater

—state-of-the-art TT decoding

O. C. Stafford K4ALS
3702 Holts Chapel Road
Greensboro NC 27401

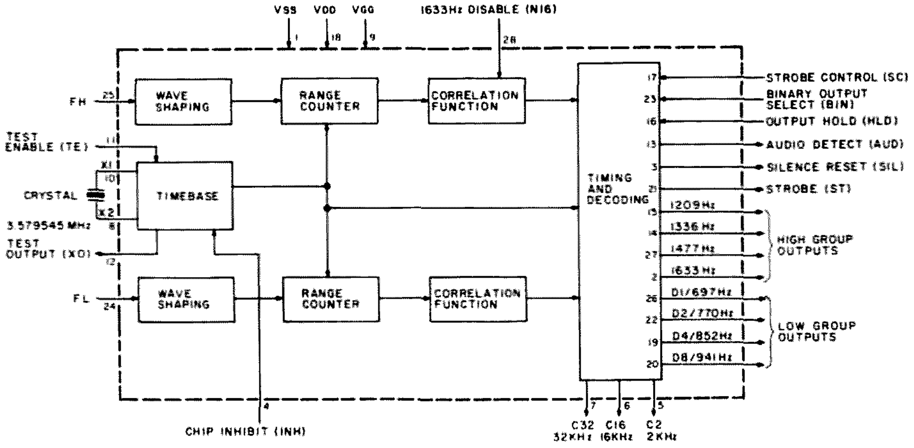


Fig. 1. CRC 8030 block diagram.

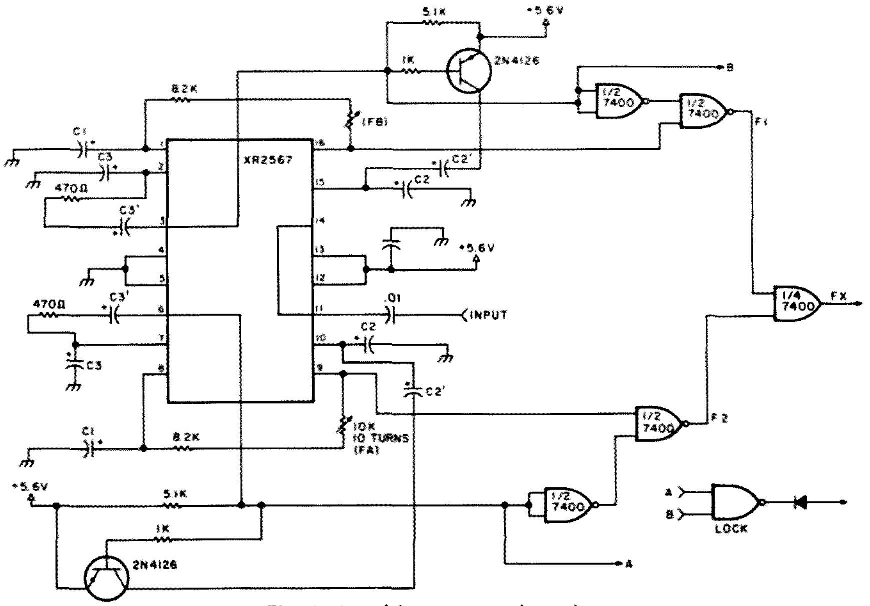


Fig. 2. Dual-loop tone decoder.

Decoding touchtone™ signals in a noisy environment can create real problems. Having the autopatch come up in the middle of a rag chew or turning on the air conditioner in the middle of winter can be embarrassing.

The development of the NE 567 by Signetics, the XR 2567 by EXAR, and the Mostek MK 5102 simplified the hardware required to construct tone decoders. Now you can replace the NE 567 and XR 2567 combos with a single chip—the CRC 8030 made by Rockwell-Collins. The chip costs more than the MK 5102, but then it does more and has more output functions.

When coupled with a suitable front end section, you can make a dual-tone multi-frequency receiver (DTMFR) that has fast lock-up time, practically no false outputs, and a few other features that will be discussed later. Pin connections for the CRC 8030 are shown in Fig. 1.

Fig. 3 shows the block diagram of the unit. I built three filters for use with the CRC 8030, but the one shown here seems to be the easiest to adjust and maintain. This circuit also produced some circuit tips that can be added to the decoder circuit described

by Buffington (*73 Magazine*, April, 1977), to decrease the lock-in time.

A single-stage agc amplifier drives XR 2567 dual-tone decoders. The decoders form bandpass tracking filters for the two tone groups. A simplified diagram of the filter circuit

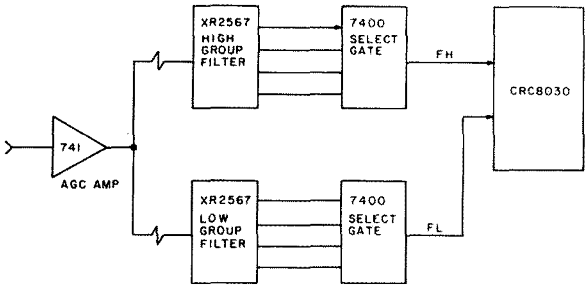


Fig. 3. Block diagram of the DTMFR.

$$Fo = \sqrt{F_1 + F_2}$$

	Freq. (Hz)			
Cap. (uF)	**732**	**895**	**1270**	**1553**
C1	0.1	0.1	.047	.047
C2	.22	.22	.10	.10
C3'	2.2	2.2	2.2	2.2
C2'	1.0	1.0	1.0	1.0
C3'	10.0	10.0	10.0	10.0

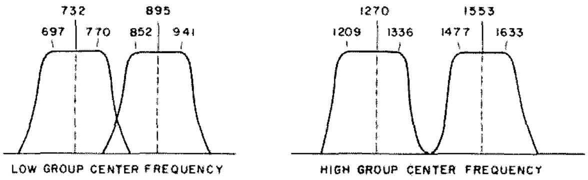


Fig. 4. Free-running frequency settings.

	1209				1336				1477				1633			
	D1	D2	D4	D8	D1	D2	D4	D8	D1	D2	D4	D8	D1	D2	D4	D8
697	1	0	0	0	0	1	0	0	1	1	0	0	1	0	1	1
770	0	0	1	0	1	0	1	0	0	1	1	0	0	1	1	1
852	1	1	1	0	0	0	0	1	1	0	0	1	1	1	1	1
941	1	1	0	1	0	1	0	1	0	0	1	1	0	0	0	0

Fig. 5. Touchtone matrix: binary outputs.

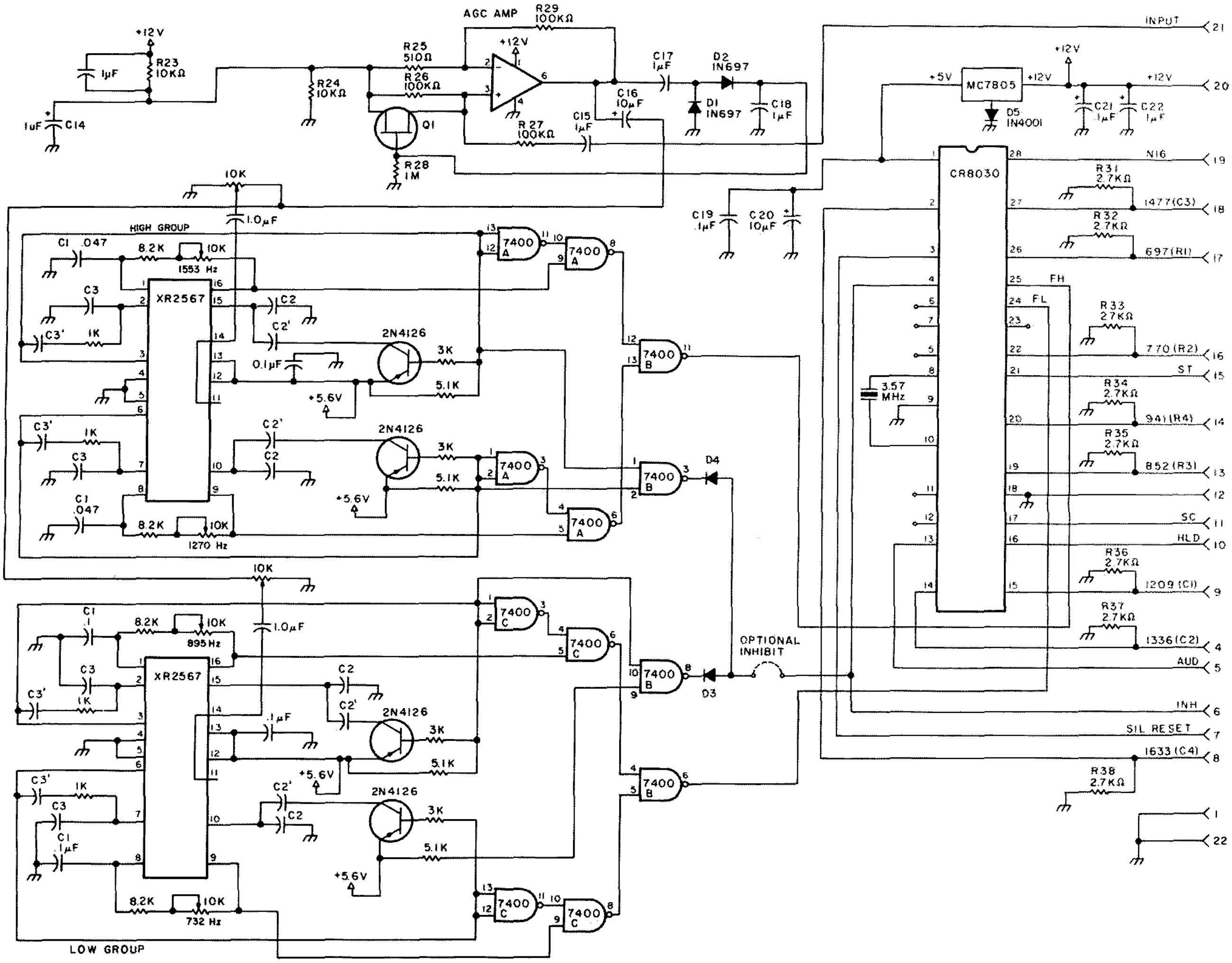


Fig. 6. Schematic of DTMFR. Values for C2, C3, C2', and C3' are found in Fig. 4.

is shown in Fig. 2. Each decoder has two control loops. When no signal is being received, the decoders are free-running at the center frequencies shown in Fig. 4. The smaller value for the loop filter capacitor allows the unit to lock faster. When a tone appears within the passband and the first lock occurs, pin 3 or 6 goes low and the second loop takes over, reducing the bandwidth and over shoot. It's like driving at 90 miles per hour and stopping immediately, if not sooner. In other words, the bounce is gone! After this occurs, the output of the locked decoder is then gated to the CRC 8030.

The CRC 8030 examines the input signal and, if it likes what it sees, generates a strobe pulse to indicate valid data, and all within 40 ms! Whenever a signal is present, AUD (pin 13) goes low to indicate a tone is present. The SIL (pin 3) stops sending out 10 millisecond pulses. Output can be 2-out-of-8 or binary if the BIN (pin 23) is held low. Binary output format is shown in Fig. 5. The output can be stored in the output register if HLD (pin 16) is held low.

I decided to use the INH (pin 4) to inhibit decoding of any tones unless a tone from each group is present. Neat, huh?

Adjustments

Adjust the four decoders to the free-running frequencies shown on the chart of Fig. 4 by first grounding pin 3 or 6 of the respective decoder. Next, apply a single tone of approximately 1 volt to the agc amplifier and adjust the low-tone group control for 1 volt at the input to the decoder for that tone group. Repeat this procedure with the high-tone group.

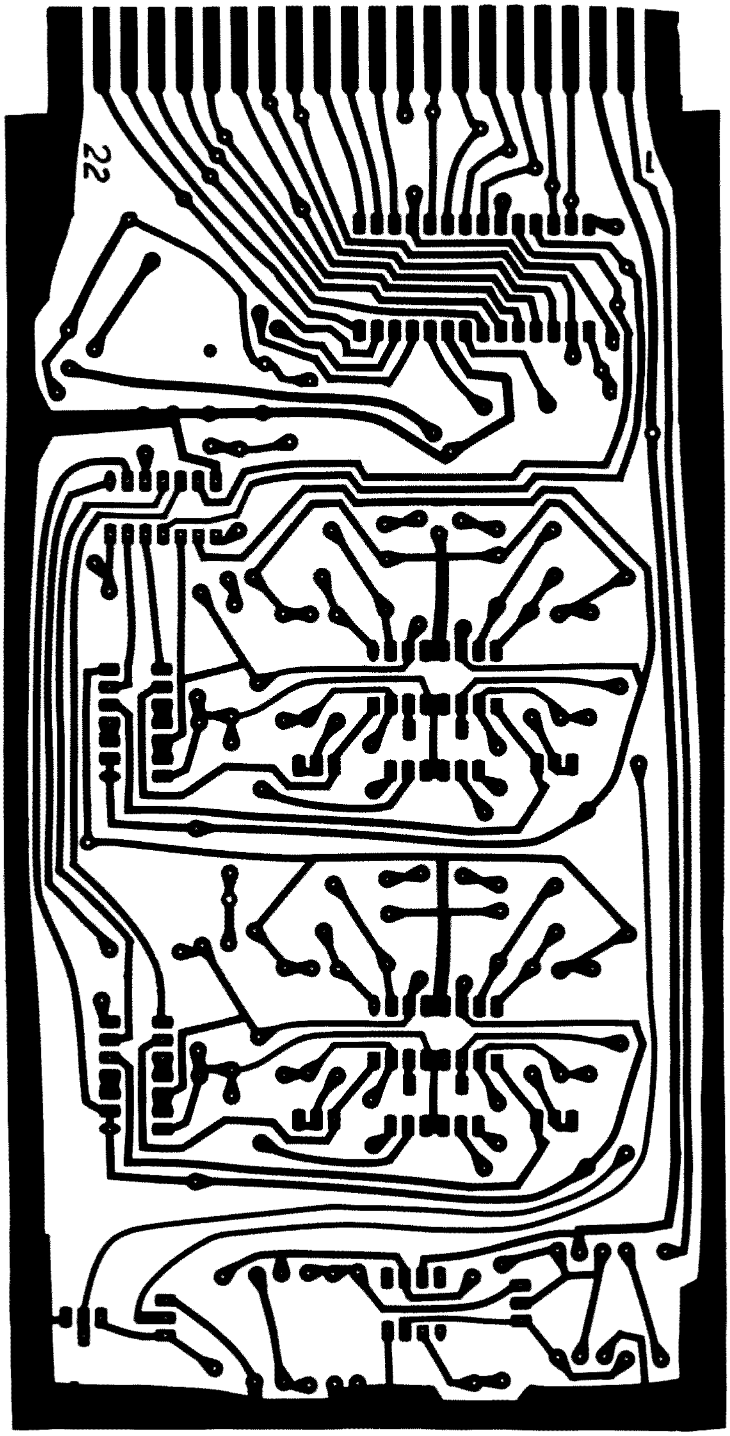
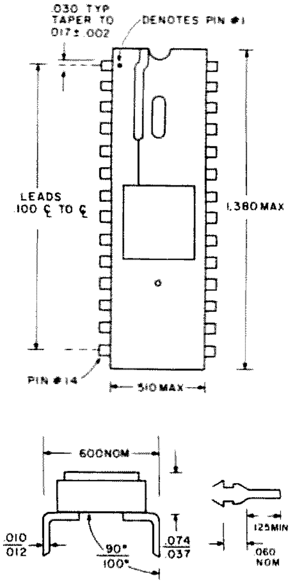


Fig. 7. PC board.



PIN NO	FUNCTION	PIN NO	FUNCTION
1	VSS	15	1209 Hz
2	1633 Hz	16	HLD
3	SIL	17	SC
4	INH	18	VDD
5	C2	19	D4/852 Hz
6	C16	20	D8/941 Hz
7	C32	21	ST
8	X2	22	D2/770 Hz
9	VGG	23	BIN
10	X1	24	FL
11	TE	25	FH
12	XO	26	D1/697 Hz
13	AUD	27	1477 Hz
14	1336 Hz	28	N16

Fig. 8. DTMF detector (CRC 8030).

The agc amplifier should handle signals from 50 millivolts to 5 volts while holding the output constant.

The dual-lock circuit for the XR 2567 can be incorporated in existing systems without too much trouble and cost. With this circuit, it is possible to use a standard card dialer which would make autopatching a lot easier and safer while mobile in motion.

Further improvements can be made to the front end by using separate agc amplifiers with suitable filters for each group. I would appreciate any and all comments on this circuit.■

Parts List

ICs, Transistors, and Diodes

1 741 op amp
1 MC 7805
1 CRC 8030
4 2N4126
3 7400
1 1N4001
2 1N697
1 MPF 111
2 XR 2567

Rasistors

11 2.7k, ¼-Watt, 5%
2 10k, ¼-Watt, 5%
1 1 meg, ¼-Watt, 5%
1 510 Ohm, ¼-Watt, 5%
2 100k, ¼-Watt, 5%
4 8.2k, ¼-Watt, 5%
4 5.1k, ¼-Watt, 5%
8 1k, ¼-Watt, 5%
4 10k, ¼-Watt, 5%
2 10k single-turn pots

Capacitors

3 .1-uF disc ceramic
4 1-uF tan., 35 V
4 10-uF tan., 35 V
2 .047-uF tan., 35 V
1 100-uF elec., 35 V
4 .22-uF tan., 35 V
2 .47-uF tan., 35 V
4 .1-uF tan., 35 V

Other

90 Molex pins
1 22-pin, .156"-spacing card edge connector
1 3.57-MHz xtal

Circuit boards and parts can be obtained from:

O.C. Stafford Electronic S. and D.
427 S. Benbow Road
Greensboro NC 27401

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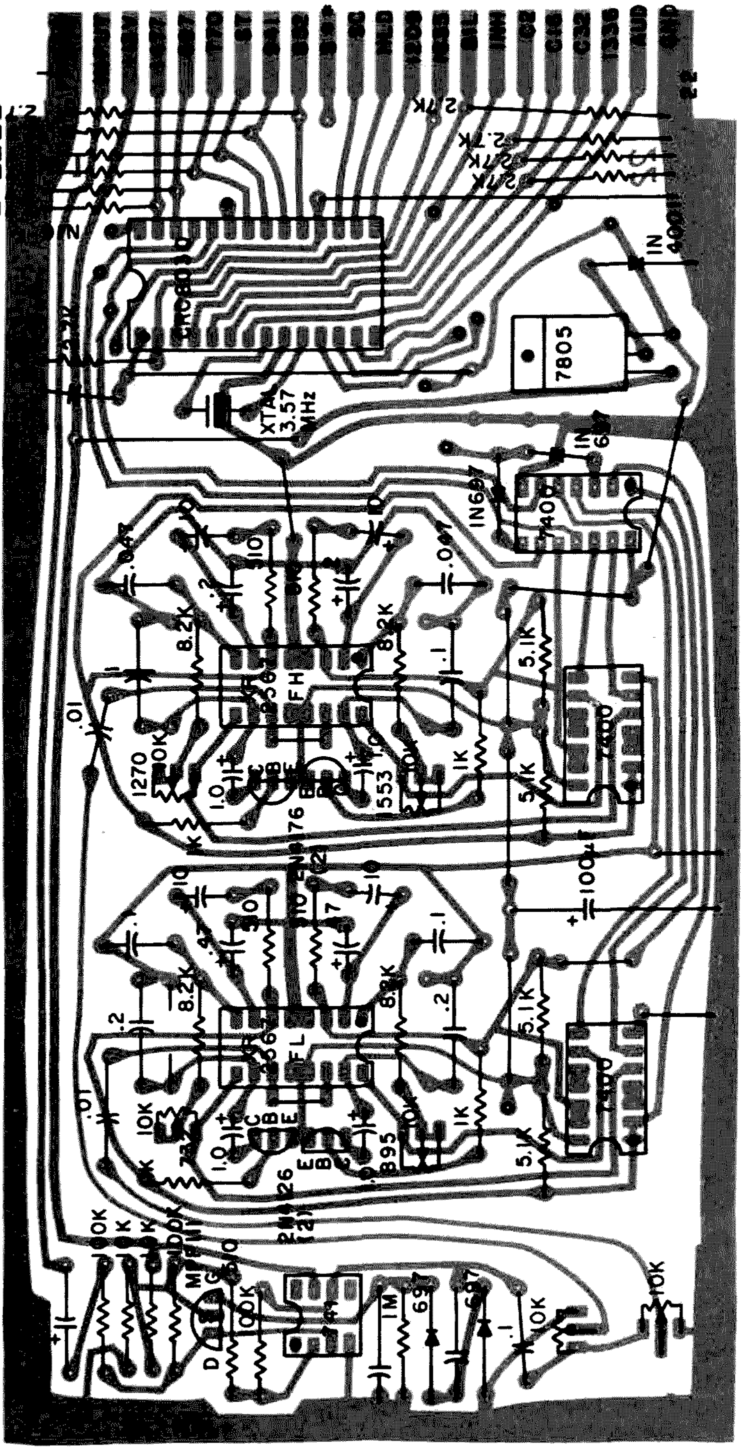

Fig. 9. Component layout.

Freedom Fighters on Forty

—SWLing the anti-Castro clandestines

Harry L. Helms, Jr. KA5M
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Dallas TX 75220

Hams by their very nature are "talkers," whether by SSB, FM, CW, or RTTY. I love to yak, too, and that desire to talk is one of the main reasons I wound up with my ticket. But there are times when listening is far more rewarding than speaking, and I can't help but wonder how many hams are aware of some of the remarkable things which could be heard on 40 meters during the first six months of 1978.

My mike and key gathered dust for several weeks as I spent my operating time searching the 7070-7100 kHz range for a Spanish-speaking OM who identified himself as "El Comandante David." His station used no call letters, only the slogan "Radio Rebelde." David did not engage in the usual ham QSOs; rather, he used his station to deliver impassioned and moving speeches against the regime of Fidel Castro in Cuba. As I listened to Radio Rebelde's broadcasts, I found myself becoming emotionally involved with David's situation, hoping desperately that he would manage to avoid detection by the authorities for another night.

David was a Cuban radio amateur. Radio Rebelde was a Cuban ham station pressed into service as a broadcasting station. David faced the death penalty for treason if caught by the Cuban government.

I entered the ranks of ham radio after several years as an SWL (shortwave listener). Unlike many hams who get their start in SWLing, I have never lost interest in the hobby and still belong to a number of SWL clubs. Thus, I was aware that interesting things do pop up from time to time in the 40 meter band. Almost yearly, some teenagers get ahold of an AM phone transmitter like the DX-60 or Johnson Ranger and set up a bootleg broadcasting station for a few days (one I particularly remember took to the air in 1973 under the callsign "WTIT, The Sound of Young America!"). During the first few years following Castro's rise to power in Cuba, 40 meters was the site for several low-powered freedom stations operating from various locations inside and outside Cuba (SWLs refer to such hidden stations as "clandestines"). But such activity decreased during the 1970s, with the last activity I can recall having taken place in 1975.

But recently Castro has become much more venturesome. Despite the continuing stagnation of the Cuban economy and hardships suffered by the Cuban people, Castro decided to launch large-scale involvement of Cuban troops in Africa. American sources estimate that over one-quarter of Cuba's armed forces are currently involved in Africa and the strain upon the homefront is reportedly severe. Goods and services, which have long been in short supply, have in some cases become virtually unobtainable by the average citizen. Moreover, certain portions of Africa, particularly Angola, are becoming as difficult for Cuba to extricate itself from as Vietnam was for the United States. Casualties are high, especially among black troops in the Cuban army, and this has resulted in smoldering racial tensions within Cuba.

Given such a backdrop, it was perhaps inevitable that some form of new anti-Castro clandestine radio activity would spring up. The first inkling came in the pages of *FRENDX*, the monthly bulletin of the North American Shortwave Association (PO Box 13, Liberty, Indiana 47353). During November of 1977, several SWLs reported hearing a station identifying as "Radio Abdala" operating in the AM mode on frequencies centered around 7085 kHz. All broadcasts were in Spanish, using male and female announcers reading scathing critiques of Castro and communism in general. Its theme music played at sign-on and during station breaks was from "2001, A Space Odyssey." It claimed to be operating from within Cuba itself, but most listeners doubted this, if for no other reason than its

elaborate and professional production. A better guess placed the transmitter either in southern Florida or somewhere in Central America. "Abdala" turned out to be the title of a well-known Cuban exile group.

Yet another anti-Castro clandestine was heard by a Miami SWL during December, 1977, operating in the 7000-7025 kHz range. The Miami SWL, Timothy Hendel, recorded one of his receptions and forwarded the tape to well-known SWL Glenn Hauser, editor of the "Listener's Notebook" section of the *FRENDX* bulletin. Glenn was able to glean from the tapes such tidbits as the announcer claiming to be operating from the Oriente Province of Cuba "especially for the Revolutionary Armed Forces." The station indentified itself as "Radio Rebelde, unida a Radio Libertad Cubana" and the announcer referred to himself simply as "El Comandante David."

I noted such reports with interest, but was unable to find either Radio Abdala or Radio Rebelde during checks during January of 1978. The two stations gradually began to fade from my memory until the evening of May 5, 1978. I was tuning 7080 kHz around 0300 GMT when I ran across an AM station badly QRMing the Europeans trying to work the states on SSB. Despite my best efforts to tune out the pest, his strong signals continued to obliterate 7080. I flipped the mode selector on my rig to AM and decided to see if I could identify the lid.

Something about the announcer's voice immediately caught my attention. It was strident, urgent, emotional. I found myself struggling to remember the Spanish I took as a college freshman. Certain words kept popping up clearly in his speech: "Cuba," "Angola," "Sovietica," and "la tirania de Fidel Castro." I now realized what I must be hearing, and it was soon confirmed with the identification as "Esta es Radio Rebelde, unida a Radio Libertad Cubana."

I heard Radio Rebelde again on May 9, and on May 10 I heard both Rebelde and Radio Abdala. By this time I was hooked on listening for these two stations. I caught Radio Abdala on May 10 at 0135 GMT on 7080 kHz. Both male and female speakers were heard, and talks were interspersed between musical breaks. Signal strength was excellent, yet modulation was quite crummy. I kept listening until they signed off at 0210. At 0253 on 7088 kHz, I again caught Radio Rebelde and David at the mike. He seemed to be having some sort of transmitter trouble this night, as the carrier left the air several times while he was speaking. Once it returned on 7089.5 kHz. David left the air promptly at 0300 and was heard no more that night.

I tuned for both without success on May 11, but again caught both on May 12. This quickly developed into a pattern; if one station was on, the other was sure to be on later that night. Radio Abdala was caught at a 0122 GMT tune-in on 7082 kHz while Radio Rebelde and David were heard beginning at 0201 GMT on 7089 kHz. David was rapidly proving the more interesting of the two stations. His voice delivery was seemingly extemporaneous, and frequently there were moments of dead air while he seemed to collect his thoughts. He claimed to be broadcasting from a hidden location in the mountains of Oriente Province and that there was a large underground in Cuba ready to rise up against Castro. He attacked the shortages of goods in Cuba and accused the Cuban government of falsifying casualty reports for its African operations.

I couldn't help but wonder if David was a radio amateur like myself. On May 12, I found out. At 0325 David paused and his carrier left the air for a few moments. Another Spanish-speaking voice came on frequency, mocking David and asking, in effect, "Why don't you give up? No one is listening to you anyway!" Immediately David's voice returned to the air, angrily challenging the unidentified intruder. No, no, that's not the case, claimed David. Radio Rebelde had "muchos, muchos oyentes" (many, many listeners). Thus wound up, David once again tore into the Cuban government and Castro until 0400 GMT, when he signed off and thanked his listeners.

David had to be listening to his transmit frequency in order to hear his heckler, indicating that he was operating transceive. That little incident convinced me that Radio Rebelde was actually a CM/CO amateur station in disguise.

As May wore on, I could hear both Radio Abdala and Radio Rebelde two to four times per week. I began to note that David was being subjected to "jamming" of a sort, such as swishing vfos and rough ac-modulated tones almost zero beat with his signal. At the time, I merely chalked these up to noodle-brained stateside hams.

On May 24, I caught a new voice on 7090 kHz from 0152 to 0159 GMT. This speaker was definitely not David, but another Spanish-speaking OM attacking Castro. At sign-off, I caught a clear identification as "Radio Libertad Cubana," the station supposedly "united" with Radio Rebelde. I felt exhilaration as I realized that David was not alone, that there were others inside Cuba who were working with him. And the very next night, May 25, David and Radio Rebelde were back on 7090 kHz until 0300 GMT.

About this time, I was seized with an almost irresistable urge to communicate somehow with David, to let him know that his message was being heard outside the boundaries of Cuba. From several sources, I was able to form what I feel to be a reasonably accurate guess as to the true identity of David and his amateur callsign. Writing a letter was obviously out, due to the chance it could be intercepted by Cuban authorities. I toyed with the idea of ignoring several FCC rules and using AM phone on David's frequency, sending him greetings in Spanish. I decided, however, to stay within the rules.

In retrospect, I wish I hadn't.

Things came to an abrupt head on June 2. At 0235, I caught David and Radio Rebelde on 7080 kHz, 10 kHz lower in frequency than normal. His subject, as near as I could determine with my limited Spanish, was the growing influence of Castro in Venezuela and his designs on that nation's large oil supplies. But, at 0238, he was suddenly QRMed by an English-speaking OM using the call CM2HB, calling CQ for stations in Europe. CM2HB was using SSB, but his signal was so perfectly placed atop the AM signal of Radio Rebelde that he could be copied without using a product detector. CM2HB and Radio Rebelde were identical in strength, and CM2HB continued to call CQ for several minutes. The operator of CM2HB

had to be aware of Radio Rebelde on the same frequency, and I knew his choice of frequency could not have been purely accidental.

At 0253, CM2HB got tired of CQing and left the frequency. In his place popped up someone swishing his vfo across the frequency. Through the QRM, I could hear David's voice thanking listeners for their letters. I couldn't help but wonder if this wasn't just some wishful thinking on the part of David, since if the listeners could figure out how to get a letter to Radio Rebelde, the Cuban authorities surely must also have had some inkling as to the identity of David. David exchanged bits of conversation with another Spanish-speaking station, but the talk was too fast for me to follow. Abruptly, at 0258, Radio Rebelde left the air.

I tuned the 7080-7090 kHz range for several minutes before I caught an open carrier on 7080. At 0315, Radio Libertad Cubana came on the air, picking up Radio Rebelde's theme of Cuban influence in Venezuela. I was never able to catch the name of the announcer for Radio Libertad Cubana, but it was not David's voice that I heard. I didn't get the chance to listen to much of Radio Libertad Cubana this night, for, at 0317, several stations suddenly came on the frequency, all using CW. There were four or five stations, all neatly spaced in the bandwidth of the AM signal so as to completely destroy the intelligibility of Radio Libertad Cubana. I switched my receiver into the CW with a narrow bandpass filter and found that each of these CW stations merely sent CQ over and over without signing any call. At 0325, Radio Libertad Cubana left the air and the mystery CW stations likewise ceased operations.

The rest of the evening was a confusion of jumbled activity on 7080 kHz. At 0330, I caught David's voice again, engaging in a brief QSO with another Spanish-speaking amateur using the AM mode. At 0335, Radio Rebelde again took to the air, with David this time sharing the mike with another male announcer. As soon as he began his transmission, David was jammed by a couple of other stations which began sweeping their vfos across his frequency. At 0345, Radio Rebelde left the air as David wished all his listeners a good night and thanked them for listening.

To date, I have not heard Radio Rebelde, Radio Libertad Cubana, or Radio Abdala since.

I have carefully searched 40 meters in the months since June 2, 1978, many nights, but have failed to hear David's distinctive voice once. Nor have any receptions of the three stations appeared in the bulletins of any of the SWL clubs that I belong to.

It could have been that David and his compatriots simply got tired of their activity. Or the jamming activity of June 2 could have indicated to them that it would be best to lie low for a while. A much more ominous possibility is that some of them are currently in a Cuban prison or even dead.

But if David or some of his friends should somehow read these words, I hope that someday he'll return to the air to let his listeners know that he's still all right. And if you should come across an AM station in the CW portion of 40 meters some evening, stop and listen. It could well be David. ■

✔ Reader Service—see page 211

The Miserly Mobile PVC Special

—radiates a very economical signal

A quickie-cheapie for 2m.

Richard L. Hladky AA4RH
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Summerland Key FL 33042

Want a quickie-cheapie two meter antenna for your car? One that doesn't need a ground plane, and makes a near-perfect match to the feedline? Try this:

Take a piece of RG-59/U coax, long enough for your feedline plus about ten feet. Trim the outer cover back about two feet. Carefully expand the braid by pushing from the free end to enlarge the diameter to about twice its normal size (but don't unravel the braid). Now, work the braid down over the top of the outer covering of the coax, so that the braid is folded back over itself over the outer covering. When it is all smoothed down, trim the length of the braid to one-quarter wavelength for the frequency you want (19.25 inches for 146 MHz). Tie or tape the braid in place.

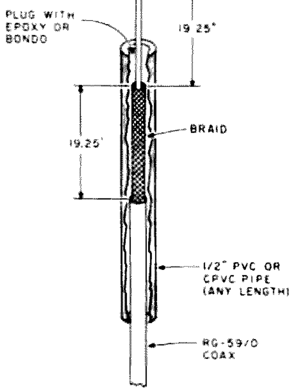

Fig. 1.

Next, cut the exposed center conductor and insulation about two inches from the folded-over end of the braid. Remove the insulation except for about an eighth of an inch. Now cut a piece of brazing rod (or #10 copper wire) to a quarter wavelength and solder it to the free end of the center conductor of the coax, with the rod butting against the insulation. Tape, or use heat-shrink tubing on the joint.

See what you have now? A half-wave antenna fed at the center, and matched to the coax it's made from.

Now take a quick trip to the hardware store and get a piece of ½" PVC or CPVC pipe. Cut it to the length you want for your finished antenna. Insert the end of the antenna through the pipe so that the rod protrudes about twelve to fourteen inches. Plug the end of the pipe around the rod with auto body filler (such as "Bondo") or epoxy. After this sets up, you can pour the rest of the pipe full of fiberglass resin if you want, but it isn't necessary if you've put a good plug in the rod end. (CPVC material seems to slow the setting of fiberglass resin, but it will set up in time.) All you need now is the appropriate fitting for the other end of the coax, and you're on the air.

The swr on my antenna is practically the same across the entire band, about 1.3:1. I have it in a six-foot piece of pipe which gets me well above the car body, so its pattern is not distorted by the metal of the car. And it is much more effective than the quarter wave I used to have on the roof. The CPVC pipe is flexible enough to bend almost double if I forget to take it down before going into the carport (but the noise is terrifying!).

The same approach works well for an antenna for the home rig, but if you're going to have a very long feedline (over about 25 feet), you should use RG-11/U coax. It's next to impossible to pull the braid on this coax back over itself, so the trick is to cut off a couple of feet of coax, take the braid completely out, expand it, and slide it over the piece you're going to use as a feedline. You can then solder the braids together, and I find it protects the outer covering of the RG-11/U if you work a small piece of fiberglass cloth under the place you're going to solder. The braid will easily expand enough to pull it over the top of a couple of layers of cloth.

This is a good project for a rainy Saturday. The antenna works well, is cheap, and, with a little care, can be made good-looking. Try it! ■

FSK Fix for the 820S

—the RTTY relay remedy

Talk up this "talk it up" solution.

Hugh Aitken W1PN
155 Amity St.
Amherst MA 01002

One of the many attractive features of the Kenwood TS-820S transceiver is the fact that circuitry for FSK (frequency shift keying) is already built in, so that the owner who wants to operate radioteletype has no need to start digging around in the vfo or local oscillator. Additionally, when in the FSK mode, one can use the very sharp 500-Hz CW filter and get really remarkable selectivity. When transmitting FSK, the rig even automatically cuts down the power to a level safe for continuous service.

There is, however, one slight difficulty. To key the transceiver, you have to arrange matters so that the FSK input is grounded on mark and open on space. This is a little different from what you may have been used to. If you own the ST-5 terminal unit made by HAL, for example, or its big brother, the ST-6, you can't just connect its FSK output to the FSK input on the TS-820S. The reason is that the HAL units provide negative and positive voltages at the FSK output—about −12 volts on mark and +12 on space. This is an excellent method for keying most transmitters, but don't try it on the TS-820S. Such voltages will confuse the diode circuits Kenwood uses to shift frequencies.

The obvious solution is to insert a sensitive relay in your RTTY closed-loop circuit and use its contacts to key the transceiver. This is what I did, at first, using a small encapsulated relay I had bought from Poly Paks. It worked fine, except that it didn't seem quite "state of the art," and also it made the required CW identification a little awkward. (Since I was no longer using my ST-5 to provide keying voltages, I couldn't use its CW ID capability.) What you end up doing is inserting a hand key in series with the relay contacts. Just remember to close the shorting lever on the key after you've completed your ID. I forgot several times and ended up transmitting a fine unmodulated carrier, but no RTTY.

There had to be a better way, and there was. If I have learned anything in fifteen years of ham radio, it's that the best way to get help with a problem is to "talk it up"—preferably on the air. That's what I did. My solution came from Gordy WB9TGB, who had had the same problem. He passed along a simple two-transistor circuit which he, in turn, had gotten from Mel WØRV.

Fig. 1 shows what is involved. You need two NPN switching transistors (2N2222 or equivalent), a couple of resistors, and a scrap of perfboard. The 12 volts dc can easily be "stolen" from your terminal unit. Note that you get your CW identification by grounding the base of the second transistor—and you don't have to remember to close any shorting lever! I built my unit outboard, but it shouldn't be too hard to squeeze it into the cabinet of your terminal unit, unless you are very cramped for space.

If you use audio frequency shift keying (AFSK), of course, none of this applies to you. All you have to do is feed your audio tones into the phone patch "in" jack on the rear wall of the cabinet. Your problem then will be quite different. Since you will be transmitting lower sideband (LSB), you won't be able to use that beautiful sharp CW filter. There is a modification to get around this problem, made available by the Dovetron Corporation, but it involves several internal wiring changes in the TS-820S, and you may not want to do that. There's no reason why you should. With this solid state relay, going the FSK route is easy. ■

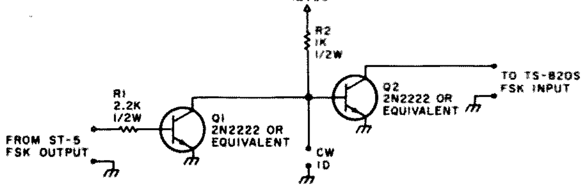

Fig. 1. An FSK relay for the TS-820S.

Richard Phenix
c/o 73 Magazine

Einstein Was Wrong!

—this story has a Mobius twist

To quote the inspiring words of that highly-placed military official in 1776, "You can't make an omelet without you break eggs."

True. Remember that near-total blackout of the East Coast in 1965? And power-outages all over New England in February, 1978? And then there were those electrical failures around Peterborough, N.H. (home of *73 Magazine*), early this year.

Well, I'm sorry! Honest. I didn't *mean* to cause them. They were just by-products of a revolution—they happened because I was working on a revolutionary step forward in the field of ham radio which now can be revealed for the first time.

I'm not going to tell you who I am, yet. (That name, above, is a phoney, as must be obvious.) There are still too many soreheads around, and I will not risk exposing myself to the mobs until my Mobius-twist, All-purpose, Synergistic, Lumped-constant circuit, Hanger-hung, Folded dipole, Phase-velocity Transcalent-Transceive System (MASLHFPTS™) is bringing happiness into the average American home.

Background

Those blackouts were simply normal side effects of my genius. They were only because of little slips of memory, actually, for I am far from inexperienced in using electrical stuff.

Electrical stuff has always fascinated me. I remember my introduction to the field, in 1934, in Brooklyn, N.Y., when I was only 14. I hooked a crystal or something up to a radiator—I forget exactly how—and heard voices! And I couldn't have been older than 20 when I was able, most of the time, to find WJZ, WEAF, WOR, and some other stations on the family wireless!

As it happened, most of the years between those early triumphs in the thirties and the Big Blackout of the sixties were devoted to other hobbies in which I also excelled—I was Brooklyn basket-weaving champion in 1939—but I kept in touch with electrical stuff through the science section of *Time* and articles in *Reader's Digest*. (Not much of importance was going on in the radio field in those 30 years, anyway.)

But then, a few years before the East Coast incident, I ran across a book which has been guiding my research in sixteen areas ever since. With regard to science, a single little-known fact published in that book brought my interest in electrical stuff flooding back. I started work on my MASLHFPTS™ at once and went all out.

East Coast lights went all out, too! Joke! (Sorry.) What I had done was to hook up my Mark I transceiver (which utilized that little-known fact) to an antenna system consisting of all of the overhead lines in Greater New York with trackage of the N.Y. Central, Pennsylvania, and Boston and Maine railroads as the ground system. I was so eager to start operating that I didn't check out the circuits, but plugged in the power supply (the main generator of Con Edison) and blooey!

I had forgotten to fuse it!

Now look, I've already said I'm sorry. And please note: Each of the other outages, in 1978 and 1979, affected fewer people than the one before. If that's not progress, I don't know what you *want*!

Oh, yes, the little-known fact. I shall quote it exactly as it appears in the book—and you can check it out yourself.

*...electricity will pass through copper wire at the rate of two hundred and eighty-eight thousand miles in a second of time—a velocity greater than that of light.**

And on the very next page (p. 910), that vital information is augmented by reference to the "electric fluid" which gives rise to the

**The Circle Of Knowledge*, "Essential Facts of Everyday Interest in Nature, Geography, History, Travel, Government, Science, Invention, Education, Language, Literature, Fine Arts, Philosophy, Religion, Industry, Biography, Human Culture, and Universal Progress," Henry W. Ruotf, M.A., Litt.D., D.C.L., Editor-In-Chief. The Standard Publication Company, 1919.

appearance of lightning, and its velocity, which

. . . is not less than two hundred and fifty thousand miles per second.

Well, I ask you! With this knowledge of more rapid electricity than was recognized anywhere and of the existence of a fluid form of the stuff, what couldn't I do?

I won't bore you with all the difficulties of those early years of the development and microminiaturization of the Mark I MASLHFPTS™. I had to revise all of Einstein's formulas, too, of course, and gradually build up my knowledge of ether (which obviously does exist, after all; I have renamed it GLOP—for Global Lubrication Of Power), but I will share with you one discovery which will help you over any difficulties you may have in accepting the fact that relativity is a lot of bunk.

Einstein was secretly an associate of Bitten, Batten, Button, Distribution, and Ozymandias, that Madison Avenue firm which had the Waltham, Transworld, and Ivory accounts! He dreamed up his concepts of time, velocity, and size simply in order to sell watches, plane tickets, and the Large Family Size!

(Yeah, I thought that would shake you. I found out because I'm also an expert in advertising, mention of which leads me to the next phase of my research, the development of the Mark II MASLHFPTS™, the heart of which was my 1954, 18", black and white Philco TV set. I selected it because of that advertising slogan. You know, "You can be sure—if it's Philco.")

By early 1978, I had charted the lines of flux of the electric fluid at my QTH and had developed the Mobius-twist™ component of my antenna. This produced the well-known single-sided band which, naturally, provides constant resonance at all frequencies. I wanted to watch the Bruins playing hockey on Channel 38, but my Philco wasn't VHF—just UHF. (Or vice versa; I always get those two mixed up.) Anyway, in my mulling over this problem I suddenly remembered that 8 plus 9 plus 10 plus 11 adds up to 38! There was my answer!

Eagerly, I hooked up Channels 8, 9, 10, and 11 in series, attached my antenna, and plugged in. Blooey! I had barely glimpsed Yastrzemski, I think it was, poised for a slapshot, when the lights went out in Connecticut, Rhode Island, Massachusetts, Maine, New Hampshire, and Vermont.

I had forgotten to hook in my Adjustment Circuit Box!

Back to the drawing board, so to speak.

But good comes from everything, and as I rebuilt the blown parts, I was able to perfect a modification, the NN™ (No-Noise) attachment, which provides 100% effective rf suppression—no non-ionizing radiation on any band.

And so it was that by February of this year my Mark III MASLHFPTS™ was an almost-fully-tested QRN-free, all-mode transceiver, covering all bands from 12 Hertz (VVLF) to 300,000 GHz (Ultra SEHF). (It was possible to go below and above these frequencies, but under 12 Hertz I kept falling asleep for some reason, and over 300k GHz something kept happening to my eyeballs.)

Only one last step remained to prove the value and reliability of my Mobius twist and the Adjustment Circuit Box: turning it on. I flipped the GPMT switch (giga-pole, mega-throw) to Channel 4271 and powered it . . .

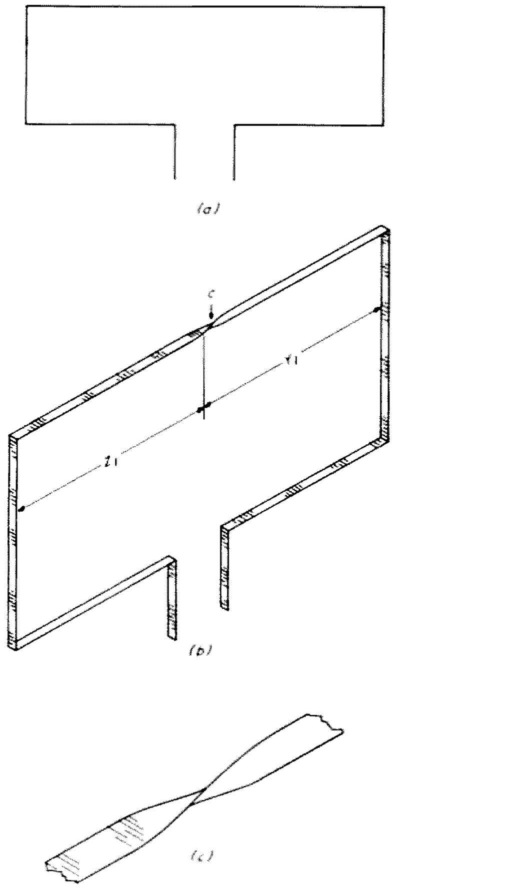

Fig. 1. (a) Schematic of Mobius-twist™, folded dipole, hanger-hung receive system. (b) Isometric presentation showing the location of the twist, with Z_1:Z: :Y_1:Y (see equation in text). (c) Detail of the twist.

Well, the blackout in Peterborough is hardly worth mentioning (no newspapers outside of some in N.H. and Boston did), but in the midst of some strange vibrations which made vision difficult, for about 72 seconds I watched the most incredible sight: The pictures coming in on my tube from the studios of the MGBC (Mars Galaxy Broadcasting Company) were in *color*! Yes, in *color*! I reached for the PTT unit to ask how come and blooey!

The blackout was nothing; the tragedy was the fire in my shack, for I had been forgetful again.

Construction

Nobody is perfect; there is this one component with which I am having difficulty and with the rebuilding of which I am going to ask your help. We'll get to it. But first, let's cover the *obvious* construction—the OB construction, I call it. (The other is the ŌB construction.)

Fig. 1 shows the basic receive system. So long as the total length of the Mobius strip is exactly L as in the following formula, it is not critical whether the unit of measure is the inch, chain, furlong, hand, or fathom. L can be made up of ells, even. Joke! (Sorry.) But L must = (300,000 GHz − 12 Hertz)/X(Z−Y), where X is the altitude of your QTH and Z and Y are its latitude and longitude, respectively. (If your shack is in Death Valley or elsewhere below sea level, it is

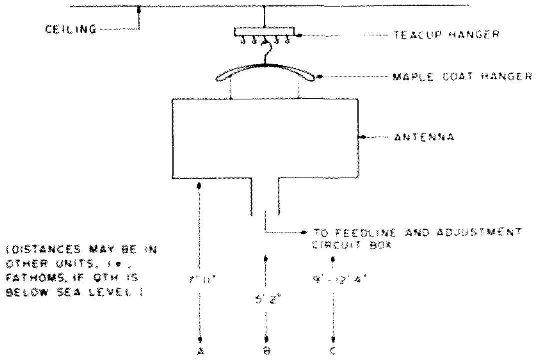

Fig. 2. Parts placement for the antenna array, and linear relationships to ambient resistances, resonances, and other wave influences. A—walnut bookcase; B—steel file drawers; C—bathroom pipes (find mean distance).

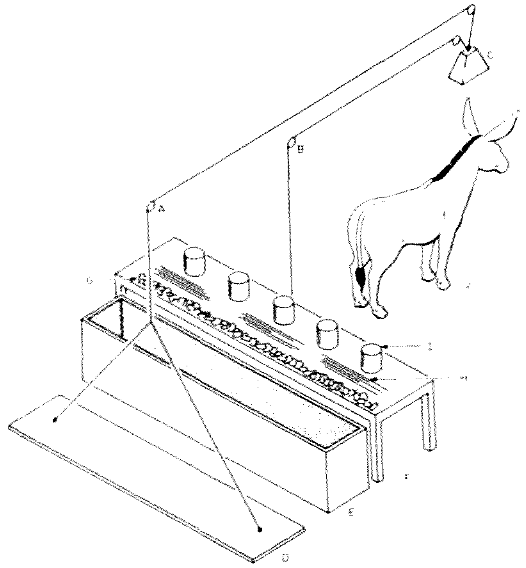

Fig. 3. Setup for the three steps. A—pulley system to jerk up cover (D) of Adjustment Circuit Box (E) when B, pulley system to weight (C) drops weight when mule (J) kicks over table (F) sending flying G—all components from your junk box, H—copper wires of assorted lengths, and I—pots of molten solder, into the perfboard-lined Box and onto the cover as it flies up and over. (Note: Weight C should be positioned to hit mule J on head to keep him calm until ready for the next setup.)

recommended that you use fathoms.)

Fig. 2 shows the critical distances between the Mobius twist and those elements which my experiments have shown provide the most favorable reception. Substitution of some materials is OK. The bookcase, for example, may be made of ebony, balsa, Hawaiian monkey pod, or Guamanian ifil instead of walnut, but the steel file drawers *must* contain from 36 to 42 back issues of *73 Magazine*; back issues of *Ham Radio* produce QRM, QRN, QSB, QSD, QTA, and 1-1 conditions.

The other important item is the Adjustment Circuit Box. It must measure exactly 2' x 2' x 8' inside dimensions, with all six interior surfaces covered with perfboard. Consult Fig. 3 and assemble all parts as shown.

Well, here is where your help is needed. You see, I was so anxious to get my transceiver operable that I plumb forgot to diagram or list, as I installed them, the diodes, triodes, tetrodes, pentodes, octodes, pigeontodes, resistors, transformers, inductors, solenoids, thyristors, shields, spark gaps, fuses, piezoelectric crystals, and switches!

Silly me!

But if you will do as I shall do, complete a setup as in Fig. 3, and follow the three simple steps listed below, one of us will *have* to come up with the internal electrical stuff for the Adjustment Circuit Box just as I had it arranged before the fire last February.

Step 1. Back a mule up to the setup and then annoy him.

2. Let the solder harden, plug in the circuit, and see if it works.

Step 3. Set everything back up again, and go back to Step 1.

Conclusion

There is one at every hamfest, and, Buster, I can hear you now, saying, "It won't work!" OM, you have forgotten the well-known fact that if a few thousand monkeys are provided with typewriters, sooner or later they will write the complete works of William Shakespeare.

All we have to do is to make monkeys out of ourselves by following the steps, and after some unknown number of mule-kicks in the future, that one last, essential component for the MASLHFPTS™ will be recreated.

And *then*, by golly, I'll be able to figure out why that MGBC program came in in color. ■

✓ Reader Service—see page 211

An 8-Bit DPDT Digital Switch

—many uses

Welcome to tristate.

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A couple of projects requiring the eight-bit output from an ASCII keyboard have been completed at W1SNN. These are an ASCII-to-Morse converter and an ASCII-to-Baudot translator.

A Southwest Technical Products KBD5 keyboard was purchased for the first of these two units, and later, when a television display and microcomputer from the same source were added to the station, the keyboard was included in the display framework. It is a considerable task to disconnect the keyboard each time the other units are used. Some might say why not use the microprocessor in the computer to eliminate these two peripherals. I thought of that, but also remembered the time and effort spent on them and decided that some means of switching the eight-bit output wouldn't be too much of a task.

By using tristate quadruple bus buffer gates with three-state outputs, as is often done in the microprocessor data input and output streams, it is very easy to reroute the eight-bit output from the keyboard to either of the aforementioned peripherals and to use the TV display to read what is being sent.

The bus buffers are 74125 and 74126 chips. The inputs of these devices are paralleled and fed into the eight-bit inputs of each of the external units. The ASCII-to-Morse unit does not require the full eight bits, and two of the buffers are unused in this requirement; however, they are all used in the other unit. Additional buffering was added to the bit stream output of the keyboard to reduce the load to the keyboard translator chip, which requires only one TTL load per bit.

Tristate buffers operate so that when the control input of each of the 74125 gates is high, the output is disabled; simultaneously, the 74126 outputs are low. The switch action therefore is completed. Control of the logic is from switch S1 which can be mounted near or on the keyboard.

As shown in the flow diagram, the data from the keyboard is directed into one or the other peripheral devices and into the television display. It may also be fed into the parallel input of the SWTP 6800. This operation provides "canned" sentences for retransmission recalled from the memory of the microprocessor.

There are many types of tristate chips available. I am sure that, by the time this is printed, it will be possible to find one LSI that will do all of the functions described. The ones used in this circuit are inexpensive and readily available from dealers found in the ads of this magazine.■

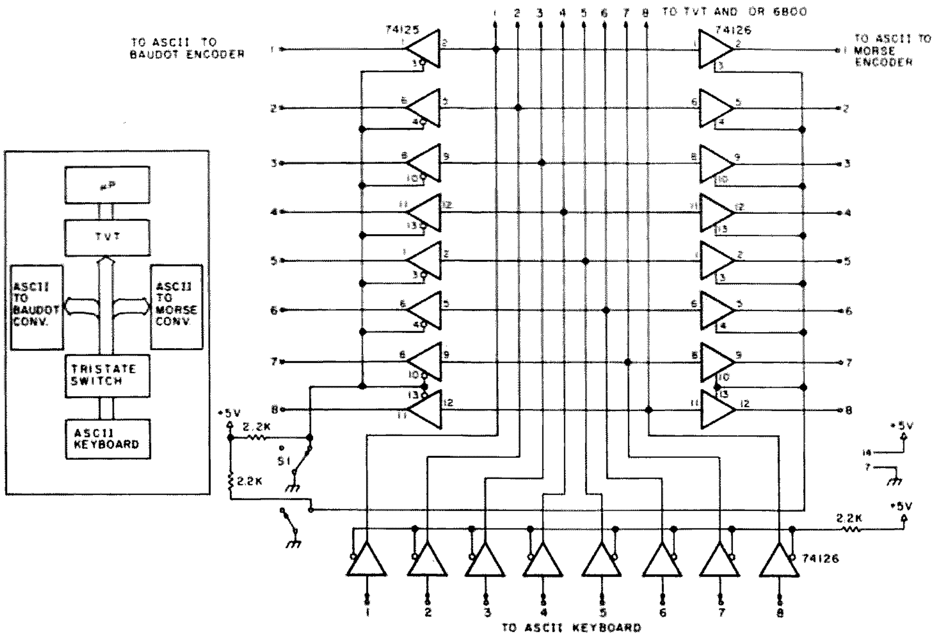

Fig. 1.

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Indianapolis IN 46219

Get a Piece of The Rock

—a DXpedition to Gibraltar

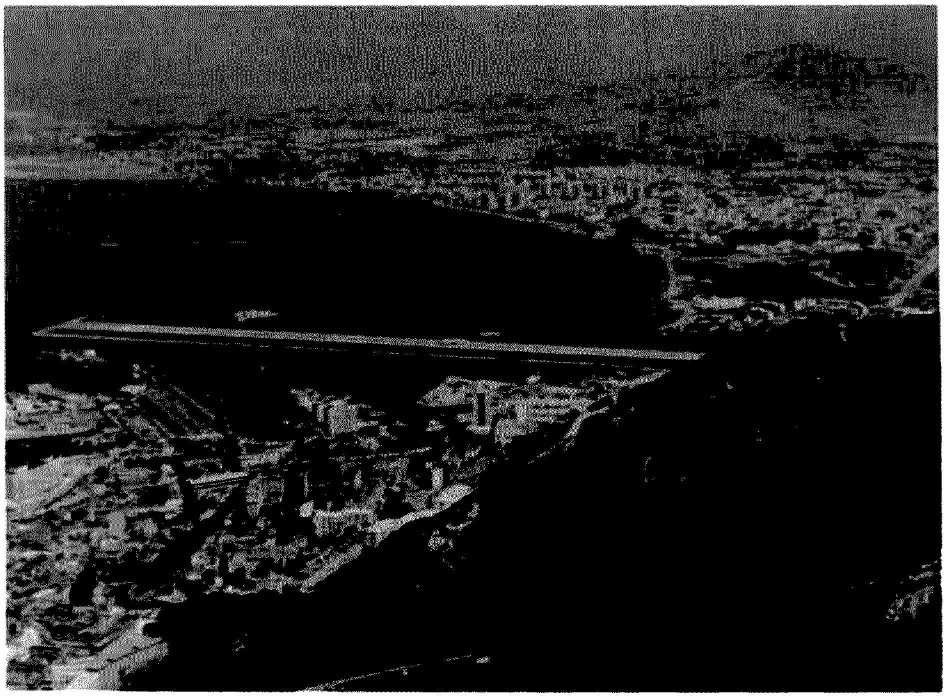
Slow careful CW, calling CQ, "de WDØEDX."

"This must be a fairly new ham," I thought. "I'll give him a new country." I called at 10 wpm, and back he came and said, "Where is Gibraltar?"

There I was, sitting in the shack of Jimmy Bruzon ZB2BL, which he very kindly loaned to me for a few days for my '78 ZB2CS expedition. In '73, I had operated from the Caleta Hotel on the east side of The Rock. In '75, I was on the west side of The Rock at the Montarik Hotel, and in '78, I was lucky enough to have Jimmy's quad to help things along.

Twenty meters was in fine shape in late July and the USA was roaring in. I slid up to 14.285 for some SSB operation. This time I was going to work a lot of Generals that I had not picked up before. One of the first was WA2PYI, who had just received his General and reported that I was his first SSB contact, his first ZB2, and his first DX. At the other extreme, W1HZV confided that in 46 years on the air, I was his first ZB2.

SSB signals from the USA are fantastic in Gibraltar. US hams are excellent operators. On a stand-by, the QRM was fierce, but when I went back to one station, everyone else was silent. The only times there were any problems with several talking at once were when conditions were marginal and some probably were not hearing me well enough to know who I was trying to work. A number of 6s and 7s came through well, and even KL7HRN was readable through the east coast curtain. It is possible, with a little concentration, to pick up 4 or 5 calls in a pileup and then work all of those before picking up more. This was not during a contest, but I was trying to work contest-style to contact as many as possible. About 50% of the people I worked said I was a new country for them. This is a real pleasure for one who is accustomed to being a run-of-the-mill W9 on the other end of the pileups.



This view shows the town of Gibraltar, left, the airstrip, center, and the town of La Linea, Spain, beyond the airstrip.

Gibraltar is probably best known through the efforts of The Prudential Insurance Company and its slogan, "Get a Piece of The Rock." The model that Prudential uses in TV advertising is only about one-tenth of The Rock. The Rock actually extends about 3 miles to the right of the model as shown and the airstrip is at the foot of the model just to the left. The concrete runway has one end in the Bay of Gibraltar and the other end in the Mediterranean. After considerable air travel, this is

the only place where I ever saw a jet airliner put the jets in reverse while still 100 feet off the runway. I found out that the British Trident is one of the few airliners to be able to handle this condition.

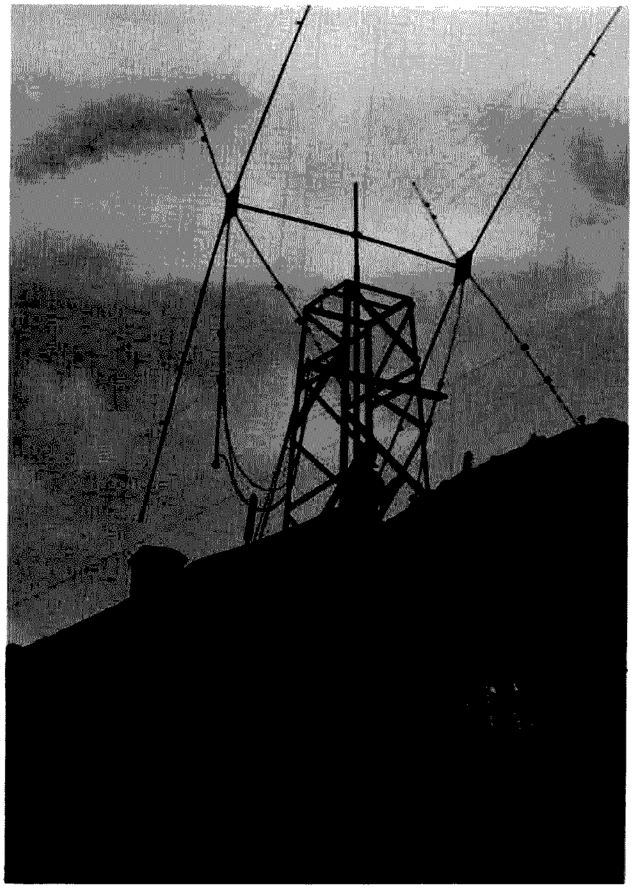
On one trip to The Rock I made the mistake of taking in three cardboard cartons of radio gear. This was impounded by customs, and I had to wait 24 hours while officialdom made a ruling that I could get it back. If your gear is in a suitcase, there is no problem.

A license is not hard to get. The postmaster is in charge of such things, and a letter in advance with a copy of your personal license is enough. The fee is about $2. Almost 200 ZB2 calls have been issued, but most of them are British servicemen long gone to other duties, and a scattering of occasional visitors like myself who show up once every few years. The most recent visitor, a few months ahead of me, was Ken Palmer K2FJ/ZB2C, who ran a Gibraltar expedition in February '78. An important consideration to remember is that Gibraltar power is 50 Hz and 250 volts only.

Parts and accessories are hard to come by. Almost everything must be ordered and shipped in; duty, plus the shipping costs, all add to the expense. Jimmy ZB2BL is a TV service man and is able to get ahold of some electronic parts, but there are needed items which normally are not in TV stock. There is a hi-fi store on Main Street across from the Montarik Hotel which has Kenwood 520 and 820 transceivers for sale at considerably higher prices than here in the USA. If one didn't mind the extra expense, it would be possible to fly in and buy equipment locally to get on the air.

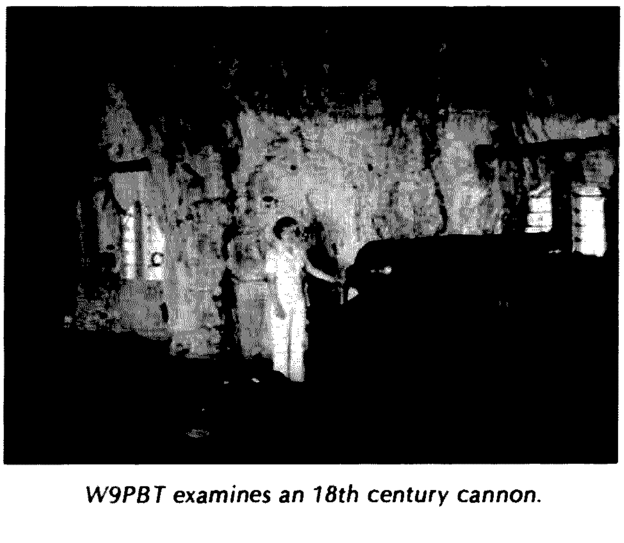
Gibraltar's people are bilingual. The schools and all public business are officially conducted in English. Everyone speaks Spanish most of the time, however. The well-educated people speak both quite well. With American or British visitors, they speak English all the time. They switch back and forth when speaking to each other. The reason, they told me, is that some ideas are expressed better in one language and other ideas better in the other.

Gibraltar is isolated; it is a peninsula connected to Spain. There is a road, but the gates were closed by the Spanish government ten years ago and no one is allowed to pass through.

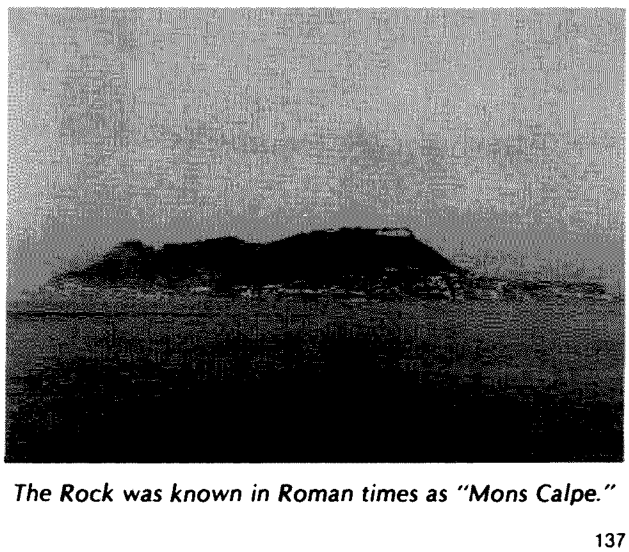


This is the ZB2BL triband quad with its owner.

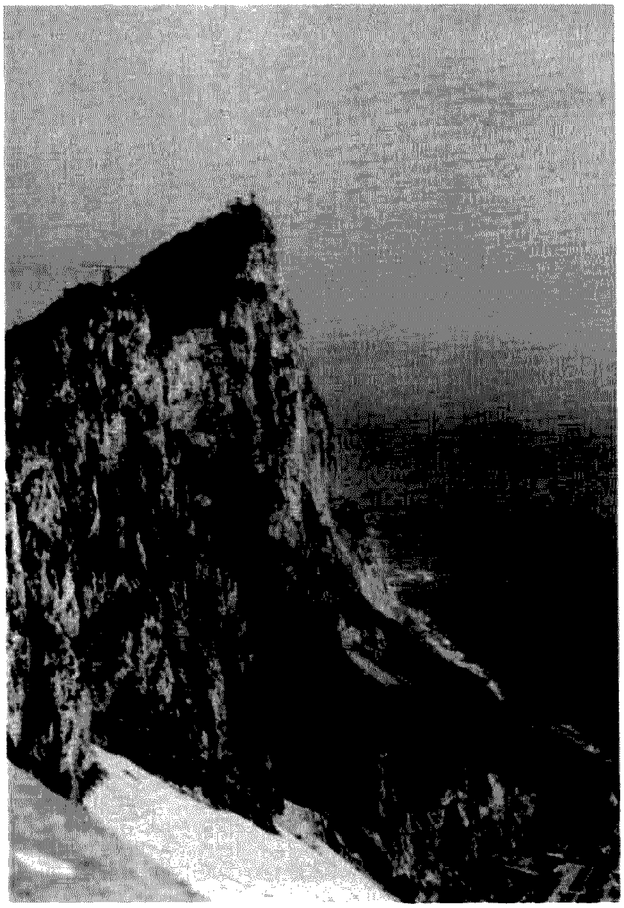
Many residents of The Rock have relatives and friends in Spain. In order to visit they must take the boat across to Tangier and then back to Algeciras. This means a considerable cost in money and time to make what should be a simple, inexpensive, short trip. Spain wants control of The Rock. The closing of the gates is part of a move to get the British to leave. The citizens of Gibraltar much prefer English rule, and many of them are of British descent.



W9PBT examines an 18th century cannon.



The Rock was known in Roman times as "Mons Calpe."



The eastern face of The Rock.

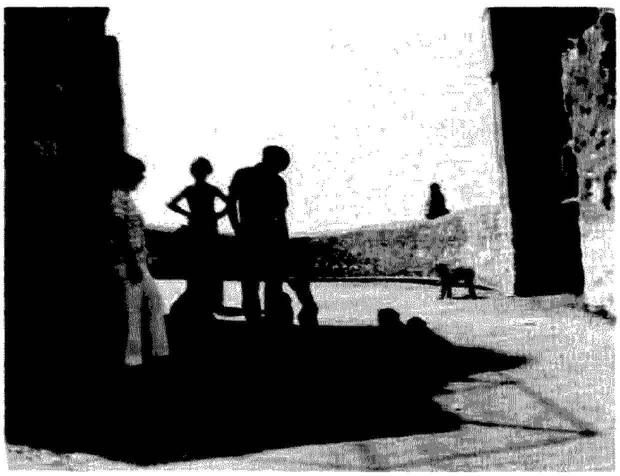
The only time the gates are opened is on the rare occasion when a critically-sick person is taken through to the Gibraltar hospital. There is no commercial or tourist traffic allowed.

The Rock apes are known far and wide. These are really monkeys in terms of size, but since they naturally do not have tails, they are classified as apes. With the rise of human population, they are concentrated in one area known as the apes' den. The British Army looks after them and supplies food and medical attention. They can be tricky rascals, stealing cameras and purses, and at times they bite. It is best to be careful when around them!

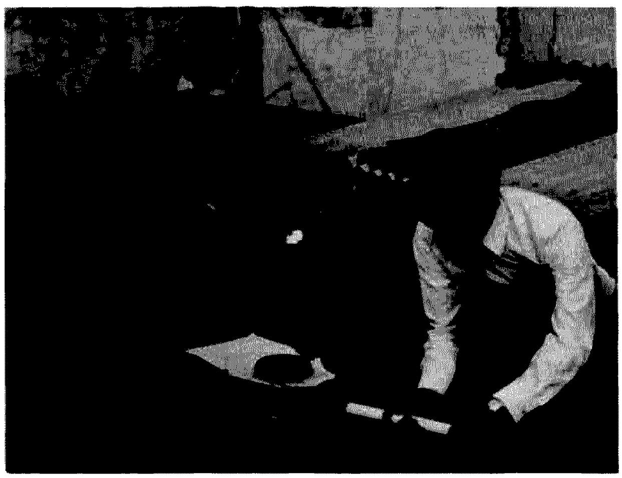
There are plenty of good hotels and restaurants available. The population is about 18,000 and there are stores, bars, banks, and all the normal activities of any medium-sized town. Ham radio from Gibraltar is quite interesting, as one is in demand and a pileup starts in a hurry. About half the people I worked wanted a card for a new country. A transceiver and a dipole are plenty. There are several places to set up—in hotels, up on The Rock, or even in a rented car for mobile operation. From the south end of The Rock at Europa Point one has a clear shot in all directions.

One place which might look good is the top of The Rock, but it is no good for HF work. Apparently due to the almost vertical cliffs falling away on two sides, the angle of radiation is not useful for DX. It has been tried with very poor results, while at lower levels, signals were strong both coming and going. The top is good for VHF. As a matter of fact, the Gibraltar Amateur Radio Club was planning a 50.3 MHz beacon to be placed in operation from the top of The Rock before the end of 1978. An earlier beacon on 50 MHz was heard over much of the eastern part of the USA in early 1978, and all the reports from this success have encouraged a better effort.

My wife, Milly, had a good time shopping in the Gibraltar stores for things to bring home to our four daughters and two grandsons. After three trips to Gibraltar, I have two very good friends there, and this time we had even more social get-togethers as my wife came, too, and we saw more of the Gibraltar wives. We had dinner with Jimmy ZB2BL and Tere Bruzon, and Cecil ZB2CF and Lourdis McEwen. On my earlier visits I had met both of these ladies and formed the opinion that they did not speak much English. It turned out that they were a little shy, and I very much admire their bilingual abilities. If I could speak Spanish half as well as all of them speak English, I would be quite pleased. As it was, I managed to add a few more words to my Spanish vocabulary.



Milly Williams W9PBT/ZB2 and a French tourist watch a British Army keeper of The Rock apes.



Cecil McEwen ZB2CF and Jimmy Bruzon ZB2BL are hunting for a defect in a loading coil.

Jimmy Bruzon ZB2BL is without a doubt the leading amateur on The Rock. He operates the DX bands and OSCAR. He also is in charge of ZB2VHF, the beacon operation, and a real pusher behind ZB2BU, the Gibraltar Amateur Radio Club. The club has several members who are working towards licenses and a very neat new club meeting room with a Kenwood 520 about to be installed. Jimmy earns his money as a TV service man, and several people told me he is the best.

Cecil "Mac" McEwen ZB2CF has given many happy 5BDXCC hunters a contact on 75. He also works various other bands at times. He recently moved into better living quarters, but has some antenna restrictions. He hopes to get something better than his present vertical and loading coil in the air.

This is the proposed site for the new 50.3 MHz beacon, atop The Rock in abandoned fortifications.

I now have 46 countries and 35 states worked from ZB2, so I will be going again in the next couple of years to finish off a DXCC and WAS from The Rock.

For those who would like to give it a try from Gibraltar, I will be glad to offer suggestions and advice and answer questions. It's an easy place to get to and to become the center of a real pileup. Now I'm planning Gibraltar IV. ■

Easy-to-Build 220 Transverter

—simple hookup to any synthesized 2m rig

Frank Kalmus WA7SPR
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Kirkland WA 98033

One day I took a good look at my 2-meter gear and found that I had an unusual amount of 2-meter equipment but only one Midland 13-509 for 220 MHz. This disturbed me somewhat, because 220 MHz is coming up strong in this country. Having only one piece of 220-MHz equipment to choose from made me wish that there was some way I could convert my excess 2-meter gear to 220 MHz, so that I could go on all of the channels without having to buy additional, expensive, synthesized 220 equipment.

Well, it did not take me very long before I came up with a block diagram showing how I could get around the purchase of a 220-MHz synthesizer by using my 2-meter synthesizer instead, and making it receive and transmit on 220 without the external LO inputs required by many transverters. No connections are needed from the transverter to the 2-meter transceiver except for a piece of 50-Ohm coaxial cable from the transceiver antenna connector to the transverter input connector. See Fig. 1. The transverter runs off +12 volts at about 300 mA for the 1-Watt model, and about 2 Amps for the 10-Watt version.

I connected my prototype to the accessory socket of the Multi-2700. The antenna connects to the output of the transverter. That's it! All of the switching and converting is done automatically by the transverter. The decimal readout remains as is, and the MHz are converted as follows: 145 MHz is 222 MHz, 146 MHz is 223 MHz, and 147 MHz is 224 MHz. It's as simple as that!

If you want to go to 223.500-MHz simplex, you set your radio to 146.500 simplex and let the transverter do the rest. If you want to go to some repeater frequency, let's say 222.500 in, 224.100 MHz out, you simply set your 2-meter radio to the repeater output frequency (147.100 = 224.100), flick the transverter mode switch to Repeater, and bingo! You have an instant 1.6-MHz offset putting you on a repeater mode for all 220 repeaters.

You can work simplex, duplex, reverse, and listen at any repeater input frequency to find those hard-to-locate secret machines.

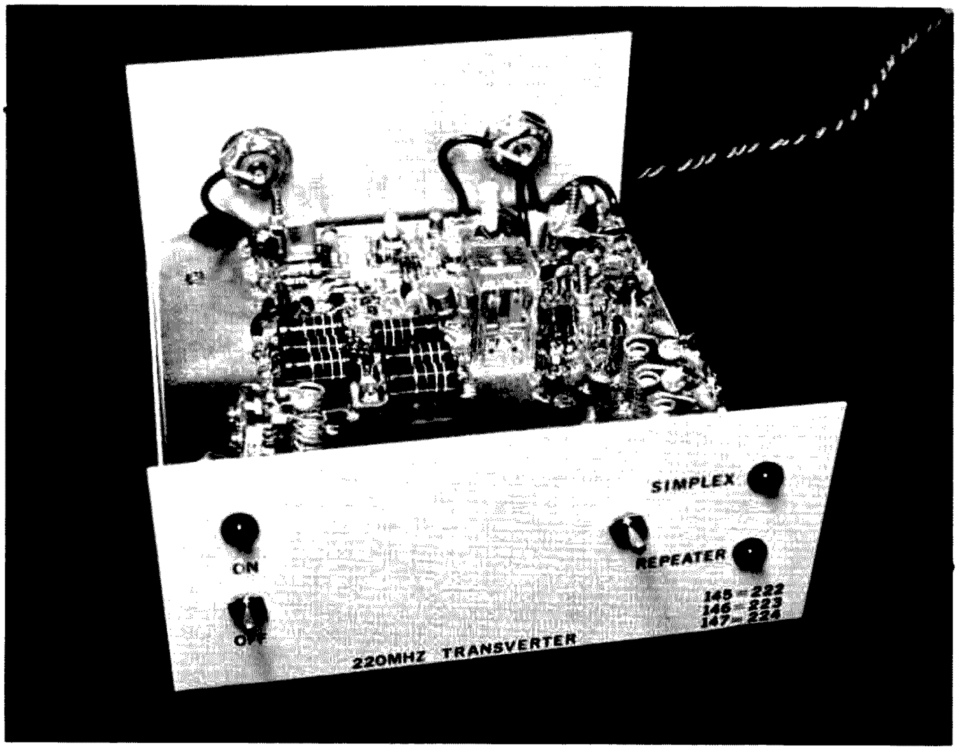


Photo A.

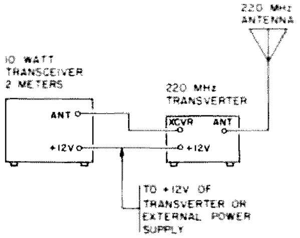


Fig. 1. Transverter connections.

Theory—How It Works

Fig. 2 shows in simple blocks the signal flow from and back into the antenna, and also from and back into the 2-meter transceiver. Fig. 3 is a complete schematic. The system is divided into two parts: the receiver and the transmitter.

Receiver: The 220-MHz signal received by your antenna is fed to a narrow bandpass filter with very low loss at 220 MHz, but high rejection at 146 MHz and all other frequencies located outside the 220-MHz band. This is required to keep strong 2-meter stations such as local repeaters from getting through the transverter and into the very sensitive 2-meter receiver. Also, the filter keeps local FM broadcast stations out of the front end of your transverter, which could cause possible intermodulation distortion.

The filtered 220-MHz signal goes through pins 6 and 5 of the T-R relay to the FET preamplifier stage. This extra stage of amplification was needed to reduce the noise figure of the transverter to about 2.5 dB instead of the 6-7 dB offered by the double-balanced mixer following it. Note that both the input and the output of Q11 (FET preamp) are tuned for good rejection and best noise figure. The gain of the preamp is about 12 to 15 dB, depending on the mood of the transistor that you happen to have in the circuit. The output is coupled directly to a double-balanced mixer consisting of D5 through D8 and T8-T9. Our 220-MHz amplified signal is now mixed with a 77.000-MHz LO from crystal oscillator Q8 through power-splitter T7, with the i-f fed to pin 9 of T-R relay K1. From here it travels to the transceiver connector, already converted to a new frequency of 223 − 77 = 146 MHz. The 2-meter transceiver connected to this terminal will eat this newly converted 223-MHz signal right up, just as if it had been 146 MHz!

Transmitter: This part proved to be much more difficult than the receiver because of the fact that we have a 10-Watt signal feeding a mixer capable of only 1 milliwatt of power conversion. Also, the signal needed to be re-amplified to a point where it was again usable for reasonably distant communications; in this case, 1 Watt, or 10 Watts, as you prefer. You may decide that 1 Watt is sufficient to

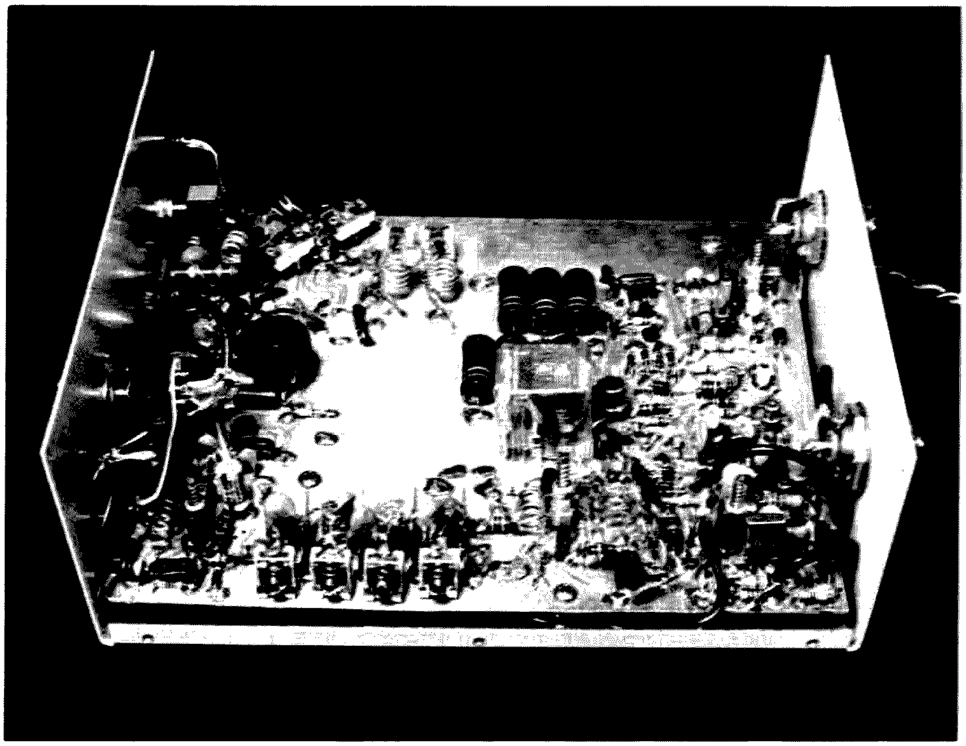


Photo B.

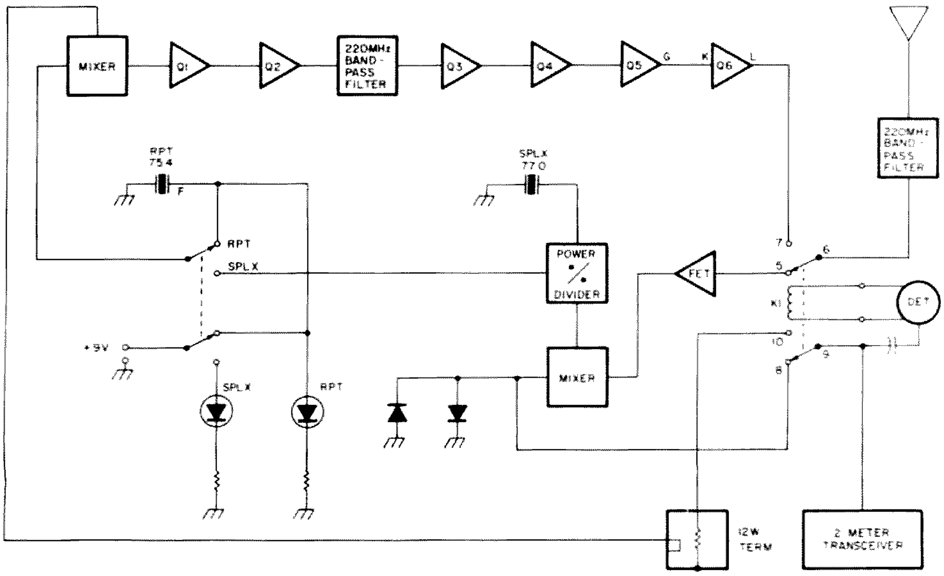


Fig. 2.

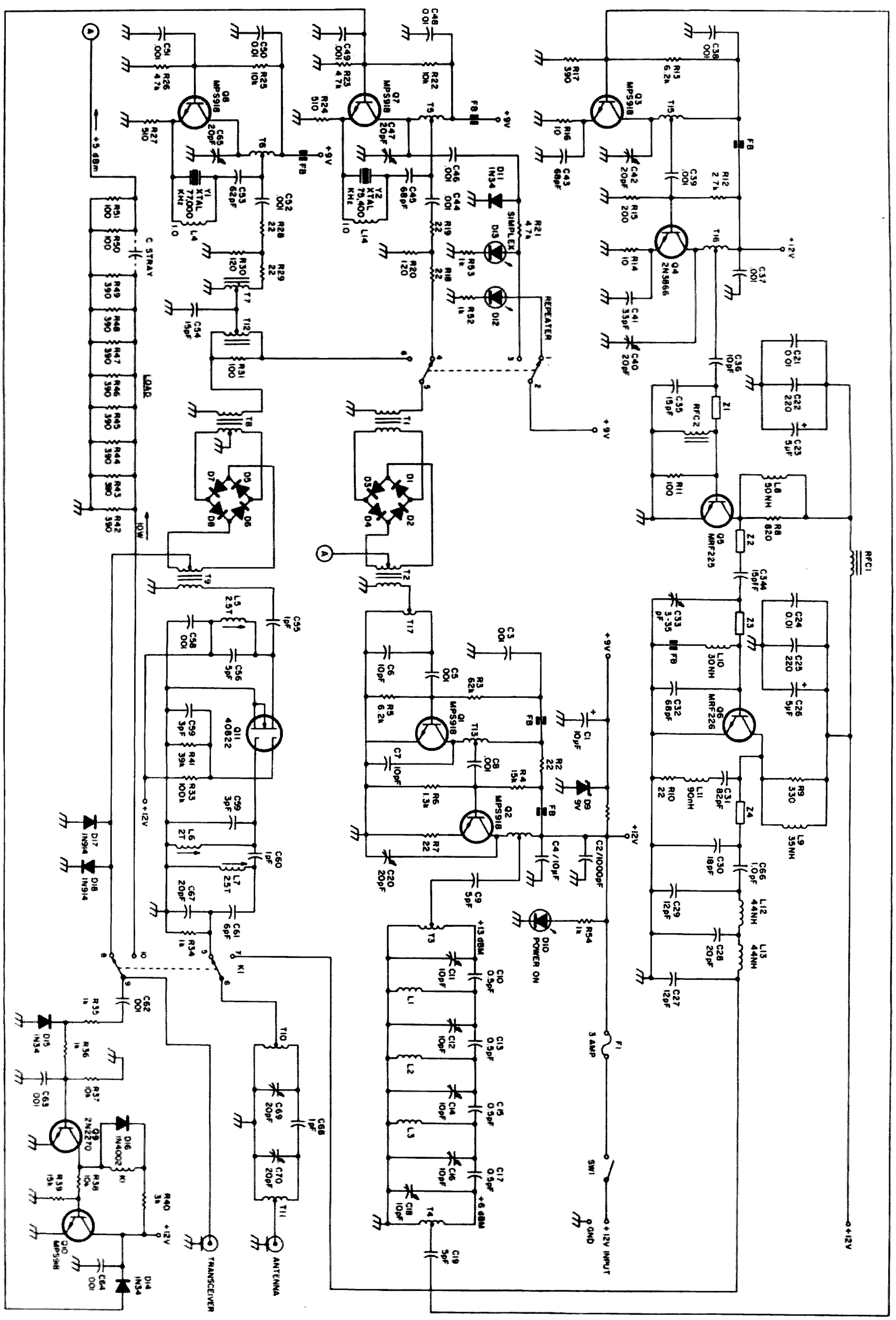


Fig. 3. Shielding beads are indicated by FB. Unless otherwise specified, resistors are in Ohms, capacitors in picofarads, and inductors in microhenrys.

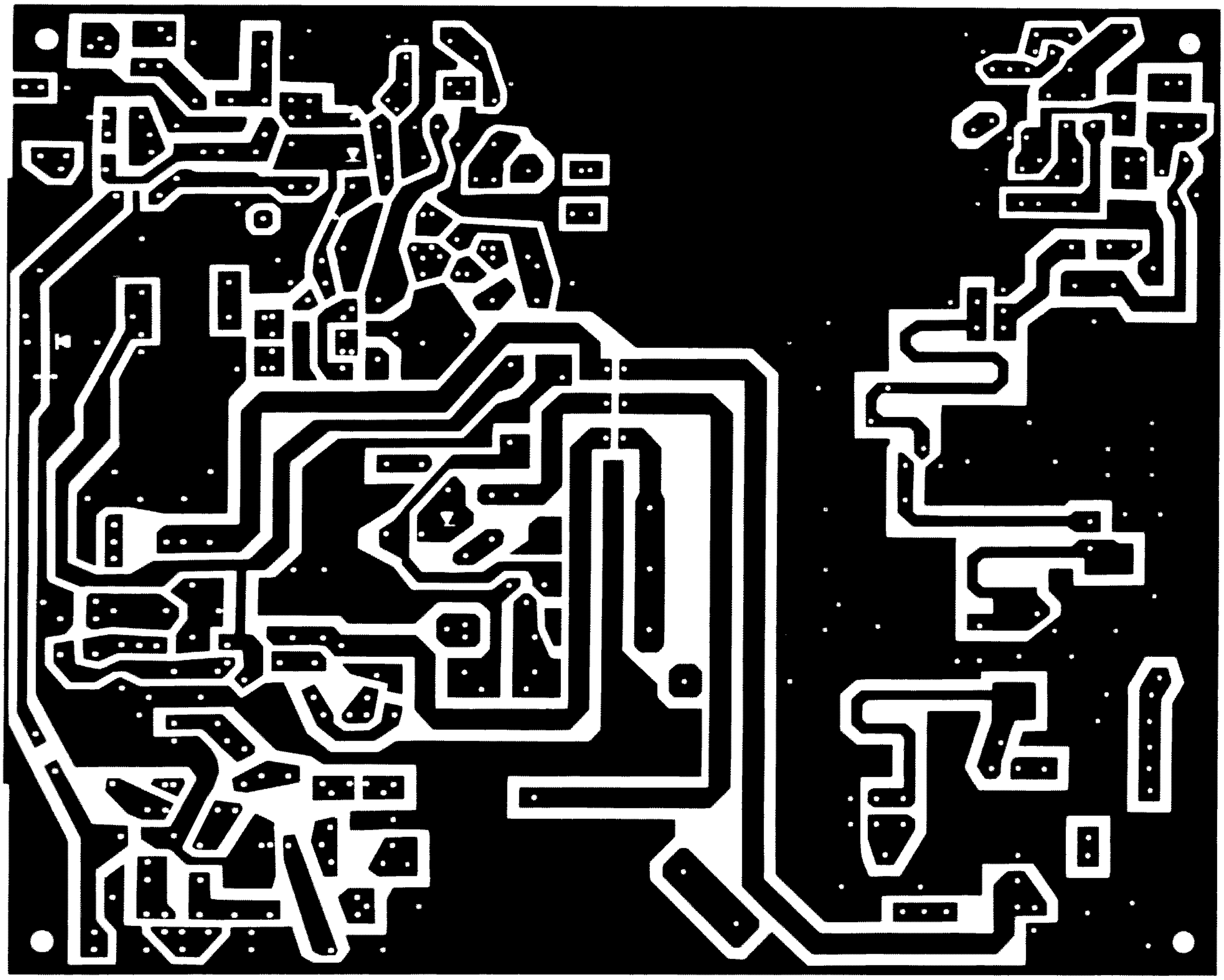


Fig. 4. Top of PC board.

get you where you want to go, or you may want to go all the way and stuff the PC board with all of the parts needed for a full 10-Watt output.

The board has been designed to make it a 10-Watt unit. For the 1-Watt selection, the last stage, Q6, is omitted and the C34 capacitor connects to pin 7 of K1 instead of to C27 and L13, as is shown in the schematic.

When transmitting, let's say on 223.500-MHz simplex, your transceiver is set to 146.500-MHz simplex and produces anywhere from 2-12 Watts. The rf power is received through the transverter input connector and is routed to pin 9 of K1. The signal is fed through the relay (pin 10) to a dummy load capable of absorbing the energy. The rf detector, D15, connected to the transceiver input signal, causes Q9 to conduct, thus pulling in K1 and consequently feeding the signal to pin 10 of K1.

Two 100-Ohm resistors in parallel give us 50 Ohms, creating sufficient stray coupling to sample about 1 milliwatt of rf energy from the dummy load. This small, 1 mW at 146.500 MHz, is fed to T2 of a double-balanced mixer (D1 through D4). With the mode switch in the simplex position on the transverter, we have selected the 77.000-MHz oscillator fed from the T8 power-splitter. The mixer upconverts the signal to 223.500 MHz at the base of Q1. Two stages of selective frequency amplification boost the small signal (about 200 microwatts) back up to about 20 mW at the input of our highly selective bandpass filter, starting with C9 and ending with C19.

This filter was necessary, not to make the transverter work, but merely to satisfy the FCC spurious-radiation specification requirement. Tuning is very delicate and could mean the difference between getting the system to work or not getting it to work. Power output of the filter should be around 1 to 5 milliwatts. The output of the filter drives Q3 and then Q4. Both stages boost the newly-converted signal up to 100 milliwatts before entering a two-stage microstrip-designed 1- or 10-Watt amplifier board. Tuning is not very critical, but care must be exercised when installing the parts. Make sure all leads are as short as possible, and that only non-inductive parts are used. Remember, this project is to be used on 220 MHz, not on 80 or 20 meters. It may sound picky, but it's not; 220 MHz is a far cry from HF, and what may work at 20 MHz will not work on 220 MHz—take my word for it. You may wind up settling for ½ Watt instead of 10 Watts, and you will be wondering why.

The output of the final

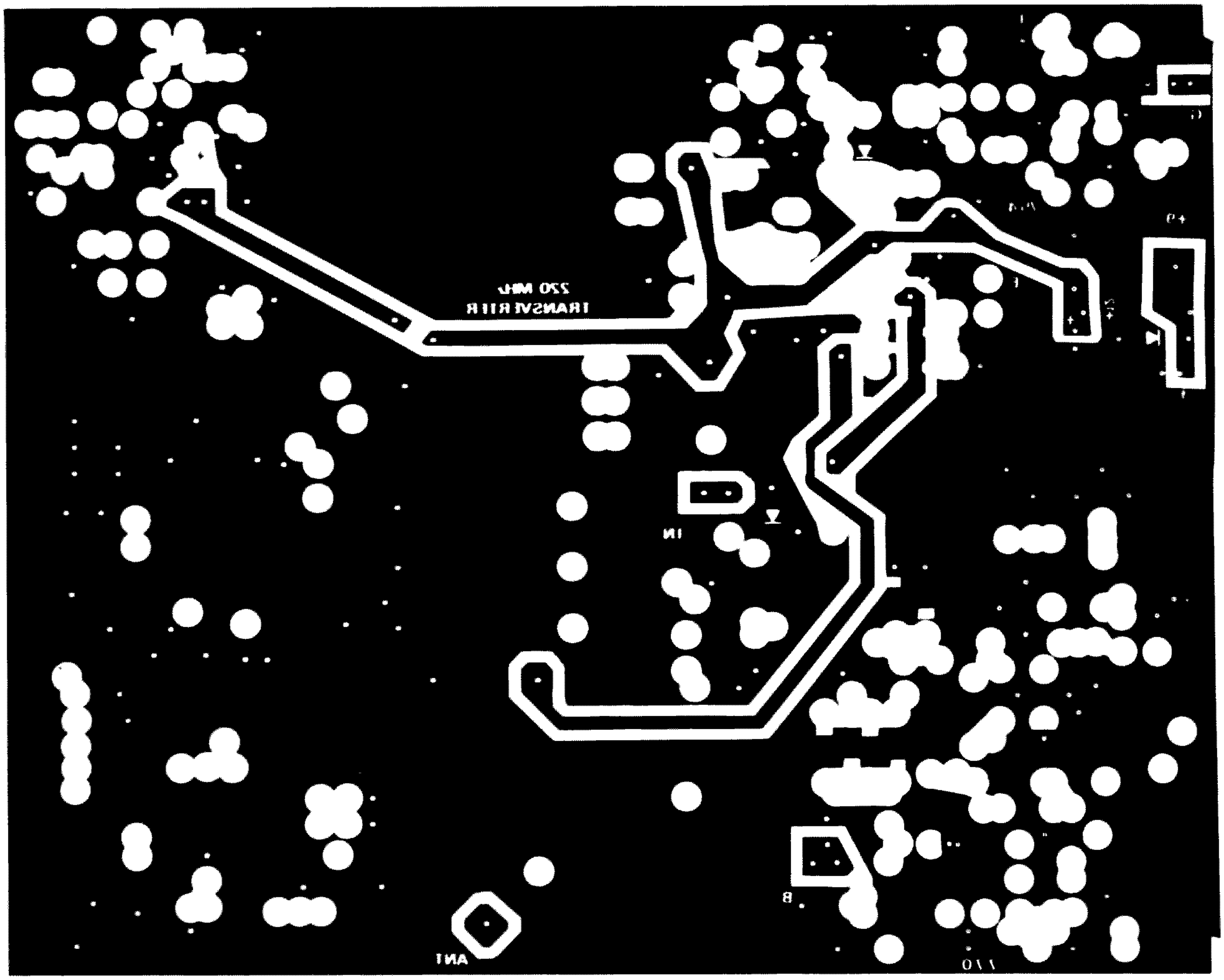


Fig. 5. Bottom of PC board.

power amplifier feeds pin 7 of K1 through pin 6 to the bandpass antenna filter and out to the coax, in the form of a very clean and respectable 223.500-MHz signal. How about that!

Should you want to work the 220 repeaters, all you have to do is to put your transverter mode switch to repeater, and forget it. The transverter automatically will select the 75.400-MHz oscillator, Q7, and connect it to the T1 mixer as before, except that the output frequency will now be 1.6 MHz lower than for simplex. The receive frequency will not be affected by this offset. It will still receive on the 77-MHz oscillator. While receiving on simplex, the 75.400-MHz LO is disabled through Q10 and D14, eliminating possible spurious responses created by the two oscillators beating. While transmitting, the 75.400-MHz LO is disabled only if the mode switch is in the simplex position. Both oscillators are powered by a 9-volt zener reference diode for good frequency stability. For extra precaution, one may want to put a diode in series with the 12-V lead for reverse-polarity protection.

One more note about the narrow bandpass filter. If properly tuned, the filter should be 4-MHz wide and pretty flat, because of later stages following the filter going into saturation amplification.

Construction

If you are going to make do with 1 Watt of power out, you will be making things a bit easier on yourself than does the ham who may want to go all the way up to the last stage of 10 Watts. The 10-Watt stage requires a little extra drilling and fitting to get the studded final power transistor in place. We will get into this a bit later.

The transverter was designed in such a way as to make it possible to assemble the entire unit on one PC board (double-sided) with only the LED lights, power switch, mode switch, and connectors to be wired after completion of the board. Foil patterns for the top and bottom of the board are shown in Figs. 4 and 5. Fig. 6 shows parts placement. I did, in fact, test and align the first unit outside the box, and later installed it into the box and completed the wiring of the final box within 20 minutes, including drilling the holes. An LMB box, no. CO-3, measuring 6″ × 7½″ × 2.75″ high, was found to be just the right size to fit the PC board with only 1/8″ of room left all around the box interior. No more extra room was needed because all of the wiring was located on the PC board. The panel LEDs, switches, and rear panel connectors did not require more than 1/8″ all around to sneak a wire through. The box also lends itself to

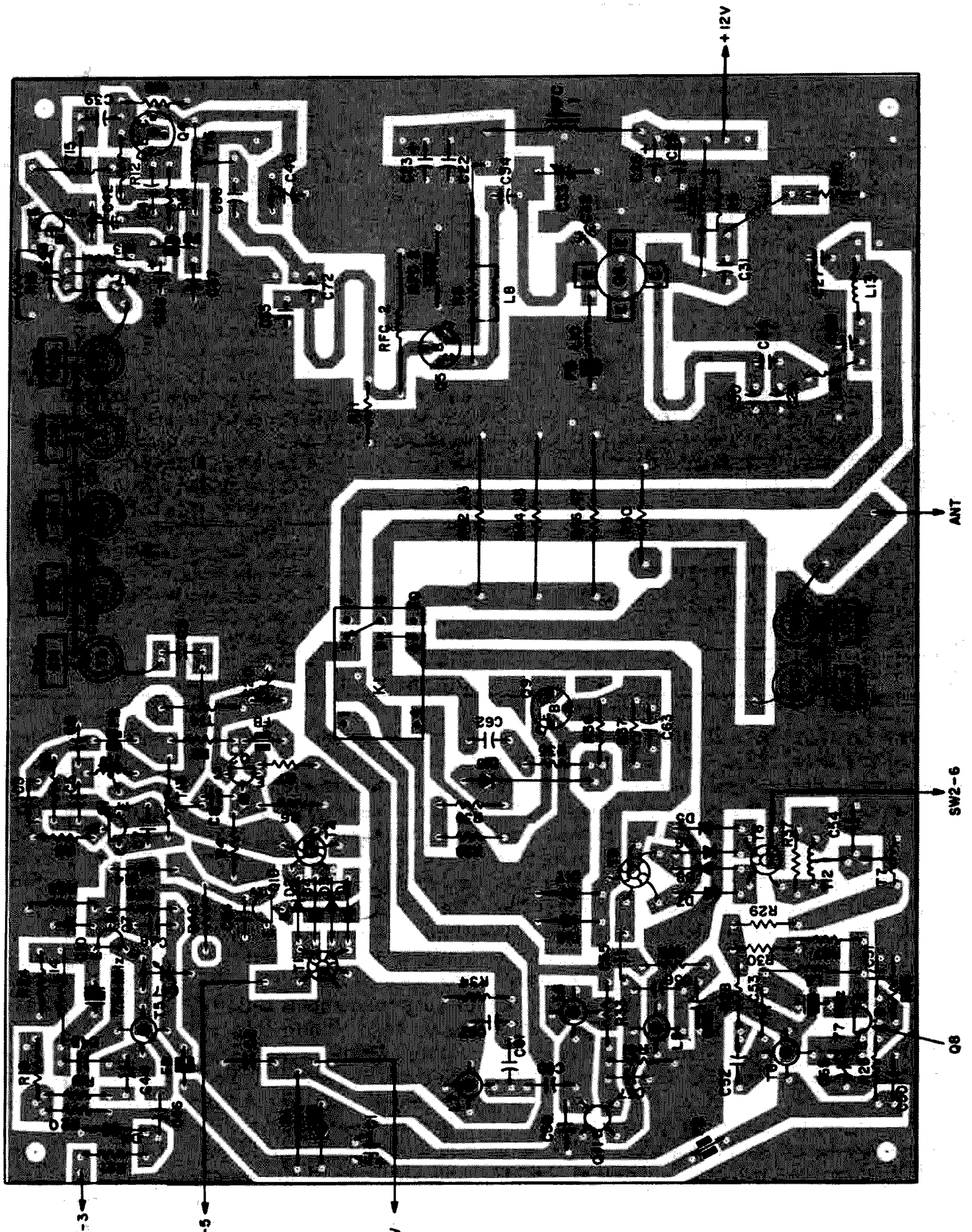


Fig. 6. Parts location.

this project very well because it has a removable top cover, enabling you to finish the wiring completely with all sides exposed. Tuning and testing will be made easy because of this. See Photo B.

The two switches and three LEDs located in the front panel take 1/4" holes, and the two UHF connectors in the rear panel can be the 5/8"-diameter type or the 4/40 mounting-screw type. They are spaced about 3½" apart and are set up about 1½" from the bottom of the cabinet, to clear the PC board. When mounting the connectors and the front-panel lights and switches, be careful to locate them in a place where they do not interfere with the components protruding from the PC board. RG-174/U minicoax is used for input and output connectors and also for the mode switch, SW2, controlling the two oscillators.

The ground braids of the three cables are connected together at the switch and are left free-hanging. The cables will be quite secure because all the connections make them very rigid. The three 1k resistors for the LEDs are connected directly to the LED terminals, and the other ends of the resistors are soldered straight to the PC ground. When soldering your components to the PC

Parts List

Part	Qty	Description
R1, 50, 51	3	Resistor, 100 Ohm, ½-W, 5%
R2, 7, 10, 18, 19, 28, 29	7	Resistor, 22 Ohm, ¼-W, 5%
R3	1	Resistor, 62k Ohm, ¼-W, 5%
R4, 39	2	Resistor, 15k Ohm, ¼-W, 5%
R5, 13	2	Resistor, 6.2k Ohm, ¼-W, 5%
R6	1	Resistor, 1.3k Ohm, ¼-W, 5%
R8	1	Resistor, 820 Ohm, ½-W, 5%
R9	1	Resistor, 330 Ohm, 1-W, 5%
R11, 31, 32	3	Resistor, 100 Ohm, ¼-W, 5%
R12	1	Resistor, 2.7k Ohm, ¼-W 5%
R14, 16	2	Resistor, 10 Ohm, ¼-W 5%
R15	1	Resistor, 200 Ohm, ¼-W, 5%
R17	1	Resistor, 390 Ohm, ¼-W, 5%
R20, 30	2	Resistor, 120 Ohm, ¼-W, 5%
R21, 23, 26	3	Resistor, 4.7k Ohm, ¼-W, 5%
R22, 25, 37, 38	4	Resistor, 10k Ohm, ¼-W, 5%
R24, 27	2	Resistor, 510 Ohm, ¼-W, 5%
R33	1	Resistor, 100k Ohm, ¼-W, 5%
R34, 35, 36, 52, 53, 54	6	Resistor, 1k Ohm, ¼-W, 5%
R40	1	Resistor, 3k Ohm, ¼-W, 5%
R41	1	Resistor, 39k Ohm, ¼-W, 5%
R42—R49	8	Resistor, 390 Ohm, 2 W, 5%
C1, 4	2	Capacitor, Electrolytic 10 uF/35 V
C2, 3, 5, 8, 37, 38, 39, 44, 46, 49, 51, 52, 57, 58, 62, 63, 64	17	Capacitor, Disc. .001 uF
C6, 7, 36	3	Capacitor, Mica DM10 10 pF
C9, 19, 56	3	Capacitor, Mica DM10 5 pF
C10, 13, 15, 17	4	Capacitor, Stackpole .5 pF
C11, 12, 14, 16, 18	5	Capacitor, Variable R-Triko 120-05, 1.2-10 pF
C21, 24, 48, 50	4	Capacitor, Disc. .01 uF
C22, 25	2	Capacitor, Mica DM10 220 pF
C23, 26	2	Capacitor, Electrolytic 5 uF/35 V
C27, 29	2	Capacitor, Mica DM10 12 pF
C28, 67	2	Capacitor, Mica DM10 20 pF
C30	1	Capacitor, Mica DM10 18 pF
C31	1	Capacitor, Mica DM10 82 pF
C32, 43, 45	3	Capacitor, Mica DM10 68 pF
C33	1	Capacitor, Variable, Arco #403 3-35 pF
C34, 35, 54	3	Capacitor, Mica DM10 15 pF
C20, 40, 42, 47, 65, 69, 70	7	Capacitor, Variable, Arco #402 1-20 pF
C41	1	Capacitor, Mica DM10 33 pF
C53	1	Capacitor, Mica DM10 62 pF
C55, 60, 66, 68	4	Capacitor, Mica DM10 1 pF
C59	1	Capacitor, Stackpole 3 pF
C61	1	Capacitor, Mica DM10 6 pF
D1—D8	8	Shottky diode, HP-5082-2080
D9	1	Diode, zener, 1N4739, 9 V
D10, 12, 13	3	Diode, LED
D11, 14, 15	3	Diode 1N34
D16	1	Diode 1N4002
D17, 18	2	Diode 1N914

board, take a little care not to push them all the way down to the ground plane; some components may have bare spots and could cause shorts across the top side of the PC board. Make sure your solder connections are good, and free from splashes. This will save you time when you get ready to fire it up. Details of filter construction are shown in Fig. 7.

The transparent rub-off lettering worked well for the marking of both front and rear panels. Make sure you put the following reminder on the front panel, as is shown in Photo A: 145=222 MHz; 146=223 MHz, and 147=224 MHz. This will keep you from guessing the new frequency after the project novelty has worn off and you can't remember the conversion formula.

If you are planning to put in the last amplifier stage for a full 10 W of output power, you will have to drill a 3/8" hole directly underneath the stud of the transistor. Place a piece of 1"x 2" aluminum over the stud before you put the screw back on it. It will act as a heat sink, necessary to keep the final cooled. You may want to add more fins to make the radiating surface larger, if you feel the transistor is getting too hot. Make sure your heat sink does not make contact with any part of the PC board that is not ground; it may cause short circuits. The PC board should be raised at least 1/4" from the deck by using four 1/4" metal spacers. This will provide sufficient clearance, and furnish a good solid ground to the chassis. The MRF225 driver transistor must also be equipped with a top-hat heat dissipator.

Alignment and Adjustment

After careful inspection to make sure that all of the correct parts have been installed in the proper places, you may proceed with the first step of the checkout procedure. All of the wires should be connected, including the lights, switches, and connectors. Should there be any serious problems, you will not have to dismantle the whole thing again. If all basic tests are positive, you may align the transverter "into the ball park," and then remove the panel gadgets and final-assemble the unit.

Last touch-up is usually easy. Take it one step at a time. With 12 volts applied to the red wire and the black wire grounded, flip the power switch to on. The "on" LED should light and also one of the mode lights, depending upon which position the mode switch is in. Flip the mode switch to the other position and the other LED should light. The total current drawn from your 12-volt supply is between 150-220 mA if all is normal.

Receiver and Antenna Filter

Tune in a known repeater on 220 MHz and hook up the transverter as in Fig. 1. Set the power switch to on and the mode switch either to simplex or repeater operation—it does not matter in the receive mode. Set the 2-meter transceiver to the frequency corresponding to the converted frequency as described earlier. For instance, if you have a busy 220-MHz repeater on 224.100 MHz, set your 2-meter transceiver to 147.100 MHz and tune C69, C70, L5, L6, and L7 for maximum S-meter reading on the 2-meter transceiver. Should you have problems, it may be that the oscillator (77,000 kHz) is not doing its thing. Usually, a few turns in either direction with the variable capacitor, C65, will get it going. All you need to do then is to put it on frequency by tuning C65 to a point that will show zero or midscale on a 2-meter discriminator meter. One more time, tune all of the previously-mentioned tuning elements for maximum signal strength. This completes the alignment of the antenna bandpass filter and also the FET preamp. Your sen-

T1, 2, 8, 9	4	Transformer, mixer, trifilar (see kit)
T3	1	Transformer, filter input, 5½T #16, .191 i.d.
T4	1	Transformer, filter output, 5½T #16, .191 i.d., tapped ½-turn cold end
T5, 6	2	Transformer, oscillator, 10T #32 on Gowanda .158, tapped 2T cold end
T7	1	Transformer, splitter, trifilar (See Kit)
T12	1	Transformer, splitter, bifilar (See Kit)
T10, 11	2	Transformer, matching antenna, 4½T #16 on ¼" i.d. tap 2T cold end
T13	1	Transformer, matching, 3T #20, .180 i.d., c-t
T17	1	Transformer, matching, 2T #20, .180 i.d., c-t
T14	1	Transformer, matching, 5T #20, .180 i.d., tapped 2T cold end
T15	1	Transformer, matching, 5T #20, .180 i.d., tapped 3T cold end
T16	1	Transformer, matching, 4T #20, .180 i.d., c-t
L1, 2, 3,	3	Coil, 5½T #16, .191 i.d.
L4, 14	2	Inductor, 1 uH, molded
L5, 6, 7	3	Inductor, variable, Gowanda #7 (.158)
L8	1	Inductor, 50 nanohenry, 5T #20 AWG on R2
L9	1	Inductor, 35 nanohenry, 2T #20 AWG on R3
L10	1	Inductor, 30 nanohenry, 1.5T #20 AWG on 0.25" i.d.
L11	1	Inductor, 90 nanohenry, 3.5T #18 AWG on .25" i.d.
L12, 13	2	Inductor, 44 nanohenry, 2T #18 AWG .25" i.d.
RFC-1, 2	2	Choke, VK200 19/4B
Z1	1	Transformer, microstrip, 2200 x 62 mils
Z2	1	Transformer, microstrip, 1200 x 62 mils
Z3	1	Transformer, microstrip, 1000 x 62 mils
Z4	1	Transformer, microstrip, 1600 x 62 mils
B	6	Bead, Ferroxcube 5659065/3B
Y1	1	Crystal, 77,000 kHz
Y2	1	Crystal, 75,400 kHz
K1	1	Relay, R10-E1-X2-V185
SW1	1	Switch, power, JBT, SPDT
SW2	1	Switch, mode, Alco MST 215
Q1, 2, 3, 4, 7, 8, 10	7	Transistor, MPS918
Q5	1	Transistor, MRF225
Q6	1	Transistor, MRF226
Q9	1	Transistor, 2N2270
Q11	1	Transistor FET, 3N202 or 40822
	1	Cabinet, LMB, #CO-3
IN/OUT	2	Connector, SO-238
	1	PC board (see kit)
	4	Spacer, ¼" brass

(For parts, PC board, etc., contact Frank Kalmus WA7SPR, 7016 NE 138th Street, Kirkland WA 98033.)

sitivity should be good—in the neighborhood of .15 uV, or so, even if your 2-meter radio is not that great. Remember, the transverter FET preamplifier is now your front end, and will set the noise figure and sensitivity unless your 2-meter radio is really bad.

Transmitter

If you possibly can do it, get ahold of any power meter capable of measuring a few milliwatts, like an H-P 430 (real cheap), and disconnect the center tap of T2. Connect a 50-Ohm resistor to ground from the end of the wire connecting to the T2 c-t. You now can fire up your transceiver in the low-power position. You should measure no more than 1 milliwatt, or so. In the 10-Watt position, you will measure 7-10 milliwatts. This is fine. If you do not get these readings, it may be necessary to change the coupling of the two 100-Ohm resistors, R50 and R51, to get more or less power sampled from the dummy load.

Once you satisfy yourself that you have sufficient drive for the mixer (consisting of T1 and T2 with the quad diode), you can proceed to the LO circuit, Q7. With the mode switch in the repeater position, the 75.400-MHz oscillator is selected. We must make sure the oscillator is working properly before we can continue. A frequency counter will help a lot—or a spectrum analyzer. (The latter is mentioned for reference only, realizing that the average ham can't afford that luxury.)

Connect the counter to R18 or pin 4 of the mode switch. Adjust C47 for a frequency reading of 75.400 kHz. You may now reconnect the c-t wire of T2 previously disconnected. Disconnect the 5-pF capacitor, C19, from T4 and measure power into an rf meter connected to this point, or into a spectrum analyzer. Tune C20, C11, C12, C14, C16, and C18 until you get some power output from the narrow bandpass filter. This is the hardest part of the tuning, and it may take several repeated efforts to get the filter to pass some rf. It is a very touchy filter, and although all other circuits are working, it might appear as if nothing was working at all. The filter can block all signals if not tuned correctly. If in doubt, disconnect the filter and bypass it to see if the 220-MHz signal is present after all of the mixing and amplification from the previous stages. If so, connect all back as before, and continue tuning the filter until you get some response. It should be possible to get 5-MHz bandpass from the filter, with very steep skirts.

The reason for the sharp filter is to reject the closely-located spurious frequencies caused by the mixer third harmonic ($3 \times 75.4 = 226.2$ MHz) and the frequency we want to process. Careful tuning will get the spurs down 60 dB. A spectrum analyzer is again the ideal toy to do it with. If all is done right, you should measure +6 dBm of 220-MHz signal at the output of the filter. Reconnect R19 and tune C42, C40, and C33 for maximum power output at the antenna terminal of your transverter. It should be about 1 Watt. If you want to go to 10 Watts and you have installed all of the necessary parts, no tuning is required. The final amplifier is somewhat broadbanded (about 10 MHz wide) and should produce about 60% efficiency when driven with 1 Watt and 12.5 volts. The output transistor is open- and short-circuit-protected for all load phase angles up to 15 V of dc input. Total current drawn by the transverter is 300-400 mA for 1-Watt output models, and 1.8 to 2 Amps for 10-Watt models. Harmonics and spurs on the prototype and first production unit were greater than 60 dB down.

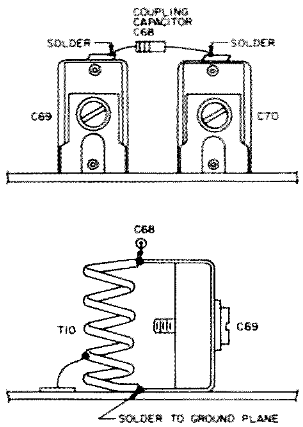


Fig. 7. Construction technique—2-section antenna filter and 5-section spurious filter.

After all checks out OK, you may proceed with the final assembly into the cabinet. Remove all lights, switches, and connectors and set the PC board inside the chassis with the crystal oscillators toward the rear of the cabinet. Mark the four mounting holes and drill them. Mount the PC board and string all of the cables through the cracks between the cabinet and the board for final wiring. You should not have to do much touching up after the final mounting process.

Putting the Transverter On The Air

After all circuits have been checked out and are working, the best way to tell what kind of a job you have done is to actually put the monster on the air and let the critical ears of your fellow hams judge you. Do not tell them what you are testing—they may be biased one way or another. If you are experiencing problems with noise or funny squeals in your 2-meter radio, it is your transverter doing it. It can be eliminated by slowly tuning one or the other oscillator slug until it stops. It will be caused by one of your oscillators putting out spurs if its tuning is not right. All you need to do now is to tune your 2-meter transceiver to simplex and let the transverter do the rest. It will put you on simplex receive and transmit if your mode switch is in the simplex position. If you want to go on a 220 repeater, leave your 2-meter radio on simplex on the repeater output frequency, but put the mode switch to repeater, and you are instantly in repeater-mode operation. You are now capable of tuning in to as many possible combinations as your 2-meter rig permits. If you have a 12-channel radio, you will have 12 channels on 220. If you are lucky and own a synthesized 2-meter radio, you will be able to play with 800 or 1000 channels on 220 MHz. Have fun, friends! I am sure having me a ball with this transverter!

The parts list is complete. All parts are easily obtainable from any local electronics shop. Most parts should be junk-box items, except for the high quality caps and Schottky diodes. A PC board is available for $14.00 from WA7SPR if you do not want to tackle your own layout. The hard-to-find toroidal transformers also are available in a small kit for $4.50 (T1-T2-T7-T8-T9 and T12). All other parts are available from the same source, should you have difficulties finding them in your area.

Total cost for the 1-Watt unit, assuming you have to buy everything, came out to about 65 bucks; it is $16 more for 10 Watts. If you have an average junk box, and wind your own coils, the 1-Watter should cost you no more than about $40. ■

✓ Reader Service—see page 211

Social Events

Listings in this column are provided free of charge on a space-available basis. The following information should be included in every announcement: sponsor, event, date, time, place, city, state, admission charge (if any), features, talk-in frequencies, and the name of whom to contact for further information. Announcements must be received two months prior to the month in which the event takes place.

BLACKSBURG VA
OCT 1-6

Two expanded workshops on 8080/8085/Z80 microcomputer design, microcomputer interfacing, software design, and digital electronics are being given by the editors of the popular Blacksburg books. Participants have the option of retaining the equipment used in these courses. Dates are October 1-6, 1979. For more information, contact Dr. Linda Leffei, C.E.C., VPI and SU, Blacksburg VA 24061, or phone (703)-961-5241).

HOUSTON TX
OCT 5-7

The Houston Area Amateurs will host the ARRL West Gulf Division Convention on October 5-7, 1979, in Houston, Texas. For further information, contact Houston Ham Conventions, Inc., PO Box 79252, Houston TX 77024, or phone (713)-466-0518 or (713)-223-3161.

SIOUX FALLS SD
OCT 5-7

The '79 ARRL Dakota Division Convention will be held from October 5-7, 1979, at the Sioux Falls Airport Ramada Inn, located off Exit 81 on I-29, Sioux Falls, South Dakota. Featured will be technical and operating forums, a ladies' program, an ARRL forum, a large exhibit area, and a banquet. Prizes include an advance-registration prize of a DenTron GLA-1000 amplifier, a grand prize of a Kenwood TS-820S and a second grand prize of a Wilson System One™ antenna and WR-500 rotor. Registration is $15.00 ($16.00 after September 1) or $6.00 for the convention only ($7.00 after September 1). Talk-in on 146.16/.76. For further information and convention-rate hotel accommodations, write Sioux Falls Amateur Radio Club, Box 91, Sioux Falls SD 57101.

WARRINGTON PA
OCT 6

The Mt. Airy VHF Radio Club Inc., will hold its Hamarama '79 and Mid-Atlantic States VHF Conference on Saturday and Sunday, October 6-7, 1979. The conference will be held on Saturday, October 6, from 9:00 am to 5:00 pm at the Warrington Motor Lodge, Rte. 611, Warrington, Pennsylvania. Featured will be an all-day VHF program, a cocktail hour and get-together, and a buffet dinner. Registration is $3.00 in advance, or $4.00 at the door, which includes the flea market. The buffet dinner is $9.00. The flea market will be held on Sunday, October 7, from 8:00 am to 4:00 pm, rain or shine, at the Bucks County Drive-In Theatre, also on Rte. 611. Registration is $2.00 with tailgating $2.00 per space (bring your own table). Featured will be amateur radio equipment, electronic parts, surplus, and door prizes. Talk-in on 146.52 W3CCX. For information, write Ron Whitsee WA3AXV, Chairman, PO Box 353, Southampton PA 18966, or phone (215)-355-5730.

CORNWALL NY
OCT 6

The Orange County Amateur Radio Club will hold its annual auction on Saturday, October 6, 1979, at Munger Cottage, Cornwall, New York. Admission is $1.00 and includes a chance on a door prize. The auction begins at 1:00 pm and sellers should arrive at noon. Talk-in on .52. For further information, contact Bill Lazzaro N2CF, 11 Jefferson St., Highland Mills NY 10930.

TAYLOR MI
OCT 7

The third annual RADAR Hamfest and Swap 'n Shop will be held on Sunday, October 7, 1979, from 9:00 am until 3:00 pm at Kennedy High School, Northline Rd., Taylor, Michigan. Admission is $2.00. Featured will be computer displays, ham gear displays, door prizes, and food. Talk-in on .93/.33, .52/.52, and .99/.39. For information, write RADAR, Inc., PO Box 1023, Southgate MI 48195.

ROME GA
OCT 7

The Northwest Georgia Amateur Radio Club will hold its annual Rome Hamfest on October 7, 1979, at the Coosa Valley Fairgrounds, Rome, Georgia. Gates will open at 9:00 am. Talk-in on 146.34/.94 and 146.085/.685. For further information, contact WB4AEG, Box 274, Adairsville GA 30103.

BERRIEN SPRINGS MI
OCT 7

The Blossomland Amateur Radio Association will hold its fall Swap Shop on Sunday, October 7, 1979, at the Berrien County Youth Fairgrounds, north of Berrien Springs, Michigan, on US 31, beginning at 8:00 am. There will be commercial exhibits, prizes, refreshments, plenty of free parking, and display space. Space for self-contained campers, at $3.50 including electricity, is on the grounds. Talk-in on 146.22/.82. Advance tickets are $1.50; $2.00 at the gate. Eight-foot tables are $2.00 and are restricted to electronic items. For advance tickets and information, write Charles White, 1940 Union Ave., Benton Harbor MI 49022.

ROCK HILL SC
OCT 7

The York County Amateur Radio Society will hold its 28th annual hamfest on Sunday, October 7, 1979, starting at 8:00 am, at Joslin Park, Rock Hill, South Carolina. Registration is $2.75 each or 2 for $5.00 in advance, or $3.00 at the gate. The main prize is a Yaesu FT-901DM. A barbecue dinner is available at the park. Talk-in on 146.43/147.03 and 146.52. For more information, write York County Amateur Radio Society, Inc., PO Box 4141 CRS, Rock Hill SC 29730.

OTTAWA ONT CAN
OCT 12-14

The Radio Society of Ontario will hold its 11th annual convention at the Skyline Hotel, Ottawa, Ontario, Canada. On Friday evening, there will be a buffet and dance. On Saturday, there will be demonstrations, forums, technical sessions, a women's program, and a banquet and dance. On Sunday, there will be a flea market and delegates' meeting. For information, write PO Box 5076, Station F, Ottawa, Ontario, CAN K2C 3H3.

SYRACUSE NY
OCT 13

The Radio Amateurs of Greater Syracuse will hold their annual hamfest on October 13, 1979, from 9:00 am until 6:00 pm at the New York State Fairgrounds, located adjacent to I-690, 3 miles southeast of the New York State Thruway, Exit 39, one mile northwest of Syracuse, New York. For commercial exhibitors, a fee of $15.00 will include a booth with a display counter ten to fifteen feet in length or a table and two chairs. Included in the $15.00 fee will be two tickets to the hamfest. Accommodations are available at nearby motels or travel trailer and motor home space will be available on the grounds. Commercial exhibitors will be able to set up their displays Friday night from 7:30 to 10:00 pm or on Saturday morning from 7:30 to 9:00 am. For more information, contact Bob Edgett or Paul Dunn, exhibitor chairmen, c/o Radio Amateurs of Greater Syracuse, PO Box 88, Liverpool NY 13088.

ASHEVILLE NC
OCT 13

The Western Carolina Amateur Radio Society will hold its Asheville Autumnfest on Saturday, October 13, 1979, at the Asheville Civic Center, Asheville, North Carolina. There will be ample space for manufacturers, dealers, and the flea market, which will be in another part of the arena. A concession stand will be operated by the Civic Center. All manufacturers and dealers will have separate booths. And it will be possible to drive directly to your booth for unloading.

MEMPHIS TN
OCT 13-14

The Mid-South Amateur Radio Association and participating Memphis-area clubs will sponsor the Memphis Hamfest and Tennessee State ARRL Convention on October 13-14, 1979, at the Youth Building at the Mid-South Fairgrounds, Memphis, Tennessee. Featured will be forums, exhibits, a giant flea market, FCC exams, a hospitality party, and commercial and manufacturer exhibits. The display area will be open from 9:00 am to 4:00 pm on Saturday, and from 9:00 am to 2:30 pm on Sunday. Fifty trailer hookups are on the premises, which the Memphis Park Commission will rent for $5.00 per night. For further information, contact the Memphis Hamfest, PO Box 3845, Memphis TN 38103, or phone Clayton K4FZJ at (901)-274-4418.

BEAVER OK
OCT 14

The Beaver Hamfest will be held on October 14, 1979, at the Fairgrounds Building in Beaver

OK. Doors open at 8:00 am, with registration at 10:00 am. Tickets are $2.50 each. There will be a covered-dish luncheon, a short program at 1:30 pm, swap tables, and door prizes. Camper hookups are nearby and the event is airport-close. Talk-in on .01/.61 and .52. For details, contact Stella Shaw WB5VUN, Box 310, Beaver OK 73932, (405)-625-3368.

LIMA OH
OCT 14

The Northwest Ohio Amateur Radio Club will hold its annual hamfest on October 14, 1979, at the Allen County Fairgrounds, Lima, Ohio. Two large heated buildings will house the hamfest where tables will be available for $3.00 each. A flea market will be held outside for free. Advance tickets are $2.00 each. For information, send an SASE to NOARC, PO Box 211, Lima OH 45802.

WEST GHENT NY
OCT 14

The Northeastern States 160-Meter Amateur Radio Association will hold its annual election and banquet on Sunday, October 14, 1979, at Kozel's Restaurant, Rte. 9H, West Ghent, New York. There will be a flea market in the rear parking lot at 1:00 pm and a roast beef dinner at 5:00 pm. All hams and XYLs are welcome. For reservations and details, contact William Derby WA5IOD, Secretary/Treasurer, 14 Plain St., Medfield MA 02052.

ISLIP LI NY
OCT 14

The Long Island Mobile Amateur Radio Club, Inc., will hold its Hamfair '79 on Sunday, October 14, 1979, from 9:00 am until 4:00 pm at the Islip Speedway, Rte. 111 (Islip Ave.), one block south of Southern State Pkwy., Exit 43, or come south from the Long Island Expressway, Exit 56, Islip, Long Island, New York. There will be free parking, door prizes, and several contests. Admission is $1.50 (non-hams are free) and $3.00 per seller's space, which permits one person to enter. For information, call Hank Wener WB2ALW, nights, at (516)-484-4322, or Sid Grossman N2AOI, nights, at (516)-681-2194.

ANAHEIM CA
OCT 19-21

The ARRL Southwestern Division Convention will be held on October 19-21, 1979, at the Sheraton-Anaheim Hotel, located at Ball Rd. and I-5, Anaheim, California. The convention will begin on Friday evening with registration and exhibits from 4:00 pm until 9:00 pm. On Saturday, registration will begin at 8:00 am and exhibits and technical sessions will run from 9:00 am until 3:30 pm. FCC testing will continue until 3:30 pm also. The ARRL Forum will be held from 4:00 pm until 5:30 pm, with a no-host cocktail party being held until the 7:30 pm banquet. The Wouff Hong pageant will be held at 00:01 am PST on Sunday morning. At 9:00 am Sunday morning the various breakfasts will be held and the exhibits will again be open until noon. The pre-registration deadline is September 15, 1979. Advanced registration price, which includes complete program, banquet, exhibits, and technical sessions, is $17.00, and $19.00 at the door. The charge for the banquet only is $12.00, and for exhibits and technical sessions, the charge is $5.00, pre-registration; $6.00 at the door. The ladies' program and luncheon is $6.00, pre-registration only. For more information and pre-registration, contact Hamcon, PO Box 1227, Placentia CA, or phone (714)-993-7140.

CEDAR RAPIDS IA
OCT 19-21

The 1979 ARRL Midwest Division Convention and CVARC Hamfest will be held on October 19-21, 1979, at the Five Seasons Center, Cedar Rapids, Iowa. Tickets are $4.00 in advance or $5.00 at the door. Forums will include FCC, ARRL, DX, antenna, AMSAT/OSCAR, FM and repeaters, microprocessors, modern CW, and more. A flea market will be held at $5.00 per table with 150 tables available. Reservations are good for Saturday and Sunday and must be paid in advance. Pre-registrations will be taken through October 1, 1979. Setup begins at 6:00 am Saturday. FCC exams also will be given on Saturday. (Send Form 610 and copy of license two weeks in advance.) There will be many prizes, including a grand prize of a deluxe HF transceiver, a TH6DXX antenna, a HAM III rotor, and a 60-ft Rohn 25G tower. There will be a Saturday-evening banquet, with Senator Barry Goldwater K7UGA as guest speaker. There are many hotels and motels available. Talk-in on 146.34/.94. For information, write Convention, Cedar Valley Amateur Radio Club, Box 994, Cedar Rapids IA 52406.

READING MA
OCT 20

The Quannapowitt Radio Association will hold its annual auction on October 20, 1979, at the Knights of Columbus Hall in Reading, Massachusetts. Doors will open at 10:00 am and the auction will start at 11:00 am. Food and refreshments will be available. Talk-in on 146.52. For information, call Bob Reiser AA1M at (617)-272-6219.

SAVANNAH GA
OCT 20-21

The first annual Hostess City Hamfest will be held on October 20-21, 1979, at the National Guard Armory, Eisenhower Dr., Savannah, Georgia. Admission will be $2.50 in advance and $3.00 at the gate, with tables for $5.00. Featured will be a flea market, ladies' programs, awards, and FCC exams. Talk-in on .37/.97, .10/.70, .28/.88, .63/.03, and 3,975 kHz. For additional information and advance tickets, write the Hostess City Hamfest Committee, PO Box 1237, Pooler GA 31322, or phone (912)-748-6125.

BILOXI MS
OCT 20-21

The Gulf Coast Ham/Swap Fest will be held on Saturday and Sunday, October 20 and 21, 1979, at the International Plaza, located at the west end of the Biloxi-Ocean Springs bridge on Highway 90 in Biloxi MS. Tables are $3 per day or $5 per weekend. Talk-in on 146.13/73 and 146.52. For information, ad-

vance tickets, and tables, contact Al Williams WD5GNR, 311½ DeMontluzin Ave., Bay St. Louis MS 39520.

NORFOLK VA
OCT 20-21

The fourth annual Tidewater Hamfest-Computer Show-Flea Market will be held on October 20-21, 1979, starting at 9:00 am at the Norfolk, Virginia, Cultural and Convention Center SCOPE, Norfolk, Virginia. There will be 60,000 square feet of air-conditioned exhibit and flea market tailgating space available. Featured will be ARRL meetings, DX and traffic forums, and a CW contest. FCC exams are planned for amateur upgrading on Saturday from 9:00 to 12:00 am. A special feature will be a dinner cruise and banquet on the *Spirit of Norfolk* cruise ship on Saturday night for $16 per person, or $30 per couple. Advance registrations are $2.50 (include an SASE) or $3.50 at the door. Flea market tailgate spaces are $3.00 per day. For tickets and information, write TRC, PO Box 7101, Portsmouth VA 23707.

KALAMAZOO MI
OCT 27

The 25th annual VHF Conference in honor of Walter Marburger W8CVQ, founder, will be held on Saturday, October 27, 1979, at Western Michigan University, Department of Electrical Engineering, Industrial Engineering & Technology Building, Room 3034, Kalamazoo, Michigan. At 10:00 am, there will be a morning registration; a final registration will commence at 2:00 pm. At 2:30 pm, Dr. Larry Oppliger will give a welcome. This will be followed by three speakers. At 6:30 pm, there will be a dinner at the University Student Center (by reservation only). For reservations, write Electrical Engineering Dept., Western Michigan University, Kalamazoo MI 49008.

CHATTANOOGA TN
OCT 27-28

Hamfest Chattanooga will be held on October 27-28, 1979, at the Chattanooga State Technical Community College, Chattanooga, Tennessee. Events include FCC exams, prizes, contests, exhibits, forums, and ladies' programs. The indoor dealer area is $15.00 per table and the outdoor paved flea market area is $2.00 per space each day. Talk-in on .19/.79 and 3980. For pre-registration, with prize ticket and information, send $1.00 to Hamfest, PO Box 95, Chattanooga TN 37401.

LONDON ONT CAN
OCT 28

The London Amateur Radio Club will hold its 2nd annual Swap and Shop on October 28, 1979, from 8:00 am until 4:00 pm at Lord Dorchester High School in Dorchester, just off 401. Admission and tables are both $2.00. Featured will be displays and prizes. Talk-in on .78/.18. For more information, write VE3CSK, RR #1, Ailsa Craig, Ontario, Canada N0M 1A0.

MARION OH
OCT 28

The 4th annual Heart of Ohio Ham Fiesta will be held on October 28, 1979, at the National Guard Armory, Marion, Ohio. Featured will be a flea market, prizes, and forums. Dealer space will be available. Talk-in on .90/.30 and .52. For more information, contact Paul Kilzer W8GAX, 393 Pole Lane Road, Marion OH 43302.

FT. MYERS FL
NOV 3-4

The Fort Myers Amateur Radio Club and the ARRL will hold their Hamarama '79 on November 3-4, 1979, from 9:00 am to 5:00 pm on Saturday and from 9:00 am to 3:00 pm on Sunday at the Ramada Inn, on the Caloosahatchee River, Ft. Myers, Florida. A hospitality welcome center will be held on Friday, November 2nd, from 7:00 to 10:00 pm. Featured will be dealer displays, forums, YL and XYL awards, computer displays, and a gigantic flea market. Registration is $2.00 each in advance or $3.00 each at the door. Talk-in on .28/.88, .19/.79, .52, and .94. For information, send an SASE to Bob Sloat K4VGN, PO Box 05-37, Tice FL 33905, (813)-334-6190, or Don Redd WD4ERQ, 1857 Sunset Place, Ft. Myers FL 33901, (813)-332-1825.

WEST MONROE LA
NOV 11

The Twin City Ham Club will sponsor North Louisiana's annual "Hamfest" on Sunday, November 11, 1979, from 8:00 am until 3:00 pm at the West Monroe Civic Center, North 7th Street and Ridge Avenue, West Monroe, Louisiana. Tickets may be purchased at the door or in advance for admission and for the prize drawings. Featured will be swap tables for buying, selling, or trading amateur and related equipment, displays of new radio and electronic equipment, information on becoming an amateur operator, and prizes. Everyone is invited. The building is heated and cooled for your comfort. Talk-in on .25/.85, .52/.52, and 3910.

FRAMINGHAM MA
NOV 11

The Framingham Area Radio Association will hold its indoor electronic flea market on Sunday, November 11, 1979, from 10:00 am until 2:00 pm at the Framingham Police drill shed behind the police station, Framingham, Massachusetts. From Rte. 9, take Rte. 126 south to the center of Framingham. Sellers' setup time is from 9:00 am to 10:00 am. Advance table reservations will be $5.00, with tables available at the door for $7.50. Refreshments will be served outside the flea market area. Talk-in on .75/.15 and .52. For information or reservations, write Framingham Area Radio Association, PO Box 3005, Framingham MA 01701.

CLEARWATER FL
NOV 17-18

The Florida State ARRL convention will take place on November 17-18, at the Sheraton Sand Key Hotel on Clearwater Beach, Clearwater, Florida. An Icom 701 HF station is the main door prize. The latest update on WARC proceedings is just one of the interesting forums we have scheduled. FCC exams will be given on Saturday at 9:00 am. Please send 610s to the Tampa office by November 9. There will be ladies' events both days, with a luncheon and style show on Sunday. Tickets are $5, which includes a Tappan microwave oven as first prize. The QCWA Gator Chapter will host the Saturday luncheon, with all hams and guests welcome, too; tickets are $6. Saturday evening banquet tickets are $9. Swap tables are $10 for both days—no one-day tables, all advance sold. There should be plenty of parking with courtesy buses running on demand for the duration of the hamfest. We have arranged for special room rates at $30 double, per day, with each extra person $4 and kids under 18 free. Hamfest donation is $3; each advance ticket includes two free prize tickets. Talk-in on .37/.97 and 223.34/224.94. Please make all reservations through and checks payable to: FGCARC (Florida Gulf Coast Amateur Radio Council, Inc.), PO Box 157, Clearwater FL 33517. For ham convention and hotel reservations, phone (813)-461-HAMS.

MASSILLON OH
NOV 18

The 22nd annual auction, Auctionfest '79, sponsored by the Massillon ARC, will be held on November 18, 1979, from 8:00 am until 5:00 pm at the Massillon Knights of Columbus Hall, Massillon, Ohio. The flea market opens at 8:00 am, with auction action at 11:00 am. There will be prizes and displays. Talk-in on 146.52 simplex. Tickets are $2.00 in advance; table reservations are $1.00 per table. For further info, write to Joe Turkal K8EKG, 1234 Concord NW, Massillon OH 44646.

FORT WAYNE IN
NOV 18

The Allen County Amateur Radio Technical Society is sponsoring the seventh annual Fort Wayne Hamfest on November 18, 1979, from 8:00 am to 4:30 pm in the Allen County Indiana Memorial Coliseum, Fort Wayne, Indiana. For more information, write Victor M. Locke, Reservation Chairman, 1415 Edenton Drive, Fort Wayne IN 46804, or phone (219)-432-8047.

OAK PARK MI
NOV 25

The Oak Park High School Electronics Club will present a Swap 'n Shop on Sunday, November 25, 1979, at Oak Park High School, 13701 Oak Park Blvd., Oak Park, Michigan. Donation is $1.50 and tables are $2.50. There will be refreshments and door prizes available.

Ham Help

I was recently sent a General Electric 40-channel mobile Citizens Band AM transceiver by a relative in the USA. I would like to convert this rig to the 10-meter band. A friend lent me some copies of *73 Magazine* and I see you've been running articles on this conversion, but I didn't see any covering my set. It's a model 3-5801.

Could any of your readers help me with this conversion? I promise to try to work you with this rig once it's on ten!

Incidentally, 27-MHz CB from the USA can be heard over here quite well when the skip is right.

My own equipment at present is Sommerkamf FLDX500 and FRDX500 and I operate all bands 80-10 at 100 Watts output, although I have an FL1000 amplifier which can go up to 600 Watts.

I hope some of your readers might be able to help me. The full name of the village QTH here is LLANFAIRPWLLGWYNGYLLGOGERYCHWYRNDROBWLLANTYSILIOGOGOGOCH. So if anyone wants a QSL from the (I believe) second largest place name on earth, just let me know.

John Parry GW3VVC
"Ar Allt," Lon Hedydd
Llanfair P.G.
Anglesey, North Wales
United Kingdom LL61 5JY

from page 32

with pre-cut and pre-bent leads. You won't be pushing diodes with plier-nicked leads or the wrong spread into the sockets, damaging the contacts. For this reason, if the 50 diodes supplied aren't enough (unlikely), I recommend ordering the extras from Drake. Since the extra offsets beyond the standard ones are set up on a diode board, elimination of diodes would require the oddball offsets to be set up with switches on the front panel. That wouldn't be a bad idea, anyway.

The power connector is a 2-pin Jones with the pins exposed on the back panel. There ought to be a guard around it to protect the pins from damage if the unit is dropped. Recessing would be better, but there isn't room inside. Also, there should be some kind of locking feature to keep this connector from vibrating off in mobile operation.

The accessory connector is very well thought out as to the functions provided on it, but it needs to be relocated to the back panel and changed to a type that permits a strain relief on the cable.

Because of heat sink limitations, the transmitter cannot run continuously at 25 Watts. This should never be a problem in two-way voice operation, but continuous RTTY or data transmission would require either reduced power or additional cooling.

Like almost all other transceivers, the UV-3 puts the encoder, if present, on the back of the mike. That makes safe phoning while in motion a rather uncertain proposition. The encoder keyboard for any mobile rig should be mounted on something that is secured to the vehicle, such as the control panel, to allow operation with one hand on the wheel and both eyes on the road. The oft-proposed solution of stopping to phone is no answer if the problem involves reporting a drunk driver and keeping him in sight until the police come up.

The UV-3 represents a big step forward in fitting a VHF transceiver to the needs of the amateur service. On the other hand, the fit isn't quite perfect yet, and a little more tailoring would be in order either on the next product or after they take another look at the placement of the controls on the panel. We hope Drake won't be seduced in the direction of copying any of the more spectacular but irrelevant features of competing products.

We are unlikely to see a transceiver of higher basic quality, especially at ham prices. In many of the most important performance specifications, though, quality is as high as ham applications require, so that improvement is probably not even definable. Various added features could be conceived to fit the unit to specific operating situations, but the accessory jack provides plenty of hooks for doing such things outboard.

I, for one, won't hold my breath waiting for a better transceiver to come along. *R. L. Drake Company, 540 Richard St., Miamisburg OH 45342; (513)-866-2421.* Reader Service number D11.

John A. Carroll AB1Z
Bedford MA

USER REPORT: THE DATONG FL1 AUDIO FILTER

The audio filter has become an increasingly popular add-on device in the amateur station. The reasons are clear. Today's amateur bands are becoming more crowded as more and more amateurs are licensed in the US and abroad, and more broadcasters and intruders sneak onto our frequencies. With the tremendous increase in QRM, amateurs have had to search for ways to improve reception ability. To some extent, recent developments in receiver design and construction have helped, but unfortunately there is a trade-off for the improvement: It is expensive!

Audio filtering has become popular because it helps to reduce the increased QRM, is relatively inexpensive, is simple to install in a receiver audio line, and is an effective filtering technique for everything except front-end overload and intermodulation.

The current state of the art in audio filters can best be seen in the Datong FL1 "Frequency-Agile" filter. It is manufactured in England and is truly the Rolls Royce of the current filter market. The FL1 has all of the most advanced features available in audio filtering, plus a couple that are unique.

By far the most unusual feature of the FL1 is its remarkable automatic notch system. With this system in operation, the filter automatically seeks out carriers and heterodyne whistles and suppresses them. If, for example, someone plops a big carrier near a frequency one is operating on, he will hear the carrier for about a second, and then it will practically disappear, totally automatically. The S-meter reading, of course, will not change, but the operator will not hear the carrier any more and will hear the signal he wants to hear. This feature is especially effective on 40 meters, where it serves well to combat all of the broadcast carriers. I have had QSOs on 40 that would have been impossible without the FL1, and it works well on other bands, too. Tuner-uppers and carriers are no longer a problem.

The filter accomplishes this feat through a highly ingenious phase-locked loop system. Not only does the phase-locked loop system allow for automatic notch tuning during SSB operation but it also provides another feature, a limited automatic frequency-control system which allows for easy receiver tuning with even the narrowest of bandwidths. The filter will crank down to a bandwidth of 25 Hz rather smoothly and with no ringing, although it is easy to tell that it is right on the verge of ringing, especially with high-speed CW.

In typical SSB operation, the automatic notch system is left operable. SSB signals can be either peaked or notched, although I have found that peaking generally works best. When adjacent QRM and splatter are severe, the automatic notch system can be defeated to allow for manual tuning of both the bandpass width and the center frequency of the filter. Here the FL1 has advantages over many of the audio filters now available. First, the gain of the filter is independent of bandwidth. This means that the bandwidth can be narrowed without affecting the gain of the audio, whereas on many filters it is necessary to readjust the volume whenever the bandpass is narrowed. When the FL1 bandpass is set on an extremely narrow setting, there is a slight reduction in gain, but not nearly so pronounced as with most other filters.

Second, and more important, the bandwidth of the filter is independent of its center frequency. In some filters of the constant-Q type, it is necessary to alter the bandwidth whenever the center frequency is changed. This is not so with the FL1, and the result is a smooth "feel" to the filter frequency tuning which approximates receiver tuning itself.

The FL1 is more effective for SSB work than other audio filters I have tried. Normally, I leave the filter in the automatic mode when I am on SSB and it does all the work. It knocks out any nearby carriers, CW or RTTY, that show up. When QRM gets tough, though, I switch to manual control and adjust the bandpass and center frequency for maximum intelligibility with minimum bandwidth.

On CW, the automatic notching system is normally left off because it will tend to notch out the signal one wants to listen to. The FL1 is very smooth on CW, even at extremely narrow bandwidths. This is due to the fact that it contains a limited afc function with a bandpass width of about ±50 Hz, making the filter tune smoothly across a wide range of center frequencies. On filters without this afc feature, it is difficult to tune in (or notch out) desired signals at extremely narrow bandwidths due to drift and varying frequencies in a net or roundtable. On the FL1, however, the afc action keeps the filter on the received signal.

Should you wish to operate without the afc feature, all you have to do is push in a button labeled -afc and the function is disabled. Normally, for CW work, I use the filter in the peak

The Datong FL1 audio filter.

position with fairly narrow bandwidth. It is then possible to vary the center frequency and tune across several CW signals, even though they may be practically on the same frequency. One ends up with a narrow window which can be moved up and down a number of signals, letting in only the one wanted. The filter works so well on CW, even in heavy contest operation, that I have decided not to purchase the optional CW crystal filters for my new solid-state transceiver.

The filter has its own audio amplifier circuit which will deliver about 2 Watts into an 8-Ohm load. This is sufficient to drive headphones easily and speakers at all but the loudest levels. Even with the volume turned up high, the audio is smooth and distortion-free. It sounds very good in a pair of 8-Ohm stereo headphones.

The FL1 has a comprehensive switching and control arrangement with three variable knobs and five push-buttons on the front panel. The knobs and buttons are large and easily accessible, which, in this age of ever-increasing miniaturization, is a pleasant change. One of the knobs controls the bandwidth and varies it from 25-1000 Hz in the peak mode and from 20-800 Hz in the notch mode. A second knob controls the center frequency, varying it from 280-3000 Hz. The third knob controls the volume and is ganged with an adjustable pot on the back of the unit which allows the input level from the receiver to be preset at any desired level. This gives considerable flexibility in the type of headphones and speakers which can be used with the FL1, and it also ensures that the audio level coming out of the speaker will be constant whether the FL1 is on or not.

The five push-button switches turn the unit on and off, turn the afc function on and off, turn the automatic notching feature on and off, control whether the filter is in the peak or notch position, and allow the filter to be left on but bypassed. One front-panel LED indicates when the unit is on and another one, labeled "lock," indicates when the automatic notch has captured a carrier on SSB or when a signal has been correctly tuned in and peaked on CW. The headphone jack is also on the front panel.

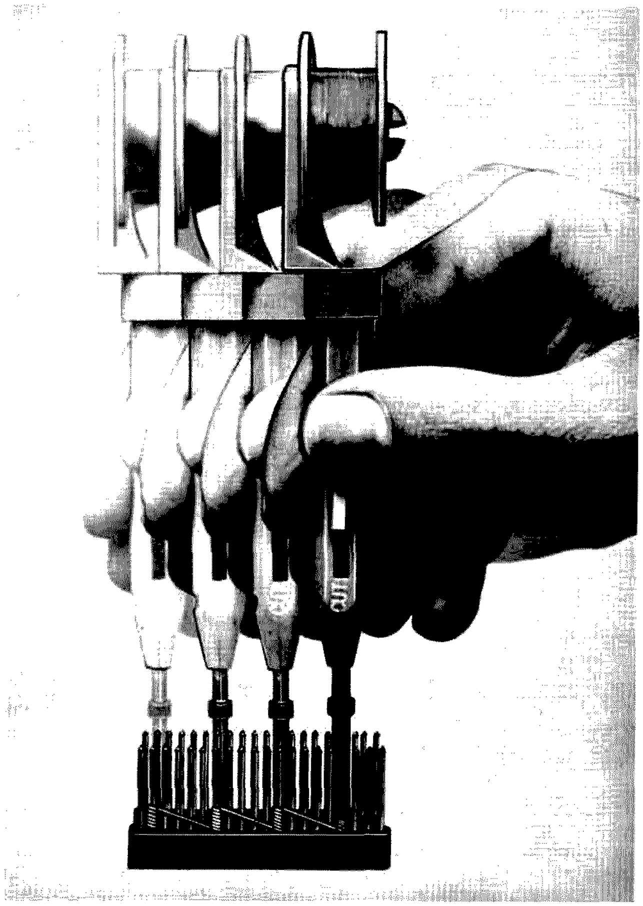
The unit is obviously of high quality construction, with two printed circuit boards and quality components packed into an attractive, high-impact plastic case. The unit is bypassed against rf, and I have noticed no rf getting into it except on a couple of occasions when I have operated the amplifier into extremely high swrs. The FL1 is a complex filter with numerous functions, and it therefore is packed with parts, including eight ICs, six transistors, and eleven diodes. It requires power of between 6.0 and 16 volts at about 100-300 mA, depending upon how much audio is needed. I use a little 12-V dc supply which works quite well. Provision is made internally to plug in a standard nine-volt battery.

The FL1 is a super filter, but no piece of gear is perfect, and this one does have some minor problems. First, it uses identical DIN jacks for the speaker/headphone output and for the power supply input. The filter itself is protected against improper plug-ins, but it might be possible to destroy a power supply if one accidentally plugged it into the wrong jack. Second, the unit is very lightweight (a little more than 1½ pounds), and it will slide across the table when one tries to push in one of the push-buttons. I have had to weigh mine down to get it to stay still. Third, the price for the unit is somewhat steep at $179.95 (although lately several other filters have come out in the same price range).

The FL1 is, however, worth the price. I have used both home-brew and commercial audio filters in the past, but I have never used one that even begins to compare to the FL1. I have found that most audio filters work well on CW but are virtually worthless on SSB, and this is where the FL1 shines. It is far and away the best filter for SSB work I've used, not only when it is in the automatic mode and doing the work itself, but also when it is in the manual mode and one controls the bandwidth and center frequency. And on CW, the FL1 compares to any other filter I've used until it gets down to extremely narrow bandwidths. There, because of its afc function, it performs better than the others. Since I have decided not to purchase any of the optional crystal filters for my new solid-state transceiver, the filter has practically paid for itself already.

Audio filtering has been proven to be effective, and with all of the filters coming out on the market, obviously it is becoming more popular. It is somewhat surprising that more of the manufacturers have not included audio filtering in their transceivers and receivers. Until they do, we shall have to continue using add-on devices, and, of those on the market today, the Datong FL1 appears to be the leader. *Datong Electronics Limited, Spence Mills, Mill Lane, Bramley, Leeds LS13 3HE, England, UK.* Reader Service number D62.

R. Stanley Dicks **W8YA**
Wheeling WV



OK's "Just Wrap"TM tool.

OK INTRODUCES REVOLUTIONARY WIRING TOOL

OK Machine and Tool Corporation has announced "Just Wrap"TM, a revolutionary wiring process and series of tools that produce wire-wrapped connections without prior stripping or slitting of the wire insulation. Designed to wrap on .025-inch square posts, each tool carries a 50-foot spool of 30 AWG wire. The tool will wire continuously through any number of pins (daisy chain). It is equipped with a handy built-in wire cutoff and is equally suited for point-to-point wiring. Wire is available in 4 colors: blue, white, red, and yellow.

For further information, contact *OK Machine and Tool Corporation, 3455 Conner Street, Bronx NY 10475.* Reader Service number O5.

THE AD-1 AUTODIALER

You are fighting bumper-to-bumper traffic during the drive home after a hard day at the office. Suddenly, a car in the opposite lane swerves out of control and causes a serious accident. The confusion that results does not allow you to take your hands off the wheel for more than a second or two. Luckily, you recently installed an autodialer on your two-meter rig. Only two buttons are pushed (one to access the patch, another to dial the number) and you are in touch with the nearest police station. Not only does the Advanced Electronics Applications (AEA) AD-1 autodialer make autopatch operation easy, but it also makes it safer for you and your fellow motorists.

The AD-1 resembles a normal touchtone pad, except that it is slightly thicker and heavier. The tough black plastic case contains the circuitry necessary to store and recall ten seven-digit numbers, provide easy callback, and act as a conventional touchtone pad. An additional eight numbers may be stored in a special factory-programmed chip. The design makes hookup to most amateur FM transceivers a simple task.

The heart of the AD-1 is four integrated circuits which provide tones that will satisfy even the most stringent repeater. The keyboard contains the ten

numerals plus the * and # functions. The user gets a reassuring click when a keypad is depressed. Other features include a small speaker so that the output may be monitored, as well as a periodic warning tone when the unit is in the program mode.

The AD-1 comes with a four-pin microphone connector and a short length of coiled cable. Depending on the rig, it may be interfaced between the microphone and transceiver or hooked to an accessory socket. The push-to-talk method involves acoustical coupling. This is a bit more awkward, but involves no permanent connections other than a 12-volt supply. An internal potentiometer allows user adjustment of the output level. If you are only interested in acoustical coupling, then the AD-1P might be a good choice. It is identical to the AD-1, except for the fact that it has only a speaker for output and contains a rechargeable battery.

The $129.95 price might seem high for an occasional autopatch user, but with a bit of imagination the AD-1 and AD-1P could be incorporated in a variety of telephone projects. The 26-page instruction booklet gives a fair description of the various modes that are available.

Autopatch operation has always been a great way to show off the utility of ham radio. Now, you can make it safer and more fun with the AEA autodialer. *Advanced Electronic Applications, Inc., PO Box 2160, Lynnwood WA 98036; (206)-775-7373.* Reader Service number A94.

Tim Daniel N8RK
Peterborough NH

THE QSL ORGANIZER

With today's more sophisticated rigs and less cluttered radio shacks, how do you keep QSL cards neatly organized, well preserved, dog-ear resistant, and always on beautiful display?

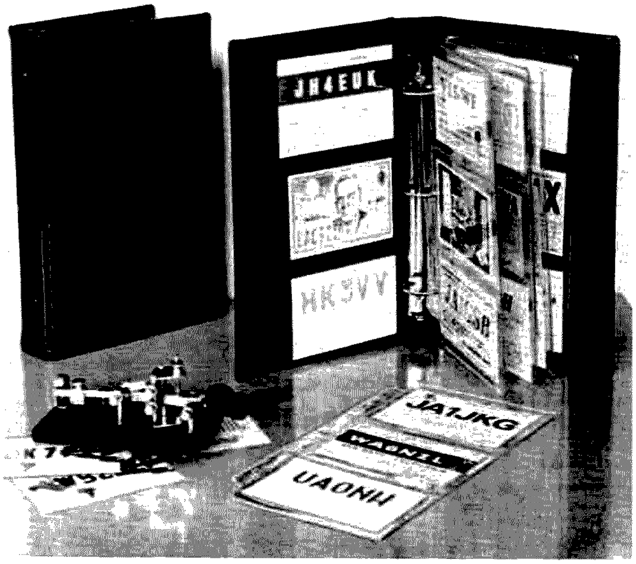
A specially designed organizer is now available from Mil Industries of Panorama City, California. The QSL Organizer contains heavy-duty plastic pages with roomy 4" x 6" slip-in pockets. Each page holds 6 QSLs (back to back), enhancing their appearance by its crystal-clear clarity. The slip-in pockets, accessible from the top, allow cards to be arranged or rearranged quickly and easily.

The QSL Organizer album is specially designed to hold the slip-in pocket pages. It's a beautiful 9" x 14" three-ring binder, richly padded in long-lasting "Brown-Hide" vinyl, with a gold-printed inscription on the cover and spine. Pages are easily inserted or removed.

For further information, contact *Mil Industries, PO Box 44457, Panorama City CA 91402.* Reader Service number M117.

THE XITEX MRS-100 MORSE CODE TRANSCEIVER

The increasing popularity of microcomputers has done more for ham radio than just improve repeater control and advance RTTY operation. The Xitex MRS-100 Morse code transceiver will be of interest to the newest Novice as well as the old-time CW operator. When used with a standard ASCII or Baudot terminal, it becomes possible to generate and receive Morse code at any speed between one and 150 words per minute.



The QSL Organizer.

The heart of the MRS-100 is a 3870 microcomputer. It contains 2048 bytes of ROM which hold the programming necessary to generate and copy code. The result is a single MOS integrated circuit which will convert a Morse input (dc levels) on one pin to a serial ASCII or Baudot output on another pin, and convert a serial ASCII or Baudot input on a third pin to a Morse output on a fourth pin. By adding a power supply, 80-Hz filter, and the necessary switching and interfacing, a complete transceiver is created.

The success of a dedicated microcomputer lies in the quality of the internal program. A MRS-100 owner doesn't need to worry about being at the mercy of the ROM's contents. Xitex spent several years developing the most versatile approach possible. The copy algorithm is compensated to accept a wide range of fists at speeds that will meet anyone's needs. Most code receiver systems assume arbitrary values for the relationship between code element spaces, character spaces, and the dot/dash ratio. The MRS-100 does not. It continually evaluates the received signal, allowing speed shifts from 150 to 1 wpm, or vice versa, missing only about five characters before locking in on the new rate or style.

The problem of generating Morse characters is somewhat more straightforward. The MRS-100 goes beyond the usual Morse keyboard utility since it contains a 32-character FIFO (First In, First Out) buffer. This allows the operator to type faster than the transmitted code and results in a smooth, clean signal. If an ASCII keyboard is used, it may be possible to RUBOUT mistakes so that the ham on the other end hears perfect CW.

The MRS-100 tested at *73* came assembled, in an attractive 7-inch by 8-inch by 3½-inch black and grey cabinet. The 43-page instruction manual includes guidelines for the assembly of the kit version as well as information on hookup and use. Ideally, the Xitex SCT-100 video terminal should be used as the display device. However, a Model 33 Teletype® was pressed into service for our tests. The hookup directions left something to be desired if you were not using an SCT-100 or an older Baudot machine. The addition of a reed relay and diode were necessary to get the system up and running. The frustration of interfacing was soon offset by several hours of enjoyable use.

The Extra class portion of 40 meters was the first testing ground. The headphone jack on a Kenwood TS-820 provided a source of audio for the MRS-100, and soon I was "copying" code at twice the speed I am accustomed to. It was apparent that other fellows were using a computer, too, since the teletype was spitting out flawless text at 40 words per minute. I guess I was disappointed that this previously uncopyable code did not contain secret messages, so I soon found myself tuning across the Novice band. Needless to say, most of the signals did not sound like they were machine generated, but the MRS-100 easily slid down to the five-word-per-minute range, copying the mistakes in addition to the correct characters.

The Search-Track-Lock switch provides the operator with three distinct copy modes. The search mode allows the unit to synchronize and track the received audio while outputting the corresponding ASCII or Baudot characters. If no instantaneous large shifts in speed are anticipated, the track mode may provide a more stable output. The reduced capture window allows a more accurate determination of the dot/dash and spacing decision points. The third mode is a lock type which is useful when there are frequent noise spikes that may be interpreted as false dots. When the operator switches from the track to the lock mode, the capture window and all internal decision points are locked to their current values.

The threshold control, like the search-track-lock modes, is best understood after several hours of practice. I found that the MRS-100 would occasionally get locked at too high a speed. By adjusting the threshold and the level of the input signal, I was able to overcome these troublesome quirks. The input circuitry for the receiver portion of the MRS-100 is relatively simple, yet the unit is able to compensate for fading, even when the signal is seemingly overcome by noise. There is, however, very little tolerance for an adjacent signal. An active filter circuit with an 80-Hz bandpass provides slightly more immunity to QRM, but I doubt if the MRS-100 would function well under contest-like conditions. In addition to the filtered CW, a completely regenerated Morse signal is available from the local sidetone oscillator. This provides a useful way to set the threshold and input levels.

A two-digit LED display shows the speed of the received signal. This does not have the versatility of the conversion algorithm since there are a number of ways that code spacing can be set. When I used a 6 wpm *73* code tape as an input, the

display read approximately 16 wpm. This is not too surprising when you remember that the *73* tapes use a character speed that is much faster than the word speed. The display provides a good relative indication of speed, but I don't think it can be interpreted literally in most cases.

The sending portion of the transceiver performed well. The code speed may be set from the keyboard or external BCD switches can be wired to do the job. The biggest problem is in keeping up; luckily, the RUB-OUT key on an ASCII keyboard lets you fix errors that are bound to occur if you are not used to high speed typing. Another deficiency involves Transmit/Receive switching. An addendum to the instruction manual shows that a single-pole single-throw switch must be put in series with the rig's keying line. This is in addition to the Send/Receive switch on the front of the MRS-100. One switch is bad enough, but two are cumbersome. This problem could be overcome with a bit of custom wiring and a relay; unfortunately, Xitex gives no suggestions.

Old-timers may scoff at the idea of using a computer to send and receive Morse code, but there are several advantages to the MRS-100 that shouldn't be overlooked. It enables amateurs to transmit CW messages and data at speeds comparable to or better than most amateur teletype operation without the numerous FCC RTTY restrictions to contend with. A "RTTY emulate" function allows the MRS-100 to transmit and receive predetermined code characters for the TTY or ASCII keyboard characters not normally used in Morse operation. Two stations using MRS-100s could thus exchange automated, high-speed transmissions that could replace the need for legalized ASCII. Just hook the unit to your computer and start transmitting.

If you're just a beginner in the world of ham radio, the MRS-100 can help to improve your fist. It's amazing how much difference it can make when you see the results of your sending printed on the TTY. Finally, a code computer can allow nonhams to share in the excitement of CW operating.

The MRS-100 is available in three forms. An assembled version costs $295, while a complete kit goes for $225. A partial kit consisting of the microcomputer components and circuit board can be had for $95. Approximately $70 worth of additional parts are needed to complete the partial kit. As computers become commonplace in the ham shack, we are bound to hear a lot more comments like "Keyer here is a computer; it copies the code, too." With the MRS-100, you can brag about your automated station at any speed between 1 and 150 wpm! *Xitex Corporation, 9861 Chartwell Drive, Dallas TX 75243; (214)-349-2490.* Reader Service number X3.

Tim Daniel N8RK
Peterborough NH

HUSTLER INTRODUCES NEW TEN-METER YAGI ANTENNA

A new beam, designated the 10-MB-4, is the conclusion of extensive design refinements of previous beam technology. The result is a four-element yagi optimized for best directivity, excellent front-to-back ratio, and maximum gain through selective element spacing and precisely resonated element length.

The 10-MB-4 employs a gamma match feed system and is fully adjustable for a 1.2:1 or better swr at resonance.

The mechanical structure of the Hustler 10-MB-4 is ruggedly designed to withstand severe weather yet light enough to be accommodated by a TV antenna rotor. The entire antenna is constructed from high-strength aluminum tubing and can be easily grounded for lightning protection.

For further information, contact *Hustler, Inc., 3275 North B Avenue, Kissimmee FL 32741.* Reader Service number H36.

THE HEATHKIT DEVIATION METER

Have you ever had someone tell you that you were overmodulating on your two-meter FM rig? One solution to overmodulation is the new Heathkit™ Deviation Meter Kit (IM-4180) from the Heath Company. This deviation meter can be a useful addition for anyone who operates FM equipment. At a cost of $149.95 it is not for everyone, but it will permit more amateurs to check their equipment's deviation levels accurately.

Construction

The kit can be constructed in two or three nights. Only two printed circuit boards are used, a main circuit board and a converter one. All components (except the front-panel controls, the front-panel jacks, and the meter itself) are mounted on these two circuit boards. The front push-button switch assembly solders directly to the circuit board and simplifies assembly. The kit uses eight integrated circuits which are mounted using IC sockets. Six of these are RCA COS/MOS operational amplifiers which help minimize current drain but require cautious handling.

The main circuit board holds all of the circuitry except for the converter circuitry and the front-panel mounted items. The converter circuitry is mounted on a separate circuit board which is mounted in a shielded enclosure on the rear of the front panel.

Calibration

The alignment and calibration requires only one piece of external equipment. The deviation meter's local oscillator can be aligned using a frequency counter or a standard FM broadcast receiver. The front-panel meter is used for alignment and calibration metering.

Operation

The deviation meter requires ten AA cells for operation. The manual indicates an operating life of about eighty hours for either zinc-carbon or alkaline cells. A battery charger/eliminator for use with nickel-cadmium batteries is an optional accessory. Battery voltage can be checked by the use of the front-panel BATT push-button.

A tune switch allows you to peak the meter indication using the main- and fine-tuning controls. The fine-tuning control is a potentiometer which controls a varactor diode in the local oscillator. The fine-tuning control simplifies tuning at VHF and UHF frequencies. Operation from 25 to 50 MHz uses the local oscillator fundamental output, but operation from 50 to 1000 MHz uses the local oscillator harmonic outputs. A dual-gate MOSFET is used as a variable frequency oscillator. This is a diode-protected device, and while no precautions are given in the manual, I advise caution when installing this transistor, since the one I installed failed to operate. A replacement was installed with no problem. A hot-carrier diode is used as a frequency-converting mixer. An i-f gain control is provided on the front panel to control sensitivity. Between 50 and 500 MHz, the deviation meter has a minimum sensitivity of 35 mV. Accuracy (full scale) is specified as plus or minus three percent.

Meter ranges of 0-2, 0-7.5, 0-20, and 0-75 kHz peak are selected by front-panel push-buttons. The 0-7.5-kHz range is useful for setting the FM deviation of amateur equipment. The 0-2-kHz range uses a low-pass filter and is most useful for adjusting continuous tone-coded squelch systems. The deviation meter uses a pulse-counting detector operating at a 200-kHz i-f.

A speaker output jack is provided for an external speaker (no internal speaker is provided). The audio amplifier provides 100 mW minimum into an 8-Ohm speaker. A front-panel switch selects a de-emphasis of 750 us for two-way radio, or 75 us for standard FM broadcast. This de-emphasis switch affects only the speaker output.

A scope output is provided on the front panel. This output provides a nominal 13-mV/kHz peak superimposed on a dc voltage of about 2.7 volts. This output permits you to monitor the input for clipping which would not be apparent from the meter reading.

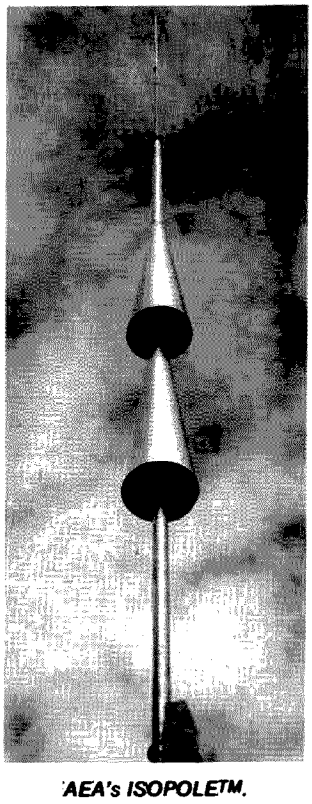
Conclusion

I enjoyed constructing my Heathkit deviation meter and find it simple to operate. Its portability makes it ideal for checking the local repeater or your friends' equipment. I particularly like the ease with which subaudible tone levels can be checked. *Heath Company, Benton Harbor MI 49022.* Reader Service number H5.

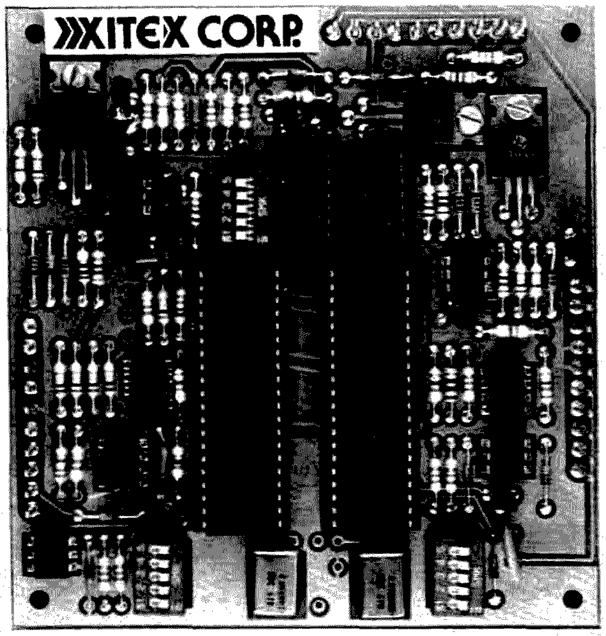
Bruce A. Beyerlein WB9WFH
Waukesha WI

THE ISOPOLE™

AEA (Advanced Electronic Applications, Inc.) has developed the ISOPOLE™, a new vertically-polarized, omnidirectional, gain-type base station antenna which provides truly superior performance over any other low-cost antennas now in the marketplace. ISOPOLE's



AEA's ISOPOLE™.



Xitex's ABM-100 code converter.

revolutionary double-cone design results in virtual elimination of the major problem plaguing other base-driven vertical antennas. This problem is the inadvertent and unwanted coupling of rf currents onto the supporting structure and the shield of the feedline, seriously degrading the radiation patterns of most competitive antennas. On-the-air field tests have shown a substantial signal improvement in favor of the ISOPOLE when switching between the other competitive antennas and the ISOPOLE.

The ISOPOLE's unique new design features a double-decoupled, center-driven, 1¼-wavelength antenna to provide maximum theoretically obtainable gain for a dipole. All rf connections are protected from the weather. The ISOPOLE is pre-tuned at the factory so that the user can obtain an 8-MHz bandwidth by following the simple assembly instructions. The ISOPOLE is intended for installation atop a standard TV mast (not supplied) and is packaged in a 7" x 7" x 29" shipping container.

For further information, contact *Advanced Electronic Applications, Inc., PO Box 2160, Lynnwood WA 98036; (206)-775-7373.* Reader Service number A94.

Heathkit's new catalog.

MICROCOMPUTER-BASED CONVERTER TRANSLATES ASCII/BAUDOT/MORSE

A new single-board code converter, designated the ABM-100, is now available from Xitex Corporation for translating between ASCII and Baudot or Baudot and ASCII. Utilizing a pair of MK-3870 single-chip microcomputers, the board provides two independently programmable serial data ports which are internally connected. Programming is accomplished using on-board DIP switches for selecting the baud rate, line length, and data format for each of the two ports.

Eight different baud rates are provided, from 110- to 1200-baud ASCII and from 45.45- to 74.2-baud Baudot. Output line lengths of either 40, 64, 72, or 80 characters are also selectable.

Other features include a built-in FIFO buffer, interfaces for both RS-232 and 20/60-mA current loop operations, and speed conversion capability.

A third port is provided for translation between Morse code and either ASCII or Baudot. This permits the generation and decoding of Morse signals (dc levels) using conventional ASCII or Baudot equipment.

For further information, contact *Xitex Corporation, 9861 Chartwell Drive, Dallas TX 75243; (214)-349-2490.* Reader Service number X3.

NEW HEATHKIT CATALOG AVAILABLE FREE

A completely new 96-page catalog, describing nearly 400 electronic kits designed for the do-it-yourselfer, is now available from Heath.

Product categories offered include electronics learning programs, test instruments, convenience and security products for the home, stereo components, color television, auto, marine, and aircraft accessories, personal computer systems, and much more.

New products in this catalog include the All-In-One H89 computer with floppy disk storage, a five-antenna remote coax switch for use in amateur radio, a 3½-digit autoranging multimeter, a low-priced dc-to-5-MHz single-trace oscilloscope, a portable solid-state VOM for the hobbyist, and professional quality audio equipment.

For further information, contact *Heath Company, Department 350-880, Benton Harbor MI 49022.* Reader Service number H5.

TEN-TEC'S MODEL 232 SWITCHER/25

Within recent years, transistor switching power supplies have come into wide use for sophisticated electronic equipment. They are characterized by the use of high frequency transformers and transistor switching to produce the regulated output voltage.

Switching power supplies are more complicated than the conventional pass-transistor types and are more expensive. However, they offer many advantages over conventional types. Some of these are greater efficiency, cooler operation, lighter weight, excellent regulation, protection against overvoltage, better reliability, and the capability of being powered by 117 to 230 volts, either ac or dc.

Ten-Tec has announced a state-of-the-art switching power supply, the Model 232. It can be used to power any Ten-Tec transceiver or any other 12 V dc system, with current requirements up to 25 Amperes.

In operation, the 117- or 230-V ac input is first rectified to approximately 160 V dc, plus and minus, using a doubler for 117 V ac and a bridge configuration for 230 V ac. This high dc voltage is applied to a switching circuit to produce pulses at 25 kHz. The internal oscillator that applies the switching signal to the transistors also adjusts the pulsewidth in accordance with a feedback circuit from the output line, so that the average value of the pulse train is 13.5 volts, plus a small amount of loss. The pulsewidth-controlled signal is then rectified and filtered to the 13.5-volt output. No heavy 60-Hz power transformers are needed with this system, and should the switcher stop oscillating, the output voltage drops to zero instead of a high dc value.

The Model 232 complements the OMNI transceiver series in cabinetry and cable and connector compatibility. For further information, contact *Ten-Tec, Inc., Sevierville TN 37862.*

W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

from page 20

just encourage them to waste more . . . like the government.

The League can make money so they will be able to do the jobs we expect them to . . . such as get amateur radio established on a good footing in most of the Third World countries . . . and put up a more intelligent battle against FCC rules which are harmful. To do this, they need someone running the place with some business background and, as far as I can see, they don't have it.

The ads in *QST* should bring in about $3 million per year . . . and so should the memberships. Books should bring in another $1.5 million, at least. With expenses around $5 million, that should leave a good supply of money for ARRL activities and lobbying.

220—USE IT OR ELSE

The makers of marine radio equipment certainly showed up the CB manufacturers for a bunch of yokels when it came to grabbing off a chunk of a ham band for commercial use. You can put me down as paranoid for thinking of the job as an accomplished fact, but we'll see what the bottom line is when all is said and done.

The CBers, led by the ex-Hy-Gain people, got the idea that they could sell everyone on CB rigs again if they got a new CB band opened up. And this one would be bigger and better than the 23 channels that were then making them rich. Quite a bundle of money was poured into the effort, and it looked as though it might just make it. It would be interesting if an investigative reporter could spare the time to try to find out where a whole bunch of lobby money was spent on this project. it went first to the EIA, as I understand it. Then I noticed that a chairman of the FCC started acting very strange, being totally convinced of the need for a CB 220-MHz band despite the contrary advice from his technical staff. Was this a coincidence?

In my younger days, I used to think well of everyone and be very surprised when I discovered that things were not always what they appeared. Then, as I looked more carefully, I found that things are seldom what they appear. And I think this holds in spades for politics and our beloved government.

And why, if this chap were not in the lobbyists' pocket, did a major equipment manufacturer at the time want to bet with me that 220 would soon be a CB band . . . as he was bringing out a new 220-MHz transceiver? And why did the FCC chairman, who then went on to the White House staff, keep the pressure on for the CB 220 band? Why would he care any more about that once he was out of the FCC?

The maritime equipment manufacturers have long wanted to get the ham 220-MHz band for marine use. Think of the radios some four million pleasure-boat owners would be buying! Now, I don't know how they managed to get their way with the US WARC preparatory group, but they pulled the sleeper of the decade on amateur radio when their plan suddenly appeared in the finished report.

Amateur groups have been furious about this, pointing out that the whole thing was totally illegal. The final report was made on matters which had not been through the legal hurdles prescribed by the Administrative Procedures Act—with no Notice of Inquiry and the usual fact-gathering and discussion stages. No, this crafty (pardon that!) bunch kept the whole thing under wraps and never gave any opportunity for opposition.

The 220-MHz amateur groups are pretty upset over this coup. They've tried to get some satisfaction from the FCC, but have been thoroughly put down. My contacts with the FCC tell me that we lost a lot more than we ever thought when the ham manufacturers refused to cooperate with each other in the linear opposition hearing . . . and then the ARRL's counsel Booth harangued the Commissioners at length, putting them down.

The League is acting as though it is part of the conspiracy, telling the 220 groups not to worry—everything will be all okay. Yes, I'm aware that some of the ARRL directors are going around to clubs saying that I don't know what I'm talking about . . . but you notice that they never challenge me face to face. I have in my files copies of letters from ARRL officials to 220 clubs which say not to worry . . . that the FCC has assured them that all is okay for the ham band at WARC.

My gradually-developed paranoia suggests a rather different story. It tells me to be careful of news like that and to look for the gimmick. In this case, let's look at a scenario. Let's suppose that there is a group that wants more frequencies for a new maritime band. Let's suppose that this group knows damned well that even without any lobby hams can be difficult to put down, so their best approach is not to go the CB route, but to slip something through the back door. We've already seen that they are pretty shrewd at this. I don't think anyone has even figured out who managed the sneak play with the WARC position or how it was done.

Next, let's assume that this group is not stupid enough to think that a lot of other countries thousands of miles away from us and with no substantial pleasure-boating population are going to jump at this proposition. In other words, anyone above the grade of moron is going to know that this proposition is not going to stand the ghost of a chance of becoming international law as a result of WARC. The band involved is a television band in some countries and is not even a ham band in much of the world.

Okay. Now we see that some group spent a lot of time and effort (that means money) getting this into the US WARC position. Knowing that it would be defeated at WARC, why did they invest so much? Well, there is a kicker known as a footnote. The US delegation at WARC can say, shucks fellows, we're sure sorry you didn't go for this fantastic band which we need desperately for our four million pleasure boats, but we agree with your right to decide these things on a one-country, one-vote basis. We also ask that a footnote be appended to the allocations table reserving the right for the US to do as we proposed. A bunch of boats in the US on 220 MHz with low-powered equipment is no hair off anyone in Lesotho, so we get our footnote . . . and we also get a new maritime band . . . and lose a nice ham band.

It is going to be more difficult for the maritime equipment manufacturers to keep this one moving if we get busy and populate the band. But we've been sporting "220, USE IT OR LOSE IT" buttons for several years, and the action is still scanty. Slogans and guilt are not people movers. We'll have action on 220 MHz when enough amateurs are convinced that they should spend the time and money to buy or build equipment for that band . . . and not before.

You get people to do things when they think it is to their benefit. This is why I was so opposed to the very concept of what was jokingly called Incentive Licensing . . . which was anything but that in its original concept. You get people to do what you think best only when they agree that it is going to benefit them. I think this holds for using 220 MHz, and thus I propose that we do something about this.

The 220-MHz groups have been particularly derelict in their approach to the situation, and if the consequences were not so severe for amateur radio, I could almost enjoy their discomfort now that they see the band slipping away from them. For the most part, these groups have been smug and cliquish. They've found a band where they are not much bothered with the rising tide of idiots and kooks who have been making life miserable for some of the 2m repeater owners. They've felt that secrecy is the best answer in order to protect their private preserve. So we see little written for magazine publication and little in the way of reported accomplishments from these groups.

The result of this snobbery is that there are but a few hundred repeaters on 220 MHz and a very few thousand users. When you talk with these people, you find that their reaction is almost universal . . . they think 220 MHz is fantastic, but please don't tell anyone. They like it as it is and don't want the screwballs from two meters to come up and get their kicks.

Well, fellows, you have to make a choice. You have to decide whether it is worthwhile to keep the band for your little group and keep it a secret . . . and possibly lose it completely . . . or whether it is getting time to open up 220 to everyone and perhaps be able to save it.

I think that we should be able to work out some practical solution to the fruitcakes who mess up repeaters. Little has been written of a constructive nature about this, and it is a situation that really needs to be tackled. I get tapes from southern California of some of these goings on, and it's almost enough to get the Ku Klux Klan out recruiting. I don't know how those fellows are able to put up with that crap without wringing a few necks.

220-MHz repeater groups do find some substantial benefits to the band. Their repeaters are generally able to coexist with

most commercial band repeaters without anywhere near the severe intermod problems from which 450-MHz repeaters often suffer. There are still a lot of repeater channels available on this band . . . so perhaps this might be the place to put some of the needed experimental repeaters which will give us access to the lower bands.

I'm still enthusiastic about developing cross-band repeaters which will let us remotely access repeaters hundreds of miles away. I'd like to see repeaters which could double as remote base stations cross-banded to the other ham bands, including the DX bands. With the remote tuning system built into the Icom 701, we have a big start in this direction. We'd need some scheme for indicating the frequency used via the repeater . . . and some way to turn the beam . . . let's see some articles.

When you come down to it, articles in the ham magazines are the answer. *You* do the inventing and the pioneering—then *write* about it, pointing out the fun and things which can be done. These articles will get the action we need. Where would two-meter FM be today if *73* had not published hundreds of articles, several books, and gotten the word to everyone about the fun they were missing? Oldtimers will remember that the first reaction of most hams was that they didn't want to read about it—didn't want to be bothered. But they eventually did read, and then began to read more, and eventually they tried it.

With articles on what is going on, with articles on new ideas and circuits, with articles on new equipment which is available . . . with all this, we will spark interest in hundreds . . . then thousands . . . tens of thousands . . . and we just might make it. It's in the hands of the 220 groups. Write about it or write it off. I guarantee that *73* will try to publish as much good information about 220 as possible.

WARC REPORT

Senator Goldwater, apparently concerned over the conflicting reports about WARC, requested the Library of Congress to prepare a report on the matter. The Library's Congressional Research Service (CRS) did some looking into the situation and reported, "The official US approach to the . . . conference could be characterized as one of cautious apprehension. There has been a change in public stance since early May; until that time, Department of State officials, especially US WARC delegation members, had been expressing a degree of optimism."

The study went on to say that Third World opposition to the US proposals "may prove a considerable challenge to US policymakers and representatives." The problem here is that politics is involved rather than technical considerations. The report said that "the US delegation is not totally pessimistic about the conference's outcome."

Several past ITU meetings turned fruitless because the Third World nations refused to enter technical discussions, but insisted on using the ITU to express their political views and frustrations.

No one can say how this conference may work out, obviously. But the preponderance of evidence and projections of past actions are certainly not comforting.

MORE FAKE HAM GEAR BEING SOLD

Last year, an outfit in Houston, Texas, came out with a police radar jammer, calling it amateur equipment because it had a transmitter built in. The only purpose of this equipment was to jam radar. We surely don't need more illegal equipment being sold under the false pretense that it is for hams when the fact is that it is in no way intended for ham use.

Now this firm, Microwave Devices, Inc., has a new and improved model which is being promoted as a ham transceiver for either X or K band. The dial, which used to be calibrated in mph (the speed it would indicate on the police radar unit), is now calibrated in audio frequency. What a rip-off of amateur radio!

It isn't even necessary to use a transmitter to give police radar units a false indication of speed. We ran an article a couple of years ago showing how to build a completely passive unit which would both indicate the presence of radar and return a reflected modulated signal to it showing the speed of your choice. I presume that most of the people who built this fiendish device are put away safely now in various prisons around the country after discovering that police have no sense of humor. Eventually, every user just *has* to give the fuzz an indication of 200 mph while driving along at 25 mph. The radar is right, and the court believes it, no matter how ridiculous. Any driver going 200 mph should be put away.

The recent cases where police radar units were able to clock a house at 80 mph has hurt the reputation of radar a bit. And not a few hams have been hauled before judges who have had no knowledge of or even interest in discussing the question of false readings on radar units, even when attempts are made to offer proof that a mobile ham rig can throw radar readings almost anywhere.

I'm no fan of police radar. Going slower than normal, namely 55 mph, may save gas, but it sure wastes a lot of my time, which is far more valuable than the cost of the gas involved.

The car magazines have exploded the gas-saving myth anyway, by pointing out that the amount of gas saved by driving at 55 mph instead of 65 mph is far less than we would save if we increased the pressure in our tires by one pound! And as far as saving lives, when you look closely at the actual statistics, you find that we are losing more as a result of the inattention brought on by driving 55 mph on 100-mph roads. They have not put any speed limits at all on roads in most European countries.

POLICE RADAR HELD ILLEGAL!

A Washington DC court recently heard a case against a chap who had been arrested for having a radar detector unit in his car. The court spoke out against this quite clearly. The judge drew the parallel of a driver who kept a pair of binoculars on the seat beside him to look ahead and spot speed traps. Can the law be interpreted so that the citizen can be prohibited from carrying binoculars in the car?

But that was only a small part of the judge's comments. He went on to point out that police use of radar is an intrusion by the government without a search warrant issued on probable cause describing the place to be searched and the persons or things to be seized. He felt that this was clearly an unwarranted search since there is no consent to such a search. The judge said that a citizen using the highways in a vehicle has a right to know whether or not the government is monitoring his actions.

Thus, with no positive evidence that a crime is being committed (speeding), the police have no right to search you with their radar to get evidence against you of this crime.

The court felt that the police infringed upon the citizen's rights under the First Amendment, the Fourth Amendment, the Fifth Amendment, the Ninth Amendment, and the Tenth Amendment to the Constitution, and that the infringement constituted an invasion of a citizen's privacy, a denial of a citizen's right to know what officials of the government are doing, an illegal search and seizure of the citizen's property in an electronic sense, and a violation of the citizen's rights as retained by the people.

Lawyers may want to reference *The Daily Washington Law Reporter*, July 19, 1979, page 1257.

MICROPROCESSORS AT WORK

Well, when I started running microcomputer articles in *73*, I warned you that these fiendish little contraptions would find their way into our radios . . . and they have.

Recently, when I finally managed to con Icom out of a 701 for a test, we plugged it into the ETO 374 linear and a Wilson tribander beam up on a Rohn tower and had at the DX. Mercy me, as the CBers say, what a difference!

It took hardly any time at all to get used to being able to tap out the desired frequency on the remote control unit. I'd hit 14.2000 and *zap*, the radio would be right on 14.2000 MHz. To tune up the band, all I had to do was push the UP button and it would advance 100 Hz at a time . . . or if I held my finger down, it would skip on up the band. I soon got used to stopping on the next voice tuned in almost right on channel. If it was some choice DX, but in a contact, I just would touch the MEMORY, WRITE, and #1 buttons . . . and tune on up the band. Then, every now and then, I would check the DX channel by touching MEMORY, READ, #1 and the rig would pop back on the desired channel.

Hey, maybe ten meters is open! 28.5000 and click-click, I'm listening to ten. Hmmm, I must not forget to switch the band on the linear. To cover the band quickly, looking for signals, I'd switch to the 1-kHz scan position and let 'er rip. Nope, dead . . . so let's go to 21.2500 and check fifteen. After working my way up the band, checking out a few Gs and DLs, I'd run into a JY and a J6, both rare enough to warrant some patience. At the first break of either of these stations, I gave a short call . . . and no answer. Damn, I forgot to switch the linear! More waiting for a break, buttoning back and forth between memory 1 and 2, checking both channels . . . then tuning on up the band, listening for more DX . . . back to the two channels again. I finally got both of 'em.

A PUBLISHING CAREER?

You could do worse. In fact, most people do a lot worse. Despite the cutbacks in employment at the ARRL, amateur radio publishing is doing well as an industry and is both fun and profitable . . . an excellent combination. The staff at 73 has grown from about five ten years ago to 110 at present, though

this includes *Kilobaud MICROCOMPUTING* and Instant Software. Sometimes it is difficult to know who is working how much for what.

We've openings for some people in several departments, and being an active ham is not going to hurt one bit.

We need a ham editor to help Jeff DeTray WB8BTH with editing articles, selecting material to be published, and following up on an endless number of special projects. There just might be some investigative reporting, too.

If we're going to get involved with any kind of a national organization, we'll need a ham or two to coordinate these matters. This might be something a retired military ham could get his teeth into.

Then there is the need for a ham who can both read and write to help Jim Perry in the book department. We'd like to step up our book production to five or six new books a month in the ham and computer fields. A knowledge of microcomputing will help a bit here.

Instant Software has about 30 full-time employees and we're looking for double to triple that in the next few months, which means there are openings for people with experience in marketing, advertising, production, accounting, packaging, data processing, and management. Some computer hobby background won't hurt here, either.

The Peterborough area is completely smog-free . . . you couldn't ask for cleaner air. We ask that all applicants be nonsmokers and not smokers who think they can give it up for a good position.

In additon to the usual dry resumé, I'd like to have a letter telling me what particular qualities you might have for working here. I would prefer people who are anxious to learn a lot and who will be working toward the development of their skills.

Ten years ago, it never even occurred to me that my publishing firm might one day grow larger than the ARRL, but we seem to have arrived at that point this year!

BEEFS

We've received a couple of beefs about a firm called HMR. These people are *not* advertisers in *73*, by the way.

INSTRUCTIONS FOR MAKING SUPERB APPLESAUCE

First, cut up apples, removing the cores and any blemishes . . . spots, bruises . . . but leave on the skins. Cut apples into bite-size chunks.

Put in a large pot, perhaps four to eight quarts at a time, fill one-third to two-thirds full with water (depending on your consistency preference), cover, and bring to a boil. Boil about five minutes at most, and stir the apples now and then to make sure all are cooked about the same amount.

When the apples are fairly soft, turn off the heat and add about ½ cup of sugar for each quart of apples. This will vary some depending on the tartness of the apples. It is difficult to get an apple which is too tart for applesauce . . . I've never found one. Stir in the sugar well and let it cool just a bit.

Spoon the 'sauce into plastic freezer containers, mark with the type of apple and the date, and let them cool. Later you can freeze them with no loss of flavor.

I prefer Transparent apples by far, with the second choice being Duchess . . . then Wealthy. Macintosh and McCowen are okay, but not nearly as great as the first. I had to plant my own trees just to get the type of applesauce I like.

Milder apples may need some lemon juice to add tart . . . use it sparingly and taste as you go. Truly tame apples may even need some cinnamon.

This process of making applesauce is so infinitely better than anything available canned that you will never go back to store applesauce again. Even old, soft apples of the most bland type will make better 'sauce than the best canned stuff.

I often keep a lot of apples in the refrigerator so that I can cut up one or two to have for lunch with some Havarti or Jarlsberg cheese. Eventually these apples get a bit withered and soft . . . so I then 'sauce them . . . you can cut up a remarkable lot of apples while watching TV and not waste your time so totally. I save some videocassette movies for this process.

If you prefer canning yourself, this works fine, too. I like freezing because it is a lot simpler for applesauce and even for jams, too.

Hey, don't strain the 'sauce. The peels of the apples soften up when you cook them and have some of the best flavor. Some peels will give the 'sauce a nice red color.

You have to have your own tree for Transparent or Duchess, both very early apples. They don't last but a day or two when they ripen, so they are not useful for selling. When your Transparents start to get ripe, start shaking the tree every day and don't let 'em ripen all the way on the tree. My first apples this year were ready to eat in mid-July, which is incredible for New Hampshire. I think the Transparent and the Duchess are the finest apples in the world.

JUNE WINNER

"The Voice of Wolf Creek" apparently reached quite a few of our readers, since they voted Dr. William C. Hess W6CK's article of the same name the best in our June issue. Enrich the author of your favorite article by $100 by using your Reader Service card ballot!

PETERBOROUGH FLEA MARKET

As if Sherry doesn't have enough to do, she decided to run a flea market in the parking lot of the 73 West building, in June. That's Sherry in the middle, with Ross, our full-time plumber, on her left, going in to see what he can do with the air conditioning system.

Aline Coutu, our advertising manager, brought over some of the ponies from her stables so there would be pony rides for the kids. One of the nice aspects of living in New Hampshire is that you can have your own stable if you like. Aline has quite a spread, complete with an indoor riding ring, and she and her family board about 30 horses and ponies.

Here are some of the pony rides . . . note the country background! Peterborough is a small town, and just one-half mile from the center of town you start getting into the forested areas. Though only an hour from Route 128 around Boston, Peterborough is a rural area.

Contests

from page 28

may be worked once on each band. The general call will be "CQ ARAC 50."

EXCHANGE:

Arrowhead amateurs send RS(T), county, and state. All others send RS(T) and ARRL section or country.

FREQUENCIES:

CW—3535, 3725, 7035, 7125, 14035, 21035, 21125, 28035, 28125.

Phone—3980, 7280, 14280, 21360, 28560.

SCORING:

Each CW contact with a Novice or Technician counts 5 points; all others count 1 point. Multipliers are: 5 for Novices/Technicans, 5 for 5 Watts or less, 2 for 6 Watts to 200 Watts, 1 for 201 Watts to legal limit. Arrowhead amateurs take the number of points times the sections/countries worked times the multiplier to get the total score. All others take number of points times 5 times the number of counties worked times the multiplier.

AWARDS:

Plaques to top-scoring Arrowhead amateur and top-scoring amateur outside area. Certificates for second and third place and to top-scoring amateur in each ARRL section and country.

ENTRIES:

Logs must show band, mode, date/time in GMT, station worked, exchange sent and received. If more than 100 contacts are made, dupe sheets must be included for each band used. Send entries to: ARAC-50, 123 E. 1st Street, Duluth MN 55802, with an SASE for awards and results. Entries must be postmarked by November 21.

CRAZY EIGHT NET QSO PARTY

The Crazy Eight Net of Pittsburgh PA will hold its first annual QSO party on October 28 and all stations are welcome to participate. Only certificate holders, however, may submit logs! All contacts must be made on 10 meters. Operating period will be the full 24 hours beginning at 0000 GMT October 28. Scoring as follows: Each contact is one point with an additional point for each contact having a 10-X number, and another additional point for each contact having a Crazy Eight number. Maximum point value per contact is 3 points. Awards will be issued to the top-scoring DX station. Submit logs with call, name, QTH, time, frequency of contact, 10-X number, and Crazy Eight number to contest manager no later than November 28. Contest manager is Jim Lundberg WB3ICC, 571 Washington St., McKeesport PA 15132. Enclose an SASE for a copy of the results.

CLUB STATION WD4KOW

Members of the Colquitt County Ham Radio Society will be operating club station WD4KOW from the site of the second annual Sunbelt Agricultural Exposition on October 9, 10, 11, 1979. The hours of operation will be 0900 to 1600 EDST each day.

This annual Sunbelt Expo is the largest agricultural show in the south. The first Expo last year drew 140,000 visitors from all over the United States and Canada during the three-day period, and this year attendance is expected to hit 200,000.

Operations will be mostly on 40 and 20 meters around 7.250 and 14.300 MHz with some operations in the other HF bands. The members will also be listening for visiting hams on the local repeater, 146.19/79. Visiting hams are invited to visit the amateur booth at the Expo and operate the amateur station.

This year, special QSL cards are being printed for this event and will be available for those making a contact and desiring one. For more information, contact the Colquitt County Ham Radio Society, PO Box 813, Moultrie GA 31768.

W3LWW CELEBRATES 20TH ANNIVERSARY

The Foothills ARC of Greensburg PA will be celebrating its 20th anniversary by holding a mini field day from 1400 UTC, Saturday, October 20, through 1400 UTC, Sunday, October 21, 1979.

Phone and CW operation will take place on 10 through 80 meters, 5-10 kHz up from the bottom of the General class portion of each band.

Certificates will be awarded to anyone working W3LWW (SASE required).

AIRSHO '79

An aeronautical mobile operation aboard a Boeing B-29, using the call W5DX, is scheduled to take place during the Confederate Air Force Ghost Squadron's Airsho '79, October 4th to 7th, in Harlingen, Texas. Communications will be available on 14.285 MHz and 21.385 MHz (as propagation permits) during the hours from 12:00 pm to 5:00 pm CDT. Local fixed stations will act as liaison for interested amateurs wishing to make contact with the B-29. A commemorative photo QSL card is planned.

Results

1979 BARTG RTTY CONTEST RESULTS

SINGLE OPERATOR

Call	Points	Total QSOs	Countries
F9XY	445720	290	37
W3EKT	428610	298	34
W7BV	408292	290	36
IT9ZWS	400656	287	36
I5GZS	392274	252	35
W3FV	372204	260	33
SM6ASD	356544	265	34
K8NN	346632	229	36
I5FZI	321816	242	33
C5AAN	319510	241	34

MULTI OPERATOR

Call	Points	Total QSOs	Countries
I5MYL	525332	373	44
W1MX	384116	238	36
G3ZRS	306816	211	37
SM5HEV	286704	235	32
G3UUP	263256	227	31
DKØOW	225342	167	30
OK3RMW	174848	164	32
YO3KAA	160430	163	27
LZ1KDP	149760	192	31
UK4FAD	119520	149	25

SHORTWAVE LISTENERS

Call	Points	QSOs	Countries
I1-50071	568764	381	37
IV3-13018	420912	292	45
OK1-11857	389546	263	45
P. Menadier (USA)	354760	250	37
H. Ballenberger	326890	233	33
Kurt Wustner	237440	175	32
Terry Musson (GB)	130744	152	29
DM8987/K	120628	114	26
Barry Niendorf (GB)	112394	62	32
Anton Muench (DL)	95616	108	28

Ham Help

I'm interested in learning about all the modifications which can be made to the Clegg Venus 6m transceiver. I'm particularly interested in reducing the receiver internal noise level.

I have been told that replacement of the 12BE6 converter with a dfferent tube and some wiring changes reduces the noise level. If anyone has any info on this or other changes, I would appreciate hearing from them.

Leon A. Savidge WA3EFE
Box 268, RD #2, Park Ave.
Binghamton NY 13903

I have been contacted by a local Civil Air Patrol (CAP) unit in need of radio equipment. If anyone can donate equipment, operating or not, I am willing to donate my time and parts to repair the equipment and pay shipping charges, if needed. An IRS donation form can be made available to donors for tax use for some equipment.

CAP operates on 4.4-MHz SSB, 28.8-MHz AM, and 143.90- and 148.90-MHz FM. CAP is a volunteer air search and rescue group that has saved several lives of victims of downed aircraft.

If you have any equipment available, or would like more information, please contact me at the address below. Thank you.

Peter J. St. Arnaud
PO Box 695
Lowell MA 01853

I have a Cosmos Industries Cosmophone 35 transceiver that I would like to obtain a manual for. Can anyone lend me a manual or a copy of same? Of course, copying costs would be covered.

Mel Stoller K2AOQ
51 Allendale Avenue
Rochester NY 14610

Awards

from page 24

123 E. 1st Street, Duluth, Minnesota 55802, before December 1, 1979, to receive this free award.

As time goes on, be sure to continually check this column for announcements of any new awards we may have added to our program. A month doesn't go by that I scratch out another set of Ideas and consider them for submission to headquarters staff. Perhaps you have some ideas of your own. Use your creativity, put your Ideas down on paper, and forward them to me.

In the meantime, continue to work those new contacts whether it's for a new state, city, or DX country; they're all important to you, so don't waste another minute! You work the stations and we'll issue the awards; the *73* Awards Program offers something for everyone!

Next month we will travel overseas and review the various awards being offered by our foreign friends. Additionally, we will look at a couple programs offered by stateside organizations.

LETTERS

from page 14

this may be old news to you. However, I heard the Russians playing with twenty for 45 minutes last night and it hacked me off so much I had to let out anxiety somehow. . .so I wrote you.

Steve Baumrucker WD4MKQ
Chapel Hill NC

P.S. Went back to my rig and the Russians reverted to the old radar system and things were business as usual! Can't figure this one out. . .

2M BEACON

A two-meter beacon station has been put on the air by the Marissa Amateur Radio Club, Inc., on July 1, 1979. This beacon will be to plot propagation and signal paths in the two-meter amateur radio band. The beacon will prove very useful to all who work the VHF spectrum.

The beacon is a project of the teenage group of the 100-member club which is located 50 miles southeast of St. Louis MO. The group will need to make a full report to the FCC at the end of December so all receiving stations are kindly asked to send their reports and weather conditions at the time to the club station, WD9GOE, PO Box 68, Marissa, Illinois 62257, attn: beacon committee.

Technical information:

Frequency—144.050.

Emission—A1 and F1 (a slightly deviated 1-kHz signal is on top of the A1 CW signal so that FM receivers are capable of detecting it).

Power—one Watt output from a VHF Eng. rf strip.

Control—220-MHz link.

Emission control—VHF Eng. CW-ID board with solid-state keying circuits added.

Power supply—12-V auto-type sealed battery with charging circuit.

Antenna—4 stacked dipoles, 2 vertical, 2 horizontal.

Height—250'.

Location—Baldwin, Illinois, 4 miles southwest of Marissa, Illinois, 55 miles southeast of St. Louis MO.

Times of operation are continuous, 24 hours per day.

Bob Hell K9EID
Marissa IL

THE QUEEN

Many thanks for the terrific coverage you gave the Associated Radio Amateurs of Long Beach and me in Bill Pasternak's story about W6RO in the wireless room aboard the *Queen Mary*.

This operation is not just a single PR stunt. With few exceptions, the station operates seven days a week with volunteer hams from throughout the area. I believe this is the only time any public display of amateur radio on a continuing basis has ever been established. So interested are the tourists in the operation that answering questions about ham radio occupies a great deal of our operator's time. As the station is part of the tour, it is estimated that about 80,000 people will see the station in operation during a year.

Again, many thanks for all your interest, from all of us in the Associated Radio Amateurs of Long Beach.

Nate Brightman K6OSC
Long Beach CA

FIRED

In your August editorial, under the subcolumn "WARC," you write that if the ARRL doesn't shape up, you'll do something about it. We both know that the League won't do anything, so it's time you went into action. The winds have been changing for a long time, and the boys in Newington still can't tell from which direction it blows.

I think you can get enough support from progressive and concerned amateurs to make a new organization successful. This is to (pardon me) light a fire under your ass and get you moving so that there'll still be amateur radio in the years ahead.

Keep up the good work with *73*. You may not have all the answers, but you raise the right questions. The League's LRPC is a hollow toothless group set up to quell the increasing dissatisfaction brewing in the amateur ranks. The time has come to stop talking and take positive action, and you're the man to lead the way. Best wishes for your continued success.

Scott Liebling WA3OXG
Baltimore MD

NEUTRAL

I have often felt that *73* lacked a rallying cry, a slogan if you will, an eye-catching, rousing phrase with an impact—words that would instantaneously impart to anyone picking up a copy of *73* the thrust and dynamic spirit of the magazine and its editor/publisher.

CQ states, on its cover, *"Serving Amateur Radio Since 1945"*—not much there!

QST says, *"Devoted Entirely To Amateur Radio"*—pretty bland!

How fitting it would be to see the cover of *73*, alternatively the vacant topside space of your editorial page, reflect the credo which I believe best exemplifies *73* and Wayne's personal stance in the field of ham radio: *"Neutral in nothing affecting the destiny of amateur radio."*

If that doesn't say it all, I don't know what does, Wayne! It would be interesting to determine how it strikes your staff.

Anyway, it's yours to do with as you wish. . .you may even desire to have it inscribed on your headstone when and if you ever depart this mortal sphere!

All the very best, Wayne, and please continue to be non-neutral (actually, I have no fear that you will ever change). I do enjoy receiving *73* over here and have a ready recollection of your visit to Frankfurt several years ago.

Burt Hubbs DJ0KQ
Frankfurt, Germany

LONELY

I got a brand-new CB rig and converted it to ten meters, using the "*73* band plan," just as suggested in the magazine.

Three weeks have passed and I have spent hours in consultation with this little box and its attendant power supply. My fingers are worn to the bone, going back and forth, up and down the forty positions, seeking a signal . . . some kind of noise . . . a voice from the past, perhaps . . . even an old, much-used cuss-word from the CB band would delight me! I can report nothing! Though the job checks out perfectly with the meter, I'm wondering if I'm even within the ten-meter band.

Considering the fact that there must be hundreds of amateurs who are suffering from the same malady, would you try to scare about two or three dozen down our way so that we might achieve just one contact and make our efforts worthwhile? You have no idea how lonely it's been these last weeks!

Dean Sturm K8CYW
Huntington WV

NIGERIA

Amateur operation here in Nigeria is now picking up and more stations are getting on each month, including even some activity on SSTV, so before long Nigeria should be one of the not-so-rare countries on the bands. Some calls heard on the bands have other prefixes than the old 5N2; now you might hear anything from 5N0 through 5N9, depending on which zone the station is in; the zones are divided among the 19 states that comprise the Federal Republic of Nigeria.

Richard Fitzgerald
WA5UTF/5N4
Lagos, Nigeria

Looking *West*

from page 10

gave the trade name Betamax. The first Betamax units (SL-7200 series) were also one-hour time limit machines like their big brother the U-Matic, but tape cost was less than half as much. Slowly but surely the Betamax caught on and began to spread into many American homes.

The one-hour time limit was still a drawback, however, until in late 1977 RCA and a number of other manufacturers announced that they also would be entering the home video recording market with machines utilizing the VHS recording format. VHS, which stands for Video Home System, is also cartridge format, but it has the added advantage of up to four hours record-play time. Unfortunately, Beta and VHS cartridges differ in size and are not interchangeable. Most VHS machines are two-speed affairs that record two hours at full speed or four hours at half speed, with some reduction in overall resolution at the reduced speed.

Not to be left out in the cold, manufacturers committed to the Beta format countered by introducing dual-speed and half-speed machines that gave up to two hours record-play on a one-hour tape cassette and then introduced a 1½-hour tape that would give up to three hours at half speed (or "X2" as it is called). Again, the Beta vs. VHS race was on with VHS appearing to be the eventual winner.

(A few weeks ago I read in one of the trade journals that Toshiba has developed an "Up To 6-Hour Beta Format Machine," and with this occurrence, the outcome of the race for the consumer dollar is anyone's guess. However, this should not keep you from obtaining a machine of your choice if you desire one.)

Regardless of which system is the eventual winner in the race to become the national standard—if, indeed, there ever is a winner or a national standard established—it's safe to say that both the Beta and VHS formats will be with us for a long, long time. Tapes, both blank and prerecorded, are in abundance for both formats, and both systems perform admirably. I went with Beta because I happen to like the machine and the results I get, but you should not judge by this. Judge for yourself, based upon your personal tastes and needs. I will tell you that having a home videocassette recorder is well within the pocketbook of most people these days. Even *73* writers.

Suppose you, yourself, have what you feel to be a good amateur-radio-related presentation. You have given it locally and now other clubs or conventions far distant want you but cannot afford to pay for transportation and/or lodging. You want to go, but with gasoline now over a dollar a gallon, you are forced to decline. If only there were some other way!

And indeed there is, if you or someone you know happens to own a home videocassette recorder and a camera. Even if not, they can be rented. Add a few lights and a friend to act as cameraperson and you literally have your own mini-production company. If you have the equipment or can get your hands on it, your cost for the raw tape will be between $14 and $20.

You do not have to be an expert at producing your own "educational spectacular." Suppose you make a mistake halfway through. If the machine you are using has good lockup, you might be able to rewind back past your boo-boo and pick up the presentation from that point. Or, you could simply rewind all the way and begin again. It's up to you and depends upon the level of perfection you are seeking. That's the nice thing about tape. Mistakes cost only time.

Video recording is here to stay and what can be done with it will amaze you once you get into it. Each day new ideas pop up in which a videocassette recorder can play an important part. Who knows; someday in the future this magazine may come to you in the form of a videocassette. Imagine having Wayne Green in your living room reading his famous editorials to you!

THE TEXAS REPORT

Walt Wiederhold W5OGZ is the Texas State Coordination Chairman for the Texas VHF-FM Society. In the current issue of that organization's newsletter, Walt relates the following:

"This quarter has seen a net increase of eight repeaters in the state. Of course, this is a gradual change and not something that takes place overnight. Many of the new repeaters have been in the planning stage for some time and have just been put on the air.

"We are always glad to see more repeaters since they serve such a good purpose in the amateur world today. But don't forget that other forms of communication work very well in the amateur bands and they should be used where possible. Working DX through a repeater doesn't really prove your rig as much as working the other station direct would. So you have a good antenna and you find that you can work across the state line into a repeater over there which is 200 feet in the air with quite a bit of power. Wouldn't it be better to use your ingenuity to talk to a station like your own without the use of the repeater?

"Every band from six meters through 1296 MHz can be used for repeaters and also for these other forms of communications. It would be most gratifying to see a big increase in activity in the 220 and 450 MHz bands and also in the higher frequency bands. We are not saying that 1296 is the top . . . just that it seems like the top right now just as six and two meters did at one time. Greater things are coming, so how about getting in on the ground floor by using your talents to explore the uses of the higher frequency bands? Didn't mean to leave out ten meters either, but it's a special band in itself.

"Wichita Falls, on April 10th, proved the need for emergency-powered repeaters. We hope a lot of operators will try to provide such power for their repeaters so they will be more likely to stay in operation when the need arises. Several repeaters in the state already have emergency power. Tornadoes can strike anywhere. Does your repeater have auxiliary power? Even the club generator, usually used on field day, can be used for that purpose. Think about it a bit and make some needed improvements in your setup."

TO THE FUTURE DEPARTMENT

I wish to close this month with the following thought from Jean AJ6Y which appeared in the June, 1979, issue of *Key-Klix*, the newsletter of the Santa Barbara Amateur Radio Club. With the World Administrative Radio Conference now upon us, I feel that the following is truly apropos.

"Many things have happened since Samuel F. B. Morse on Friday, May 24th, 1844, at 8:45 am sent the first telegraph message to Alfred Vail over the wires for a distance of forty miles. If each one of you will look back over your experience with radio and Morse code, you will see what I mean. The technology of this event was far beyond the scope of most people of the time and the event itself was probably viewed in the same way that you and I react to pictures from Jupiter. I keep wondering about the future of amateur radio and what the communication picture will look like in the year 2000 . . ."

As we remember the achievements of Samuel F. B. Morse, Thomas Edison, and others, so should we remember the foregoing from AJ6Y. In a very few words, Jean has said it all.

Review

INDEX TO HOW TO DO IT INFORMATION

(1978 edition, Mary Lou Lathrop and Norman M. Lathrop, Norman Lathrop Enterprises, PO Box 198, Wooster OH 44691; 161pages; $10.00 + $1.16 shipping)

How many hobbies do you have? Mine number at least seven at the moment: microcomputing, photography, electronics, astronomy, scale modeling, camping, and (of course) amateur radio. These diverse avocations have one thing in common. They are do-it-yourself hobbies—active, rather than passive, ways of using leisure time.

Recently, I discovered a very useful book for us do-it-yourself types. It's called the *Index to How To Do It Information*. This book indexes magazine articles from 52 different publications, ranging from *McCall's* to *Scientific American*, and *National Carvers Review* to *Kilobaud Microcomputing*. That's quite a range.

More than 1,000 subject areas have been used to catalog the magazine articles, making it easy to zero in on specific items of interest. Subject areas are liberally cross-referenced, so you'll often find yourself looking for more information under headings you might otherwise have missed. When you look up "Radio," for instance, you are advised to check no less than 13 other subject headings for further information.

The *Index* is very strong on electronics, photography, and all types of crafts. At present, articles from the ham magazines are not included, but new publications are being added to the *Index* every year. Naturally, this book is useless unless you have access to the publications it references. However, if your local library has a good periodicals collection, ten dollars invested in the *Index to How To Do It Information* would be money well spent.

Jeff DeTray WB8BTH
Assistant Publisher

DX

from page 12

the last to operate there several years ago) is talking about maybe trying again next summer, and a G-land group has high hopes for an operation in the immediate future. Work 'em first . . . etc.

Hans ST0RK has a new linear and TH3 beam courtesy of the W7PHO group. Look for Hans on Sundays around 21320 or 28600 kHz and during the week on 14225 kHz between 1500Z and 1600Z.

Bob T2AAA is on 14225 kHz almost daily from 1200Z.

A group of UA0 types will be signing U0Y from Tana Tuva in rare zone 23 from now through November 20th.

Congratulations to Dan WD6CDU/KH9 for a first-rate performance from Wake Island. Dan's debut into DXpeditioning was a model of good operating practices.

OH2BH had to cancel his Mt. Athos plans due to a prior commitment with the stork.

DJ9ZB's *QSL Managers Directory* is updated quarterly and presently contains some 3900 listings. Price is $5.00 and it is available directly from DJ9ZB.

Lou 3A2HB keeps regular Tuesday skeds with N1ACW and W4LRI on 14240 kHz at 2000Z.

Father Moran 9N1MM is down to 100 Watts since his linear died. Someone advised him to tune for maximum smoke. That's what he did and that's what he got.

During the period October 10 to November 10, Dutch amateurs will be allowed to add a "5" to their callsign, signifying 50 years of amateur radio in the Netherlands. PA0s will become PA50s, PA1s become PA51s, etc.

Slim was back at his original QTH recently again signing 8X8A from Cray Island. Some may remember when Slim signed 1Z4NG, lined up a QSL manager, and then actually forwarded his logs and a stack of QSL cards to the manager. Everything was going fine until the ARRL bounced all the cards back.

Jim Walter WA4GWD, who recently signed VP2VFD, dropped us a note to let everyone know that the correct QSL route is 249 Clearlake Drive W., Nashville TN 37217.

New officers of the Northern California DX Club are President—Ted Davis W6BJS, VP—Ron Rasmussen K6OP, Secretary—Joe Dillow W6UR, and Treasurer—Dave Palmer W6PHF. Directors are Charles Kump W6ZYC, Hal Godfrey N6AN, and Merle Parten K6DC.

Gordon Orelli K1OR has worked WAZ from five different QTHs. Working 3B8DA finished his latest one off from Brazil. Wonder if anyone else has worked WAZ from more than two locations.

ZS4MG reports never receiving any H5AA logs, so he can't fill the many QSL requests.

Has anyone received a bona fide card from LU3ZY or 5R8AL?

ARRL membership at the end of May totaled 167,541, up from 165,163 at the end of January. Total amateur licenses came to 363,820, including 66,363 Novices, 69,162 Technicians, 120,903 Generals, 84,181 Advanceds, and 23,211 Extras.

For the last couple of years, there has been a persistent jamming of DX activities in Europe. Finally fed up with the constant interference, a group of irate European DXers set out with RDFs and soon identified the culprit as an EI type. Swedish authorities have forwarded complaints through official channels and some Swedish amateurs have openly identified the EI station in on-the-air QSOs in a vain attempt at clearing up the problem. SM5BBC was recently discussing the problem on the air and a few days later ZA2BC showed up giving SM5BBC as the QSL route. Slim seems to be not only persistent, but vindictive as well.

The correct QSL address for all of K5VT's operations including K5VT/5T5, /6W8, /5H3, SV5, and XT2AE, 9G1LM, and TY9ER is c/o W2TK, 366 Rutherford Avenue, Lyndhurst NJ 07071.

Although it may all be straightened out by the time this column appears in print, as of early August the TH8JM problem was still very much up in the air with those holding QSLs wondering if they would ever be accepted by the DXCC desk. The origin of the TH8 prefix dates back some ten years when the American Ambassador there was issued a TH8 license with the stipulation that the Ambassador could issue TH8 licenses to any members of the Embassy delegation, but not to visitors. Since this privilege was never rescinded and since TH8JM is an Embassy communications officer and therefore a member of the Embassy delegation, it would seem on the surface that everything is on the up and up and there would be no problems in getting the confirmations accepted for DXCC credit. Of course, life for the deserving is never easy and problems have developed somewhere along the line. Fortunately, another license, TL8JM, has been issued and the necessary documentation forwarded to those hard-to-please guardians of the eternal DX flame in Newington. The Delta DX Association has forwarded a new Yaesu rig, and, if everything works out, before long TL8 will probably be just more garden-variety DX.

NOVICE CORNER

Never, but never, go to your local post office and purchase IRCs. The best source for IRCs at a reasonable price is one of the more active QSL managers. They receive IRCs from overseas stations and are usually quite happy to unload them in bundles of 25 or so for something in the neighborhood of a quarter each. An especially good source is the QSL manager or managers of a recent DXpedition to some exotic location. They receive literally thousands of IRCs and generally announce their availability once the QSLing has been taken care of. Once the announcement has been made, they disappear in short order, so it is important to plan ahead and get your request in early.

OKINO TORISHIMA

We just received two photo QSLs from the recent JF1IST/7J1 DXpedition to Okino Torishima and they are fantastic! One shows a wide view of the island(?) with the operating platform jutting up from the sea. The other one has a close-up shot of the tent on top of the operating platform. Hopefully, we will have some color shots of this one-man operation for next month's column.

WEST COAST DX BULLETIN

With honest regret, we report that the weekly *West Coast DX Bulletin* ceased publication with the July 18th issue. The *Bulletin* was a one-man effort by Hugh Cassidy WA6AUD. During the all-too-short eleven-year life of the *Bulletin*, Cass somehow managed to never miss a week in bringing us all the latest DX news. Much of what you read in this column came straight from the *Bulletin*'s multi-colored, hand-typed pages. Thanks a lot, Cass; it was fun.

DX RIDDLE

Someone finally sent in the correct answer to our DX Riddle—which three DXCC countries share the same prefix but are located within separate continental boundaries? Actually, there turned out to be more than one correct answer. Will Roberts AA4NC and Tim Fanus WB3DNA guessed KA1 USA, KA1 Ogasawara, and KA1 Minami Torishima. Rick Cole WD4CTA was the only one to come up with the answer we had in mind: HK0 Mai Pelo, HK0 Bajo Nuevo, and HK0 Serrana Bank. Congratulations, guys, and thanks to everyone who took the time to send in an answer.

That's about all there is for this month. Remember, pictures and DX news are always welcome.

Thanks for much of the preceding to JA1NRH, WD4CTA, AA4NC, WB3DNA, WD9COA, WA4PRU, WA1ZXF, N8AJA, VE2FIT, the LIDXA *Bulletin*, *Worldradio News*, and, for the last time, the *West Coast DX Bulletin*.

Ham Help

I wish to purchase, in any condition, a BC-314. I will pay a fair price plus shipping costs.

Kenneth Hunt
6519 Valhalla Ave.
Klamath Falls OR 97601

I need operating manuals with schematics for a Hallicrafters SX-40B receiver and an Eico 720 transmitter. I will pay in advance by money order for originals or good copies.

George E. Davidson KA4FNB
5290 Joan of Arc Place
College Park GA 30349

An Icom 701 international users club is now operational. Send an SASE for details.

Rob Pohorence N8RT
9600 Kickapoo Pass
Streetsboro OH 44240

I'm looking for information on how to combine my Superboard II from OSI with ham radio for RTTY, Morse, and ASCII send and receive functions. Can anyone help?

C. B. Smith VE3IEN
33 Todd Road
Agincourt, Ontario
Canada M1S 2K2

I have a Midland model 13-895 SSB Citizens Band radio, and wish to convert it to 10 meters. I have not as yet seen an article on this particular rig. Can anyone help? I recently picked up my General ticket and I am curious as to what is happening on 10.

Larry Starkweather
5731 Desert View Dr.
La Jolla CA 92037

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14A	14	14	7	7	7	7	7	14	14A	21A	21A
ARGENTINA	21	14	14	14	7	7	14	21A	21A	21A	21A	21
AUSTRALIA	21A	14	7A	7B	7B	7B	7B	14	14	14A	21A	21A
CANAL ZONE	21	14	7A	7	7	7	14	21A	21A	21A	21A	21A
ENGLAND	7A	7	7	7	7	7A	14A	21A	21A	21A	21	14
HAWAII	21A	14	14B	7B	7	7	7	7B	14	21	21A	21A
INDIA	14B	14B	7B	7B	7B	7B	14	21	14	14	14	7B
JAPAN	21	14	14B	7B	7B	7	7	7	7B	7B	14	14A
MEXICO	21	14	7A	7	7	7	14	21	21	21A	21A	21A
PHILIPPINES	14A	14	14B	7B	7B	7B	7B	14	14	14	14B	21
PUERTO RICO	14	14	7	7	7	7	14	21A	21A	21A	21	21
SOUTH AFRICA	14	14	14B	7B	7B	14	21A	21A	21A	21A	21A	21
U. S. S. R.	7	7	7	7	7B	7B	14	21A	21A	14	14B	7B
WEST COAST	21A	14	7	7	7	7	7	14	21	21A	21A	21A

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	14	7	7	7	7	7	14	21	21A	21A
ARGENTINA	21	14	14	14	7	7	14	21	21A	21A	21A	21A
AUSTRALIA	21A	21	14	7A	7B	7B	7B	14	14	14A	21A	21A
CANAL ZONE	21	14	14	7	7	7	14	21	21A	21A	21A	21A
ENGLAND	7A	7	7	7	7	7B	14	21	21A	21A	21	14
HAWAII	21A	21	14	14B	7	7	7	7	14	21A	28	21A
INDIA	14	14	7B	7B	7B	7B	7B	14	14	14	14	7B
JAPAN	21A	14	14B	7B	7B	7	7	7	7B	7B	14	21A
MEXICO	21	14	7	7	7	7	7	14	21	21	21A	21A
PHILIPPINES	21A	14	14B	7B	7B	7B	7B	14	14	14	14	21
PUERTO RICO	21	14	14	7	7	7	14	21	21A	21A	21A	21A
SOUTH AFRICA	14	14	14B	7B	7B	7B	14	21A	21A	21A	21A	21
U. S. S. R.	7B	7	7	7	7B	7B	7B	14A	21	14	14B	7B

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21A	14A	14	7	7	7	7	7	7A	14	21	21A
ARGENTINA	21A	21	14	14	14	14	7B	14	21A	21A	21A	21A
AUSTRALIA	28	28	21	14	14	7B	7B	7B	14	14A	21A	21A
CANAL ZONE	21A	14	14	7	7	7	7A	21	21A	21A	21A	21A
ENGLAND	7B	7	7	7	7	7	7B	14	21A	21A	21	14
HAWAII	28	21A	21	14	7	7	7	7	14	21A	28	28
INDIA	14	14	14	7B	7B	7B	7B	7B	14	14	14	7B
JAPAN	21A	21	14	7B	7B	7	7	7	7	7B	14	21A
MEXICO	21A	14	14	7	7	7	7	14	21	21	21A	21A
PHILIPPINES	21A	21A	21	7B	7B	7B	7B	7A	14	14	14	21A
PUERTO RICO	21A	14	14	7	7	7	7	14	21	21A	21A	21A
SOUTH AFRICA	14	14	7B	7B	7B	7B	7B	14	21	21A	21A	21
U. S. S. R.	7B	7B	7	7	7B	7B	7B	7A	14	14	14B	7B
EAST COAST	21A	14	7	7	7	7	7	14	21	21A	21A	21A

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor
SF = Chance of solar flares

october

sun	mon	tue	wed	thu	fri	sat
	1 G	2 F	3 G	4 G	5 G	6 G
7 G	8 G	9 G	10 G	11 F	12 F	13 F
14 F	15 G	16 G	17 G	18 G	19 G	20 G
21 F	22 F	23 G	24 G	25 G	26 G	27 G
28 G	29 G	30 G	31 P			

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Info

nagging, and other negative means to try to force him to do what you want, you'll be as successful as the FCC was in trying to force hams to get the Extra class license. They flatly refused to do it until the FCC came up with some rewards instead of punishment.

There is one feature of many ARRL conventions that irritates the hell out of me. This is the SWOOP ridiculousness. I think that stands for the Suffering Wives of Operating Personnel or some such foolishness. One high point of these SWOOP meetings is the destruction of a piece of ham equipment by the wives . . . taking out their frustrations and resentments on equipment. Disgusting.

Won't you be happier if your husband is happy? So all you have to do is look at the good points and work out ways to have him enjoy some of the things you want to do, too.

Now, OMs . . . it is really important for you to come to terms with your wife. Explain to her that your love of your job or your love of amateur radio are not taking away from your love of her. Your progress in your job is a reflection of her help . . . and your fun and relaxation with amateur radio are an important part of your life. It is important that you be considerate and fair. You can't really expect her to enjoy being dragged to a hamfest and made to look at a hundred booths full of ham gear and parts any more than you'd probably want to go to a knitting show. You'll be happier in the long run if you go to a hamfest and give her the car and a credit card . . . and tell her how to find the big shopping mall. She might get you a present. She also might put you in hock.

Despite the fun you have with amateur radio, you still have responsibilities to the world . . . to do a good job of work . . . and to keep your wife and family happy. It's tough to have dinner with another ham and not sit talking ham talk all night, so keep this in mind and maybe get your wives together at the next table for their dinner so they can talk, too. In the long run, you'll get a lot more out of ham radio if you have a good working relationship with your wife about it.

MICRO COUNTRIES

A chap who specializes in getting information on very small and often virtually unknown countries called the other day. I think I convinced him to write an article which should be of intense interest to DXers . . . and even more to hamming activity from there, more's the pity. And Sealand is still virgin territory. Do I have to start working on these things myself? I have plenty to do without leading another DXpedition somewhere.

He mentioned that as far as he knows, Miller's St. Brandon's Island is completely mythical. He also suggested a new one which has never been done by a DXpedition . . . an easy-to-reach island in the Mediterranean. Anyone interested in putting a new one on the air? If I tell you the name, I know damned well that a bunch will pop off to there and I'll get left behind. I've had that happen a couple of times. I'll be cagier this time.

FIFTH ANNUAL HAM WORKSHOP JANUARY 12-19

Members of the ham industry get together each January in Aspen, Colorado, for a week of skiing and workshops on ham topics. With the growth of amateur radio stagnating and the sales of ham gear along with it, both manufacturers and dealers will be discussing plans for getting the hobby going again.

Some of the problem is obviously the drop in interest in CB radio, which had gotten thousands of newcomers interested in radio communications each year. Another has been the worry over what might happen at WARC. Still another has been inflation and the recession. One of the workshops will be devoted to discussing ideas for reviving interest in hamming.

Those firms in the consumer electronics business may want to go first to Las Vegas for the Winter Consumer Electronic Show, January 5-9. Then, for those with a strong stomach, there is SAROC, January 10-12. One day of that is more than enough, if they have the same number of exhibitors as two years ago and the same exciting program. If enough people want to fly from Las Vegas to Aspen, we could charter a special plane.

There are workshops planned on dealer financing, mail-order success, how to get over $50,000 in free advertising, what the ham gear of 1983 will be like, how the ARRL turned the American ham industry over to Japan, how to design and write ads which will sell like crazy, where to run the ads, what to do about the WARC results, etc. It should be understood that the workshops will not interfere with skiing.

The host hotel this time will be the Limelight, which is one block from downtown Aspen. You won't need a car. The organizing committee for the Ham Workshop checked out Vail last winter, just to make sure that it was not as good as Aspen. It wasn't, despite its having a McDonald's and a Burger King. Aspen has more good restaurants per square mile than any other town in the world . . . and some of them are incredible. I've got to start dieting, to be ready for that.

You are on your own as far as getting to and from Aspen is concerned . . . and also hotel reservations. Please let Sherry know (c/o *73 Magazine*, Peterborough NH 03458) so she will include you in the meeting room plans and dinner reservations. There is no charge for the event again this year . . . except for the costs of Aspen, which are formidable. Any manufacturer, dealer, or even a ham seriously interested in both skiing and the progress of amateur radio is invited. We have about a dozen signed up so far . . . including Chuck Martin WA1KPS of Tufts Electronics.

It will be fun and might be money well spent if you get one good idea which bears fruit in business.

JULY WINNER

July's most popular article, as voted by our readers with their Reader Service card ballots, was James Wyma WA7DPX's "So You Want to Raise a Tower." A check for $100 is on its way to him.

Ham Help

I have acquired a Model 34 oscilloscope manufactured by Bell & Howell Schools—De Vry Institute and need manuals and/or information on it. I would like to purchase the manuals, if possible, or borrow them for copying. I will pay for all expenses. Any assistance will be

I would like to exchange ideas on Atlas 210 mods.

Chris Kilgus N7ABI/0
PO Box 3000
Boulder CO 80307

I'm interested in contacting anyone who has experimented in the VLF (FCC Part 15 approx-

LETTERS

INTRUDER WATCH

Wells R. Chapin W8GI
Byron H. Kretzman W2JTP
Steve Baumrucker WD4MKQ

I refer to W2JTP's comment to W8GI in the August, 1979, Letters section regarding the ARRL and the Intruder Watch.

I do not think that you are correct about the ARRL coining the word "Intruder" and establishing the first Intruder watch —well, not exactly. I believe from the RSGB's *Radio Communications* publication and other sources that the "Intruder Watch" was first formed in Britain and was followed, somewhere around 1965 in the USA, as one of many such watches organized under the IARU around the world. However, the thousands of reports monthly via the ARRL and massive help from the FCC Monitoring Branch and Treaty Branch have brought about many improvements, but not in every country. It was my estimate some time ago that about 80% of the intruders (disregarding assigned sharing of the 40- and 80-meter bands by normal broadcasting) were Russian, 10% Chinese, with the remaining 10% being miscellaneous intentional or accidental occupants.

My records were searched over the past several years, but none of you was listed in the "roster" of USA and Canadian "Intruder Watchers." The ARRL could not begin to handle the massive problem of intruders using paid help in Newington, but they do make an effort (particularly before the present "bind" in Newington regarding manpower) to keep up with the IARU monitoring system.

Within that system, and sometimes a little outside of it, we have eliminated numbers of intruders—but few Russians or Chinese. Personal contact also has been helpful, including designing antenna traps for distant broadcasting stations, getting some moved to proper allocations, and so on. BBC Johore (Far-East Relay) had a strong harmonic on 14240 kHz; with the help of the British watch, BBC designed a new antenna trap for the second harmonic of 7120 kHz, then wrote to me saying that they had reduced the harmonic to −76.9 dB, asking me to check it (it had completely disappeared) and to inform them informally if it ever returns. Many such improvements have been brought about.

But the manpower to listen to cassettes of Russian fishing boats on 3550/3650 kHz and the like just wasn't available at Newington, which already had received many, many identifications, calls, times, frequencies, dates, and records of alerting FCC Monitoring to confirm this intrusion of 80 meters.

If you look into the *ARRL License Manual*, you will find a "Geneva Amateur Allocations Summary" taken from their big allband "Allocations" chart. This shows that mobile services share the 3500-3800-kHz segment of the 80-meter band in Region 1 (Europe-Africa-Siberia-Middle East), 3500-4000 in Region 2 (North and South America), and 3500-3900 in Region 3 (rest of the world). So, the Russian fishing fleet was legal, at least when it was in Region 1 waters. If the FCC was able to find some point on which to base a complaint, my guess is that they *did* take such action, usually by an ITU-standardized cable or radiogram. So, what more could we do, especially with the frequency being legally shared with the mobile service in each region?

Until recently, I averaged 95 long-distance calls to FCC Monitoring a month to alert them to intruders on the air at the time subject to "treaty" action—with the phone expense paid by the ARRL. Subsequently, I found that I was overloading the monitoring system of the country and cut it down largely to those transmissions with a particularly good reason to complain and get action, such as spurious families in the bands, whether the cause is inside or outside. Remember that the USSR has the special right to use 14250/14350 for "fixed" (point-to-point) service, and also the ITU allocations have a footnote exempting "military" everywhere. I lay off of legal broadcasting like VOA and others, though recently I did try to point out to VOA that by the USA giving up Okinawa and VOA moving to the Philippines, their Chinese service antennas now practically point at the USA east coast, which ought to be protected from receiving "harmful levels" of interference. I informed VOA of the specific cases in Europe and Africa where sites are used which involve antennas which, in addition to covering the service area, are incidentally aimed at Region 2 and cause harmful interference in North and South America. Also, we have complained about Deutsche Welle broadcasting on 3995 kHz afternoons and evenings in German to Latin America, which is contrary to ITU regulations.

But there are hundreds upon hundreds of individual cases of intruders on amateur frequencies. I have been preparing reports on some 400 to 450 different frequencies (mainly 14 MHz, lately) a month, with many reports listing as many as 25 additional date/time groups of "sightings" of the same signal. The ARRL has had to sort and ship by air up to about 4000 report forms a month to G3PSM, who produces a 20-22 page *Intruder Monthly Summary*. This goes to the ITU in multiple copies, to VOA and others, and to many Intruder Watchers around the world requesting action on *their* country's responsibilities in the summary, and so on. We especially need more Intruder Watchers from the Caribbean and Central and South America, now coordinated by K6DL, who has taken over the Region 2 work so that I can write letters such as this!

Let's give more of the facts about what is going on, what is legal and what is not, who is doing what, and what can be done. But let us not repeat WD4MKQ's boo-boo of doing illegal things ourselves and becoming intruders, too, by following that suggestion of trying to jam the intruders. Often that harms other amateurs as much as, or more than, the intruder. We have had little apparent success over the years on the part of those, especially in other countries, who are willing to jam the radar pulse, but it is very unlikely to be more than a happenstance, if it seems to work.

Remember that if A and B are intruders, and we may know the direction to A, which we hear, we still do not do any harm unless we jam the receiver at B, who is in an unkown direction usually. Not only that, but because of the geographical problem, it is highly likely that the band is not even open to the receiving point, B, from the USA. Two amateurs on CW did, however, get on an Arabic phone net in the 14-MHz CW band, call "CQ Intruder Watch," and raise other stations, who proceeded to discuss the interference; when the phone net moved, more "CQ IW" calls appeared on the new frequency, and finally the intruders got out of the amateur band and stayed out. But intentional jamming of communications draws very severe penalties under FCC Regulations, Sec. 97.125: "Interference—No licensed radio operator shall willfully or maliciously interfere with or cause interference to any radiocommunication or signal."

Let us divert our efforts to legal things that we can do to assist in this work, worldwide, and hope that our efforts, at least in part, may minimize the increase of such interference from intruders. I personally hope that my last 14 years of nearly full-time IW and OO work, to the exclusion of most other activities, has not been in vain.

E. H. Conklin K6KA
La Canada CA

RIGHT ON!

I read your August, 1979, editorial with great interest. I agree that Mr. Booth's attitude towards the FCC's commissioners was indeed wrong. As a sales representative, I know your method is the most successful.

I would add, in closing, that this was the first issue of *73* that I have read in one year as a ham. I read your editorial with fervor, and I can honestly say that that never happens when I read *QST*. Right on!

John Cerniglia N9AGB
Madison WI

2M RTTY

In reference to Wayne's editorial concerning crossband repeaters (August, 1979, p. 6), I might pass on a unique situation that occurred not long ago.

On January 16, 1979, quite a few local 2-meter RTTY buffs were astounded to see in print, from autostart, that a KH6 had been on the repeater (146.10/.70) calling CQ RTTY! A little further down the paper, they also saw that two stations actually worked him. After a previous QSO on 20-meter RTTY and a short lesson in how to access, Tony KH6JEO from Makakilo, Hawaii, transmitted at 14.083 MHz. My station, acting as a manual repeater, retransmitted his signal onto the input of the 2-meter repeater via my ST-6 terminal system and a few routing switches (the same way we retransmit W1AW RTTY bulletins onto the RTTY repeater).

The replying signals, originating on two meters, were reversed, outputting onto twenty meters, and, therefore, became perhaps the first "crossband,

Continued on page 190

Looking West

Bill Pasternak WA6ITF
24854-C Newhall Ave.
Newhall CA 91321

CONGRESSMAN TO HELP THE AMATEUR COMMUNITY CONQUER MALICIOUS INTERFERENCE

"Amateur radio is a service, not just a hobby, and must be protected." These were the words of Congressman James Corman, a democrat from Van Nuys, California, spoken in an exclusive interview with this reporter on Monday, August 29, 1979, at the congressman's San Fernando Valley office.

I met with Congressman Corman after it had been reported that he had shown an interest in helping the amateur community to clean house. I wanted to know exactly where he stood on certain issues and thought you might also be interested. In early August, Congressman Corman met with ARRL Southwestern Division Director Jay Holliday W6EJJ and Special Assistant Director Joe Merdler N6AHU to discuss the growing malicious interference and regulatory violation problems. At that time, he voiced strong support for the cleanup task that Jay and Joe had started; many felt that his was the type of help most needed now. It was through Joe Merdler (who also serves as our legal correspondent for the Westlink Amateur Radio News) that the interview with Congressman Corman was arranged.

From the start, Congressman Corman made it clear that this would be a coordinated effort on his part. He stated, "Four hundred thirty-five congressmen going in different directions will accomplish nothing." He intends to meet in Washington with ARRL General Council Bob Booth, along with Joe Merdler. There they will begin attacking the whole problem, with the support of the ARRL. He also stated that he intends to find out the reason why the FCC has failed to act in the case of Scott Lookholder WB6LHB, who was convicted of malicious interference earlier this year. The congressman concluded by stating that the 1st Amendment does not give any person the right to use obscene language or in any other way maliciously interfere with the legitimate use of the airwaves.

THE CREATION OF "NATIONTIE '80" DEPARTMENT

In last month's column we began discussing what might be accomplished were a fair number of already existing two-meter open repeaters linked together to provide coast-to-coast, border-to-border amateur relay communication. We suggested that you might want to try some interlinking experiments with other repeaters in your general area that are outside your normal system coverage. In essence, we hope that we have whetted your appetite for even bigger and better things. If we have, then I suggest you pay special attention to this column for the next couple of months because the creation of an open national intertie will be the center of attraction for some time to come.

If you have never operated through a repeater intertie, you are really missing something. When you spend a lot of your operating time on local repeaters, it is easy to forget that there are many people out there who, while still living in your general area, may have dramatically different lifestyles than yours. Most HF operators, especially those who enjoy chewing the rag, can easily relate to this. Through long-winded QSOing, amateurs in different areas learn about each other through the interaction that is the classic QSO. It's sad, but true, that this is rarely the case for VHF repeater operation. Most amateurs, even those with the most sophisticated equipment, seem to wind up as habitual users on one or two local repeaters where they become part of that system's "in" crowd.

There is another aspect of repeater operation that tends to be a limiting factor in this area. On many repeaters, holding anything more than a quick "hello, how are you, good-bye" QSO is a taboo, enforced by a device known as a "blab-off timer." I never could see the strict rules barring normal QSOs on repeaters, because "someday an emergency might arise and the repeater will be busy." Believe me, if I ever have an emergency and a repeater is busy, I will find a way to be heard! It is, however, such regulations that tend to discourage true interaction by amateurs. True, two people living six blocks away from each other should not hold their QSOs through a repeater sixty miles away just to have an audience for their rhetoric. Such regulations do tend to discourage this type of activity; however, the same rules also tend to stifle meaningful communication. If necessary, a telephone call to an offender can usually solve any problem quite quickly.

While we cannot and will not attempt to change the operating rules on a repeater belonging to someone else, we will suggest that one of the objectives of Nationtie '80 must be to develop true lines of intercommunication and interaction among those amateurs who desire it.

Another objective must be the "advancement of the state of the art," or, more simply, "scientific achievement." There are two aspects of science, research and the application of what has been learned. Research is pointless if never applied. I say this because in many ways we will be doing nothing really new. Interlinks of varying sizes have existed for years, but their accessibility has been limited to a select few. These limited operations can be the cornerstone of something bigger and better, available to any amateur who may wish to utilize it. The technology already exists and is waiting for us to develop and utilize it.

Last month, we described a simple linking experiment that might best be termed "haphazard local linking." If we are to build a national intertie, we must have a definite objective. The obvious objective is to find a way for point A (Los Angeles, perhaps) to converse with point G (New York, perhaps) even though they are well outside what is considered normal VHF communications range. They must have their signals relayed several times. Now, if at each of the relay points you place input/output ports (local relay devices that can talk with any other relay point as well as with both terminal points), you will have an interactive radio intertie. There are various ways in which such linking can be accomplished, and we will now touch upon each.

For occasional links over long distances, the most common form of linking is accomplished via the long-distance telephone call—along with its long-distance toll rates. If the two systems involved in such a link have autopatch facilities or telephone accessibility for command purposes, the task of completing such a link is simple. If I, as repeater A, want to link with repeater G, I simply dial their dial-in number. This has been the basis of many long-distance links reported in this column over the years. The major drawback of this method is its cost, and for that reason it has never really become popular.

A second method involves the use of crossband, remote-base operation from spectrum considered local to one of our HF bands, which provides for longer-distance propagation. Many links have already been accomplished by cross-linking from VHF/UHF to ten-meter FM. However, ten meters is far from the ideal band in which to develop an interlink system that will function with reliability on a day-to-day basis. This is due to the somewhat erratic nature of long-haul ten-meter propagation. Actually, our most crowded HF band, twenty meters, probably offers the best potential for such an operation by crossband/cross-mode (FM to SSB) remoting. Again, this is far from an ideal situation, even though 14.285 MHz has become the de facto HF remote downlink DX frequency, much to the chagrin of many other spectrum users who do not appreciate hearing SSB signals with built-in squelch crashes! Though far more predictable and reliable in its propagation characteristics, the crowding one finds across the twenty-meter spectrum precludes its use on a regular basis for the establishment of an ongoing intertie operation.

This brings us to our third and probably most cost-effective method of interlinking, that of total radio relay. If we were to start from scratch to build a coast-to-coast intertie using multi-hop radio relay techniques, there would be very few able to foot the bill. However, with over 3,000 operational open two-meter repeaters throughout the country already, the cost factor looks a little more positive. Most of what is needed is already in place. The equipment sits atop tall buildings, towers, and mountaintops, and is already in day-to-day operation. The cost of interlinking is thereby minimal, since only one receiver and one transmitter need to be added to any existing system in order to interlink with any other system, and only two receivers and two transmitters are needed for it to become an interactive radio-relay device as part of a large intertie. (This is assuming that the existing two-meter facilities will take on a second job as the local access port to such a national system.) If the 220 band were used for the actual linking, then, at today's current market prices for new equipment, you are talking under $500 for the basic hardware (including your yagi-type antennas). You can get very elaborate and "go for broke," but that is neither necessary nor encouraged. If we keep sight of the old computer-industry adage of KISS (Keep It Simple, Stupid), we are far better off. The less complex we make it, the fewer headaches we will have in days to come.

Continued on page 194

The following are excerpts from unsolicited letters and registration cards received from owners of the new TEN-TEC OMNI transceiver.

"I sold a Yaesu to buy this and am very impressed" —WB5ULA

"My first QSO with OMNI-A was LA1SV on CW and second was EA8SK on SSB." —N2CC

"Excellent rig, just as advertised." —WB5TMD

"Very pleased with performance. QSK feature very slick." —WB0ELM

"This is my 5th TEN-TEC transceiver in less than 2 years. I loved them all and still have 3." —WB0VCA

"Through the years I have had complete Drake and Collins stations. I tried a 544 Digital and liked it the best so decided to purchase the 546 OMNI-D Digital." —WA4NFM

"Your OMNI is the best rig I have had in 20 years of haming." —K4IHI

"As a owner of Collins rig, your OMNI-D is the best." —K9JJL

"I already have an OMNI-A, 544 and a TRITON IV. You may ask why I own so many TEN-TEC rigs. In case there is a great RF famine, I want to be ready!" —WD4HCS

"You guys really know how to turn on an old timer!" —K8ELS

"Best operating & most conveniences of any transceiver I've ever used." —W6LZI

"I like CW. Compared OMNI against IC701 (rcvr) and OMNI won hands down. XYL WD6GSB really enjoys rig on SSB. Finds rig is very stable and digital readout accurate." —AC6B

"Have checked it out on both modes from "top band" (160) all the way to 29 MHz. Terrific!!!!" —W4DN

"Works well, parts layout and design much better for any possible servicing than other ham gear. The Japanese hybrid sets can't compare to TEN-TEC for audio. Audio reports excellent without special speech processors, etc., to distort the signal." —AG8K

"I have been using the S-Line over 15 yrs and never thought anything could outperform it. I got the biggest surprise and THRILLED with this OMNI-D even though I have been a ham since 1936." —KV4GD

"This must be the greatest. I've spent enough money on final tubes to almost pay for this." —KA4BIH

"This transceiver was recommended to me by old time hams (Xtras) whom I have known for 40 yrs. Has excellent break-in." —N6AVQ

"Best package job I've ever seen! First licensed 6AAV in 1926. Now in operation—a sweetheart!" —W7LUP

"From a 32V2/SX115 to an OMNI is a big step!" —K6YD

"Receiver prominent—transmitter likewise—working comfortable—pleasing design." —OE1FAA

"First new rig for me in 10 years but seems to be very good." —W5GBY

"The best transceiver I ever used or owned." —W3TS

"I wouldn't swap my OMNI for anything on the market, regardless of price." —WD0HTE

OMNI/SERIES B FEATURES

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Model 545 Series B OMNI-A . . . $949
Model 546 Series B OMNI-D . . . $1119

To add your name to the fast-growing list of OMNI owners, see your TEN-TEC dealer, or write for full details.

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SEVIERVILLE, TENNESSEE 37862

RTTY Loop

Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

Not all keyboards are created equal. Depending upon what you are copying, ham RTTY, weather, or press, some are definitely more equal than others. With the interest shown in copying these other-than-ham RTTY signals, I thought it might be a good idea to review the keytops and symbols found on Teletype™ machines.

My Model 15 manual lists over a dozen sets of keytops used on various models of teleprinters. Most of the variation is in the uppercase, or FIGS, character set. The diversity can be simplified to three main groups, and I will call them, for the sake of simplicity, communications, weather, and press. These names derive from the principal function of each character set. A diagram of their relation is presented in Fig. 1. This shows the binary code, lowercase character, and uppercase character of each set.

The communications character set, also known as the American Communications keyboard, Teletype keyboard BS, 78932, or a few others, is what we commonly use on ham RTTY. It contains all the commonly-used uppercase characters with no unusual representations. Several variations of this keyboard are possible without too much conflict. Uppercase H has at least three assignments commonly found: #, STOP, and £ (British pound sign). For this reason, it is usually best to avoid sending very many uppercase Hs unless you know what the fellow has to whom you are sending. That STOP code, if hooked up, will disable his machine!

There is one other variation of the communications keyboard that bears mentioning: the so-called "Western Union" keyboard. This is identical except for one minor variation: The BELL is an uppercase J rather than an uppercase S. The S, in this case, is an apostrophe ('). These keyboards are common enough so that, frequently, when one wants to send a series of bells, JSJSJSJS is sent in uppercase. The printer prints '''' with a bell between each apostrophe, no matter which code is used.

The press code, also known as a Bell System, TWX, or fractions code (again, there are many other names and numbers), is notable for replacement of certain uppercase symbols with fractions. Now, you and I might not be too thrilled with having uppercase B a fraction instead of a question mark —imagine sending "HOW ARE YOU COPYING OVER THERE 5/8"—but if you are trying to send stock quotations and such, there is great value in being able to send each fraction in one byte rather than three. If this is what you have or is the only kind of machine you can get, don't despair; I'll touch on what you can do later.

Another interesting code is the weather code, with aliases of Weather Map Service, 89410, or 82750. Here, specialized symbols are used to give weather information that might otherwise take several characters or words. The utility of this for pilots and meteorologists is self-evident; for the rest of us, it means one more code to crack if we anticipate copying some of those interesting commercial stations. In Fig. 2, we look into just what those symbols mean and how to interpret them. These aviation weather reports provide a wealth of information, and Fig. 3 is derived from a US Department of Commerce example of how to decode them.

Now, if you don't have a particular set of symbols and you want to change, all is not lost. For Model 15s and 19s, it is rather simple. If you have, for example, a communications keyboard and you want to be able to copy weather code, the easiest way to change is to obtain an extra typing basket set up for the new codes. When you desire to shift codes, simply slide the old basket off and the new one on. Voilà!—a transformed machine. Return things to normal by shifting back. Extra typing baskets are available

Continued on page 194

5-Level Code	Lower-case	Communications	Weather	Press
11000	A	-	↑	-
10011	B	?	●	5/8
01110	C	:	0	1/8
10010	D	$	↗	$
10000	E	3	3	3
10110	F	!	→	¼
01011	G	&	↘	&
00101	H	#	↓	#
01100	I	8	8	8
11010	J	'	↙	'
11110	K	(	←	½
01001	L	)	↖	¾
00111	M	.	.	.
00110	N	,	⊖	7/8
00011	O	9	9	9
01101	P	Ø	Ø	Ø
11101	Q	1	1	1
01010	R	4	4	4
10100	S	BELL	BELL	BELL
00001	T	5	5	5
11100	U	7	7	7
01111	V	;	⦶	3/8
11001	W	2	2	2
10111	X	/	/	/
10101	Y	6	6	6
10001	Z	"	+	"

Fig. 1.

Sky cover symbols are in ascending order. Figures preceding symbols are heights in hundreds of feet above station.

Sky cover symbols are:

- ○ Clear: Less than 0.1 sky cover
- ⊖ Scattered: 0.1 to less than 0.6 sky cover
- ⦶ Broken: 0.6 to 0.9 sky cover
- ● Overcast: More than 0.9 cover
- \- Thin (when prefixed to the above symbols)
- -X Partly obscured: 0.1 to less than 1.0 sky hidden by precipitation or obstruction to vision
- X Obscured: 1.0 sky hidden by precipitation or obstruction to vision

Fig. 2. Sky symbols on aviation weather reports.

CEILING:
Letter preceding height of layer identifies ceiling layer and indicates how ceiling height was obtained.
A = Aircraft B = Balloon E = Estimated M = Measured
R = Radar W = Indefinite V (suffix) = Variable Height

VISIBILITY:
Reported in statute miles and fractions (V = Variable)

WEATHER AND OBSTRUCTION TO VISION SYMBOLS:

A	Hail	IC	Ice Crystals	RW	Rain Showers
BD	Blowing Dust	IF	Ice Fog	S	Snow
BN	Blowing Sand	IP	Ice Pellets	SG	Snow Grains
BS	Blowing Snow	IPW	Ice Pellet Shwr	SW	Snow Showers
D	Dust	K	Smoke	T	Thunderstorms
F	Fog	L	Drizzle	T+	Severe T'storm
GF	Ground Fog	R	Rain	ZL	Freezing Drizzle
H	Haze			ZR	Freezing Rain

Precipitation: -- very light, - light, (no sign) moderate, + heavy

WIND
Direction in tens of degrees from north, speed in knots.
Example: 3627 = 360 degrees, 27 knots

RUNWAY VISUAL RANGE (RVR):
RVR is reported from some stations. Extreme values for ten minutes prior to observation are given in hundreds of feet. Runway identification precedes RVR report.

ALTIMETER SETTING:
The first figure of the actual altimeter setting is always omitted from the report.

CODED PILOT REPORTS:
Pilot reports (PIREPS) of clouds not visible from ground are coded with MSL height data preceding and/or following sky cover symbol to indicate cloud bases and/or tops, respectively.

Fig. 3. Aviation weather reports, other features.

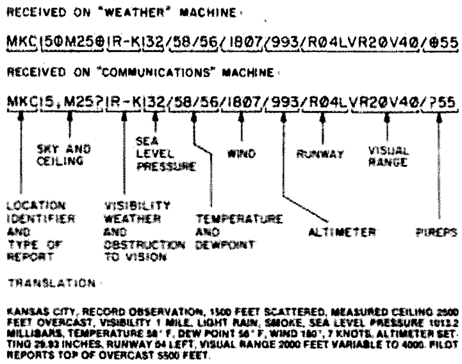

Fig. 4. Sample aviation weather report.

Awards

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The response to the new *73* Awards Program announced in the September and October issues has been beyond all expectations. Award applications are being received from all over. Countless letters and telephone calls of support have been received, each claiming *73* now has one of the best award columns in existence. Let it be known that the readers are the ones to thank if this is true. All I can say is that we'll continue to strive for improvement.

Speaking of improvements, those of you who have your September copy of *73* might turn to pages 28 and 155, respectively, and make the following additions and changes. Completely overlooked was Jamaica (6Y5), which should have been included on the North American list. Looking at the list for Africa, transfer Yemen (4W) and People's Democratic Republic of Yemen (7O) over to the Asian listing. Also, it should be noted that the prefixes for each country shown do not represent the entire list of prefixes assigned to that country. Prefixes were shown merely for convenience.

By telephone, amateurs have asked why the Central American countries were identified as a South American claim. One such caller assumed our reasons were political. I assure you that this editor and this publication are not in the business of politics. The identity of Central America's countries was given to the South American listing merely to add balance to the overall program, nothing more. As for the contacts which are made to Antarctica, it was decided long ago that there would be 6 continental awards and contacts with Antarctica would count toward that country from which the callsign was issued. In other words, should I confirm contact with KC4AAA, I would be able to count that as USA toward my North American award. Likewise, should I work FB8YF on the polar cap, I would be able to count that as France in my bid for the European award.

And speaking of the WTW (Work the World) Award Program, there has been some confusion as to the award fee schedule. Let me try to explain it. In the WTW Award Program, there is a series of six continental awards which are in themselves quite an accomplishment. Each of these continental awards has a $3.00 award fee. Once the applicant has collected all six continental awards (European, African, Asian, South American, North American, and Oceanic), I (as custodian of the Awards Program) will request the New Hampshire offices to issue the seventh and ultimate WTW (Work the World) Award at no extra charge.

A week ago, I received a very impressive letter from one of our readers and I can't resist sharing parts of it with you. Hal Dennin AC3Q, who is the Chief of Police in Watsontown, Pennsylvania, wrote to inform me that he had accomplished in a little over one week something which takes most of us months and even years to achieve. To add insult to injury, Hal went on to claim that his feat was mastered operating QRP with his new Yaesu FT-7 into an ATB-34 triband beam. Claimed power . . . a mere 9 Watts output!

Well, have you guessed Hal's achievement? Not to keep you in further suspense, it appears that over 73 DX countries have been worked by Hal in only 10 days. Once confirmation is received, Hal will have qualified for the new 73 DX Country Club which was announced for the first time only a couple months ago. Hal's first contact was with LU3EEC on 28.750, and QSO number seventy-three came only 9 days later when he exchanged signal reports with 6W8FZ on 14.220 MHz.

Not one to give up, Hal proceeded past the 100 mark, having reached that goal on the thirteenth day, and is well on his way to 200 countries as you read this. As a matter of fact, Hal is so insistent on breaking records that he didn't even take the time to put his letter to me in the mailbox for fear he might miss a "new one" while away from the radio. Instead, his XYL was delegated the duty of putting the letter in the hands of the postman for delivery. Talk about dedication!

Neither Hal nor I know if this feat is a world record or not! I would think not too many (if any) could claim such an accomplishment, which, I might add, was completely independent of contest operation. Whether a world record or not, Hal deserves a hearty congratulations from us all . . . although at the same time I wonder if perhaps there shouldn't be a law against a crime like this.

Should any readers have a similar success story, why not drop us a line? Keep the details brief and straight to the point. Can you top Hal's new record?

The other day I received a letter from Vic Misek W1WCR, who represents the Top Band SSB Net. For those not familiar with the term, "top band" refers to those frequencies assigned the 160-meter segment of the radio spectrum. This band also has been referred to as the "gentleman's band" on occasion, largely due to the carefree, easygoing pace that appears so predominant on the band.

The Top Band SSB Net was formed in February, 1972, by a small group of operators composed of W2FWU, K2ANR, W2UBL, W2IMB, and W4NVN (formerly W1GJE). Over the

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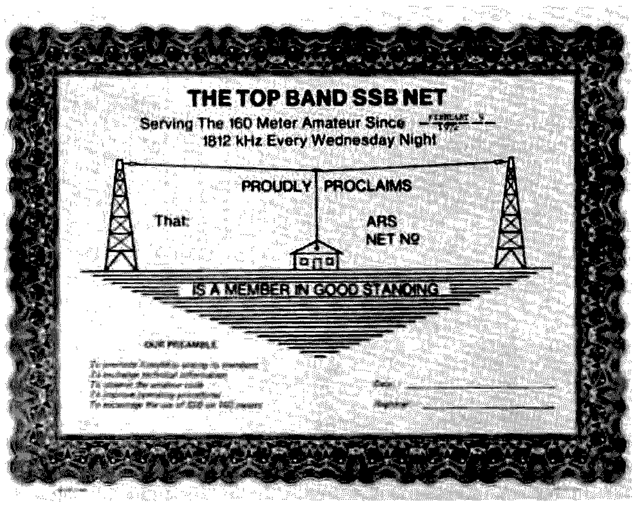

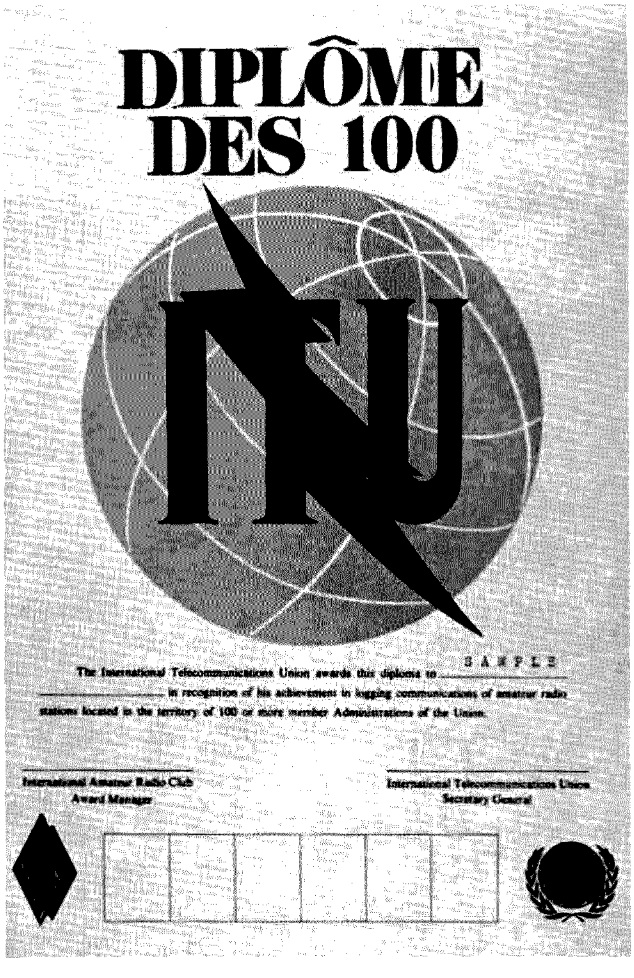

Microcomputer Interfacing

Christopher A. Titus
David G. Larsen
Peter R. Rony
Jonathan A. Titus

In the September column, we described several different seven-segment display interfaces as well as programs that can be used to display information on these displays. Here we shall describe the hardware and software required so that information can be entered into a microcomputer using a keyboard. There are a number of other general-purpose devices that can also be used to enter information into a microcomputer, including thumbwheel switches, analog-to-digital converters, thermostatic switches, and pressure switches. Of all the different input devices, keyboards are probably the most popular, simply because they are the most general-purpose input devices.

There are basically two types of keyboards that are used with microcomputers: *hardware-encoded* and *scanned*. A hardware-encoded keyboard, regardless of the type of keys used (metallic contact, Hall effect, capacitive), produces a unique code for each key. The code produced by each key may be ASCII, EBCDIC, binary, or BCD. The encoder section of the keyboard also produces some sort of *strobe pulse*, or logic level change, to indicate that a key is pressed.

Owing to recent advances in integrated circuit technology, the encoding logic may not only produce a unique key code, but may also transmit the code as an asynchronous serial character. A number of integrated circuits that can be used to encode individual key closures include the AY-5-3600 (General Instrument Corporation), the MM74C922 and MM74C923 (National Semiconductor Corporation), and the 8279 (Intel Corporation). A typical hardware-encoded keyboard interface is shown in Fig. 1. Because the hardware in the keyboard already encodes the key closures, the software required to sense a key closure and input a key code is very simple (see Fig. 2).

The first instruction in Fig. 2 inputs the strobe line, or flag, of the keyboard into the 8080's A register. If the flag is a logic zero, then no key in the keyboard is pressed. If the flag is a logic one, then a key is pressed. The ANI instruction sets all the bits in the A register to a logic zero with the exception of bit D0, which represents the state of the keyboard's flag. If the flag is a logic zero (no key is pressed), the A register will contain zero as a result of the ANI Instruction and the JZ (jump on zero) instruction to KEYIN will be executed. When a key is pressed, bit D0 of the A register will be a logic one after the first IN instruction is executed. As a result of the ANI instruction, the JZ to KEYIN will no longer be executed. Instead, the second IN instruction will be executed, which will cause the code for the key that is pressed to be read into the A register. *This instruction also causes the keyboard's flag to be cleared.* The keyboard flag must be cleared before the 8080 calls the KEYIN subroutine again, so that the 8080 does not sense that the same key is pressed. Remember, the key has only been pressed once. After the key code is input, the second ANI instruction sets the parity bit (D7) of the code to a logic zero. This means that the programs that call KEYIN can be used with keyboards that generate odd parity, even parity, or no parity.

Another type of keyboard that is often used with microcomputers is a *scanned* keyboard. This type of keyboard, like a multiplexed display, requires very little interface hardware but requires a large amount of software. Typically, scanned keyboards are used in calculators, microwave ovens, single-board microcomputers, and low-cost microcomputer-based games. The interface for a 16-key keyboard, arranged as four columns of four keys, is shown in Fig. 3. The software that causes the 8080 to scan the keyboard and generate a unique code for each key is listed in Fig. 4. This software has to perform many of the functions that were previously performed by the hardware-encoding logic. For instance, the software must (1) sense a key closure, (2) debounce the key closure, (3) determine which key is pressed, (4) generate a unique key code for the key that is pressed, (5) wait for the key to be released, and (6) debounce the key opening.

To detect if a key in the keyboard is pressed, the 8080 outputs a logic zero to one of the columns of keys and a logic one to the remaining columns. If one of the keys in the column that is being "driven" by the logic zero is pressed, the 8080 will input a logic zero and three logic ones into the A register. If no keys in the column being driven by the logic zero are pressed, the 8080 will input four logic ones. If this occurs, the 8080 will test another column of keys with a logic zero.

At the beginning of KEYSCN in Fig. 4, the D register is loaded with three, the code for the first key closure that can be detected. The B register is loaded with 11111110 (octal 376, hex FE), the first test pattern that will be output to the scanned keyboard. The test pattern is then moved to the A register where it is output to the keyboard. The same test pattern is then rotated once to the left, and the result, 11111101, is saved in the B register. The 8080 then inputs the row data of the keyboard and sets bits D7-D4 of the A register to zero (ANI 017). If no key in column A is pressed (keys 3, 7, 11, or 15), the A register will contain 017. If one of the keys in column A is pressed, the A register will not contain 017. Therefore, the JNZ to NXTKEY will be executed if one of the keys in the A column is pressed. If no key in this column is pressed, the 8080 executes the DCRD instruction, causing the content of the D register to be decremented from three to two. Since this value is not equal to 377, the 8080 jumps back to NXTGRP, so that the B column of the keyboard can be tested. Remember, the B register already contains the test pattern required to test this column of keys.

If a key in the A column is pressed (3, 7, 11, or 15), the 8080 calls the DELAY subroutine at

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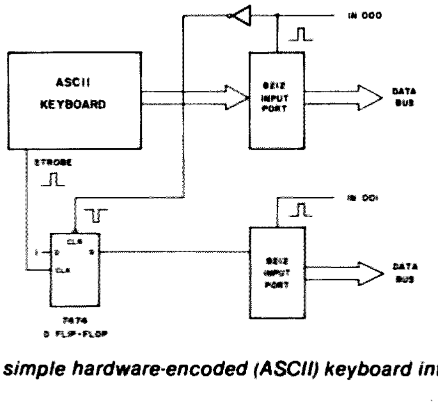

Fig. 1. A simple hardware-encoded (ASCII) keyboard interface.

```
/THIS SUBROUTINE SENSES A KEY CLOSURE ON AN
/ASCII KEYBOARD AND THEN INPUTS THE EIGHT-BIT
/PARALLEL ASCII KEY CODE.

KEYIN,  IN      /INPUT THE DATA WORD THAT CONTAINS
        001     /THE STATUS BIT FOR THE ASCII KEYBOARD
        ANI     /SAVE ONLY THE STATUS BIT FOR
        001     /THE KEYBOARD
        JZ      /JUMP BACK TO KEYIN IF THE STATUS BIT
        KEYIN   /IS ZERO, BECAUSE NO KEY IS PRESSED
        0
        IN      /A KEY IS PRESSED, SO INPUT THE
        000     /ASCII CODE INTO A
        ANI     /SET THE PARITY BIT TO
        177     /A LOGIC ZERO
        RET     /AND THEN RETURN TO THE CALLING PROGRAM
```

Fig. 2. A simple ASCII keyboard input subroutine.

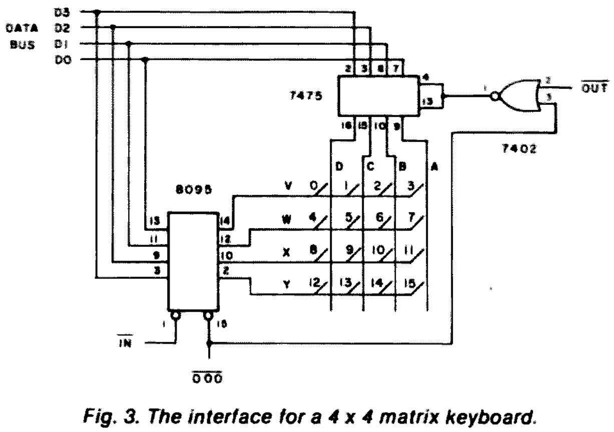

Fig. 3. The interface for a 4 x 4 matrix keyboard.

Contests

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5 CONTINENT WORLD RTTY CHAMPIONSHIP 1979-1980
Sponsored by IATG-Radiocommunications

IATG-Radiocommunications and CD Publications, in continuation of their more than 10 years of activity promoting the most advanced radio amateur techniques, have decided to sponsor a new series of contests for teletypers of all continents.

The purpose of the contests is not only to increase interest among radio amateurs for the radioteletype, but also to promote interest in long-range contacts, that is, to stress intercontinental contacts rather than domestic and intracontinental contacts as in previous contests.

For this purpose, IATG and CD have organized the following three contests: Australia-Oceania and Asia RTTY Flash Contest—3/4 November 1979; North and South American RTTY Flash Contest—19/20 January 1980; Europe and Africa RTTY Giant Flash Contest—9/10 March 1980.

For each of the three contests, there will be a general winner plus a winner from each of the two continents involved.

Separate standings for each continent plus a general standing for each contest will be published in *CO Elettronica Magazine* and other magazines and points will be awarded as follows:

a) For contest winners: first place—50 points, second place—46 points, third place—43 points, fourth place—41 points, fifth place—40 points, etc., 44th place—1 point.

b) For continental winners (e.g., Australia-Oceania and Asia in the first contest): first place—25 points, second place—22 points, third place—20 points, fourth place—18 points, fifth place—17 points, etc., 21st place—1 point.

Standings are independent, that is, continental winners can also be general winners.

At the end of the three contests, continental and general standing points will be totaled and a *World Champion of the 5 Continents* will be declared according to the new final standing obtained.

Grand prizes, as usual, are reserved for the four first place winners. Consolation prizes along with medals and certificates will also be awarded.

AUSTRALIA-OCEANIA AND ASIA RTTY FLASH CONTEST
Contest periods:
0800 to 1800 GMT November 3
0800 to 1800 GMT November 4

This contest is sponsored by IATG-Radiocommunications to increase interest in intercontinental communications. Experience gained from this contest will be incorporated into the organization of future contests. All suggestions and constructive criticism are welcome. The DXCC list will be used except that the VE/VO, W/K, VK, PY, LU, JA, and UA0/9 call areas will be considered as separate countries. Use all amateur bands from 80 to 10 meters. Operating classes include single- or multi-operator, single transmitter, and SWLs.

EXCHANGE MESSAGE:

RST, number of the QSO, and continent.

SCORING:

Score 1 point per 80- or 40-meter QSO, 2 points per 20-meter QSO, 8 points per 15-meter QSO, and 12 points per 10-meter QSO. No points or multipliers for contacts with one's own country. Only 2x RTTY QSOs are valid. Each station may be contacted only once on any band; additional contacts may be made with the same station if a different band is used. Multipliers are given for countries and continents. A multiplier is given for each country worked on 20-10 meters. No multipliers for 80-40 meters. A separate multiplier may be claimed for the same country if a different band is used (max. of 3 times). Only countries which appear in at least 5 other logs will be valid as multipliers. One's own country is not valid as a multiplier. The continents are valid as multipliers; for contacts with Europe and/or Africa, the sender and the receiver will each be assigned 100 points as multiplier. 50 points will be assigned for each of the remaining continents contacted. An additional 100 points will be given for each contact with Australia-Oceania and/or Asia on 15 or 10 meters. Total points times total number of countries times total continent points plus total Australia-Oceania and Asia station points equals total score. Also, there are two promotional periods included in the contest: Saturday, November 3, between 1300 and 1400 GMT, and Sunday, November 4, between 1600 and 1700 GMT. Stations operating from NA, SA, EU, and AF contacting Australia-Oceania and/or Asia during these hours will *double* their points for these periods.

RTTYers entering logs in the contest who have not participated in previous contests will receive an additional bonus of 5% of their final score. Winners of previous RTTY Championships will receive 10% of the total final score; there is an 8% handicap of the total final score for the winner of one or more previous RTTY contests. This contest is also open to RTTY SWLs with the same scoring.

ENTRIES:

Use one log for each band. Logs must contain date/time in GMT, callsign, RST, QSO number, continent sent and received, country, and continent multipliers, points, and final score. In order to qualify, all logs must be received not later than December 15th. Send all logs to: Prof. Franco Fanti, Via A. Dallolio n 19, 40139 Bologna, Italy. Grand prizes are reserved for the four first place winners. Consolation prizes along with medals and certificates will also be awarded. Logs with compiling errors which exceed 10% of the final score will be excluded from the final standing and will receive/serve only as check logs. Logs will not be returned.

REMEMBER: this contest is valid towards the final standing of the 5 Continent World Championship!!!

IPA CONTEST
Contest Periods:
Saturday, November 10
0800 to 1000 GMT
1400 to 1700 GMT
1800 to 2000 GMT
Sunday, November 11
0800 to 1000 GMT
1400 to 1700 GMT
1800 to 2000 GMT

The International Police Association Radio Club—Section Francaise (IPARC) has organized a contest which will enable participants to work the Sherlock Holmes Award. The contest is open to all radio amateurs and SWLs. General call is "CQ IPA." Non-members may contact only members.

EXCHANGE:

Non-members send RS(T) and serial number. Members send IPA, RS(T), and serial number.

SCORING:

Every completed QSO counts 2 points on 80 and 40 meters, 4 points on 20, 15, or 10 meters. Staions may be worked once per band. Cross-mode and cross-band contacts are not valid. Multiplier is the nômber of IPA countries worked per band. Final score then is the total

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Results

RESULTS OF THE 9TH WORLDWIDE SSTV CONTEST 1979
Sponsor: IATG—Radiocomunicazioni

1) SM5EEP	32,032
2) WB9OGS	31,360
3) I6VMV	30,688
4) I9PCB	26,418
5) W6WDL	25,974
6) HA6JI	21,216
7) G3WW	18,800
8) HA1ZH	16,224
9) HA5KBM	14,952
10) I4LRH	14,608

SWL

1) Tonezzer Luciano	1,722
2) Hans Schalk	378

Calendar

Nov 3-4	ARRL Sweepstakes—CW
	RSGB 7 MHz CW
	Australia-Oceania and Asia RTTY Flash
Nov 10-11	CQ-WE Contest
	IPA Contest
	Delaware QSO Party
Nov 11	OK DX Contest
Nov 17-18	ARRL Sweepstakes—Phone
	Austrian 160 CW Contest
Nov 24	DAFG Short Contest—SW
Nov 24-25	CQ Worldwide DX Contest—CW
Nov 25	DAFG Short Contest—VHF
Dec 1-2	ARRL 160 Meter Contest
	TOPS CW Contest
	North Carolina QSO Party
	Connecticut QSO Party
Dec 8-9	ARRL 10 Meter Contest
Dec 22-23	Teenage Radio Sprint
Jan 5-6	QSL Exchange Contest
Jan 19-20	North and South America RTTY Flash
Feb 2-3	South Carolina QSO Party
Mar 9-10	Europe and Africa RTTY Giant Flash

New Products

REVIEW OF MAGGIORE COR IDENTIFIER

Everybody wants to build a repeater, it would seem. Many groups are stopped by the high cost of a "store-bought" machine and are unable to handle the task of designing the necessary logic for the identifier and COR circuits. If you fit this category, however, take heart. I was asked to do a review of the Maggiore COR Identifier, and since I have designed units for a competitor, it was felt that I would understand the unit and be able to appraise it in a knowledgeable manner. Before I get into the details of this unit, let me say this: If you are wanting to build a repeater, take a look at this unit.

When looking at the board, the first thing that you will notice is the diode matrix located at one end. The board given to me to test had 58 diodes installed. My first thought was, "Who wants to figure out and stuff all of those diodes?" My next thought was, "This unit comes wired and tested and diodes are a sure and safe way to program an ID." Upon closer examination, I found that the ID may be set for a short ID and the whole matrix does not have to be scanned, which is a nice feature.

Another nice thing about this unit is the provision for running a backup battery. If primary power fails and the repeater is running on battery, this unit produces a distinctive beep to signal the user that the repeater is on battery.

Interfacing this circuit to other circuitry should be a snap, because three inputs are provided for squelch information. One looks for a high-to-low logic change, one looks for low-to-high logic change, and finally another looks for a small voltage change in the noise amplifier of the receiver. It would seem to me that this covers just about every possible need that might arise in building your repeater.

The COR also provides a choice between an adjustable time-delay drop or an instant drop with the drop of the received carrier. This COR/ID circuit also has a built-in timer for the ID circuit. Assuming the repeater has been sitting unused and somebody keys it, the ID will cycle once and the timer will trigger. Until the timer times out, the repeater will not ID again. This is a good way of doing the ID time as the repeater will only ID while the repeater is in use. If the repeater has IDed and activity stops, the repeater will not ID at the end of the time cycle as the trigger that keys the ID after the timeout is the received carrier and that is not present since activity has stopped. The ID circuit produces an audio tone to go directly into the transmitter and has plenty of drive even to drive a small loudspeaker.

This circuit has another nice feature in that one of the option modes is a "beacon" mode. In this mode, the unit will produce a tone with regular IDs. This feature makes this unit good for the person who wants a beacon and might not even be interested in a repeater.

I did find a couple of things that I did not care for, but they are minor. One is the optional beep. I like the idea of the beep, but on this unit it occurs the instant the COR goes, which says that it is right on the end of the squelch tail. In talking to the people at Maggiore, I am told there is an option on a separate PC board that can be added to allow an adjustable delay before the beep, but I am sure this is not a problem to lose any sleep over.

Another thing I noticed was the timeout function. It is adjustable and can be disabled, of course, but when it times out, the repeater drops. It can be in the middle of an ID or anything else. The repeater would drop off the air. If the offending carrier clears, there is no way for the other users to know, except to give a kerchunck to see if the repeater responds.

One very nice feature of this circuit is the output key. It is a relay so that there should be no problems with interfacing to anything.

In way of summation, let me state that I rate this Maggiore COR Identifier quite high. The design is straightforward; the PC board is double-sided and of the hightest quality. The components are of high quality and are common parts. The circuit has a built-in connector so that it can be plugged in and out as necessary. And last but far from least, *the unit comes wired, tested, and programmed.* I say that for the money, it's hard to go wrong on this deal.

Maggiore Electronics Laboratory, 845 Westtown Road, West Chester PA 19380; (215)-436-6051. Reader service number M36.

C. W. Andreasen N6WA
Van Nuys CA

KANTRONICS' GENERAL COMBO

Kantronics' General Combo is a complete, carefully-organized program with the upgrading amateur in mind.

The *General-Class Amateur License Study Guide*, SAMS #21617, by WØXI, explains radio circuits in an easy-to-understand style. The primary purpose of the text is to assist the prospective General in obtaining the General class license.

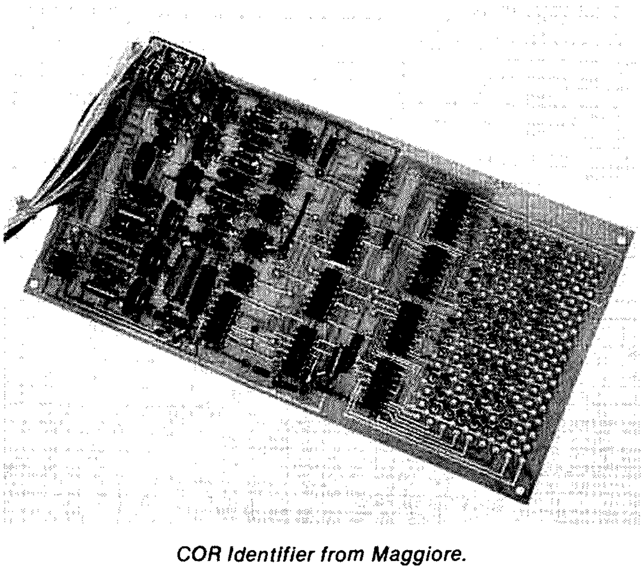
A second purpose of the text is to provide not only memorizable information for the exam, but also usable knowledge on electronics and practical radio circuits. The author's point of view is that an understanding of the material can then lead to a more detailed study of electronics later and to a greater enjoyment of our hobby, amateur radio.

Each chapter begins with introductory material and builds on this material to form more general concepts. The text explains the test, amateur regulations, radio-wave propagation, practical radio circuits, modulation characteristics, and transmission lines. Throughout each chapter, sample exam questions test your understanding of the material and prepare you for the FCC exam.

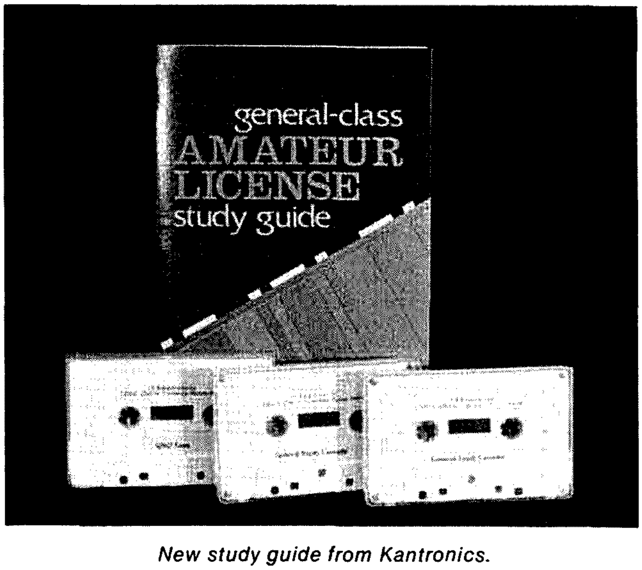
The General Cassette Tapes discuss rules, regulations, and radio theory in an interview format. The QSO Tape simulates exam-like "on-the-air" code transmissions. It progresses from 7½ to 15 wpm. Text key and practice exams are included. These test your proficiency in copying the content of the message and prepare you for the new FCC code test format. *Kantronics, Inc., 1202 E. 23rd Street, Lawrence KS 66044; (913)-842-7745.*

PERSONAL USE REPORT—THE BEARCAT BC-250 SCANNER

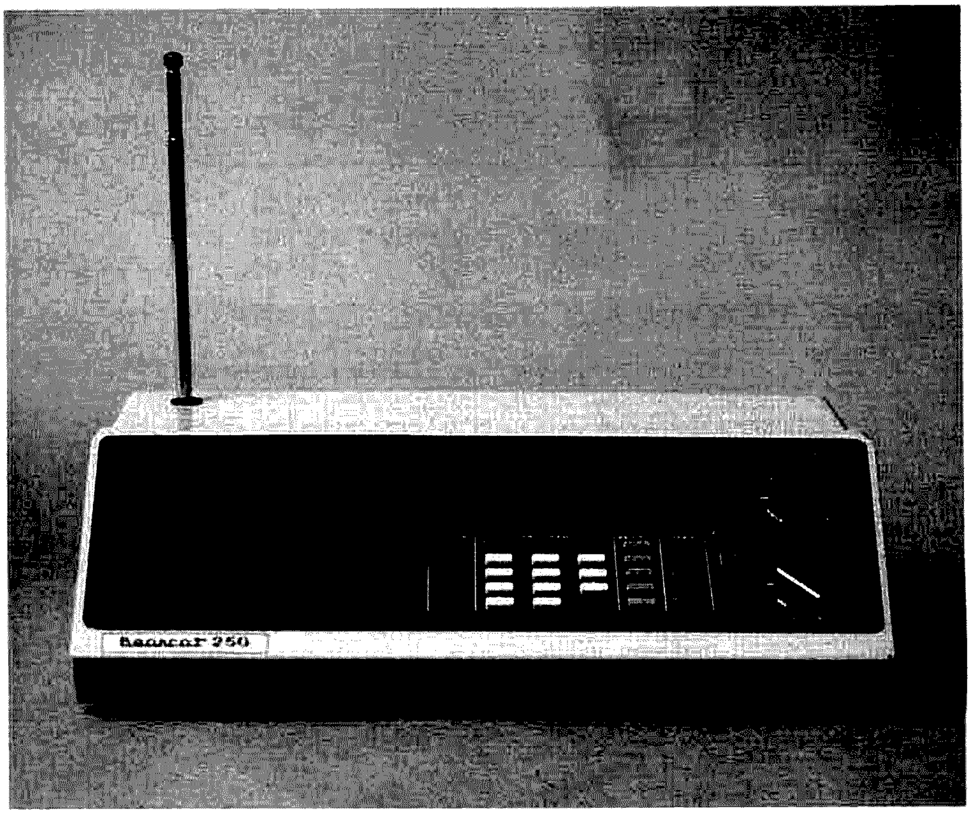
In the not-too-distant past, a great pastime was listening to



COR Identifier from Maggiore.



New study guide from Kantronics.



The Bearcat BC-250 scanner.

police calls on about 1700 kHz, just above the standard AM broadcast band. I can remember tuning the beautifully-cabineted Zenith that stood in our living room and feeling the excitement as dispatchers sent cars to various incidents.

In the quest for more channels and better communications, the police (and other emergency services) have moved to the VHF and UHF spectrums. Public Safety Radio, as it is called, still has police and firefighters, news reporters, radiotelephone calls, air rescue, G-men, weather forecasts, and just about any other safety service that you might imagine. The frequencies may be different, but the excitement is still there, and scanning monitor receivers have become the hottest item in consumer electronics since calculators.

Several generations of product development have yielded the Bearcat BC-250 scanner by Electra. When I saw the specs of this programmable scanner, I had to have one. After using it for a few months, I feel that it is a complete listening post in one package.

This microprocessor-controlled scanner needs no crystals for any of its 50 synthesized channels; frequencies are entered directly by a simple numerical keyboard. An 11-digit LED readout displays frequency, channel number, and function in large bold digits.

Any frequency in the five bands (32-50 MHz, 146-174 MHz, 420-450 MHz, 450-470 MHz, and 470-512 MHz) can be entered on any channel. Bearcat automatically retunes the front end for optimum sensitivity at any frequency, including the 2-meter and 450-MHz FM bands. The 50 channels are arranged in five groups or banks of 10 each. Each bank can be selected to scan or bypass. This allows you, for instance, to put the police on bank 1, fire on bank 2, and so on. My favorite local repeaters are on banks 3 and 4. If there are no QSOs that interest me, I just push a button and bypass those banks.

Momentary power outages or moving the radio to another room pose no problems for the BC-250. All frequencies are stored in a non-volatile memory that requires no battery. If power is lost, the scanner still retains all frequencies.

The Bearcat BC-250 has a unique search function to find those hidden or secret channels. Just enter an upper and a lower frequency limit and the BC-250 will check all channels between the limits. Active frequencies can then be read out on the display or entered into one of the 50 regular channels. It's great for finding those "secret" repeater inputs or special channels used by the local police.

A special 64-channel memory is set aside for use with the search function. In the search/store mode, the Bearcat BC-250 will search between the limits and automatically store the frequencies of up to 64 active channels. These can later be recalled on the display and/or entered into any of the 50 regular channels. The special memory also can be used to store frequencies to be bypassed during the regular search mode.

I hate to miss any action on the local "DX tip-off" frequency, so I program it on channel one. Priority listening is a selectable feature of the BC-250 that allows me to hear channel 1 whenever it becomes active, regardless of any other signals or functions. This is automatically done by momentarily sampling channel 1 and, if active, switching to that channel.

A two-second delay can be selected on any channel. This delays the start of scanning long enough to allow a reply to be heard on simplex channels. When things get boring on any channel, a lockout can be programmed. The BC-250 will then skip over that channel when scanning.

My favorite function available on the Bearcat BC-250 is the auxiliary control. This allows selective control of accessories connected to terminals on the rear of the scanner. I use the auxiliary control to record the paramedic channels on a battery-operated tape recorder while I'm not at home. When I am at home and not in the shack, a Sonalert triggered by channel 1 lets me know that the DX net is active.

The Bearcat BC-250 is, of course, 100% solid state. Most of the functions are controlled by seven custom-designed ICs. It has a sensitivity (12 dB SINAD) of .4 microvolts VHF and .6 microvolts UHF. Dual power supplies allow operation on 117 V ac or 12 V dc. There are external antenna and speaker jacks on the rear, and the scanner comes with power cords and a mobile mounting bracket. Useful even when not scanning, the BC-250 also functions as a highly-accurate digital clock, displaying time to the second. The darn thing's so exciting, my CW is getting a little rusty.

Electra Company, PO Box 29243, Cumberland IN 46229. Reader service number E40.

James E. Arconati K0FBJ
Creve Coeur MO

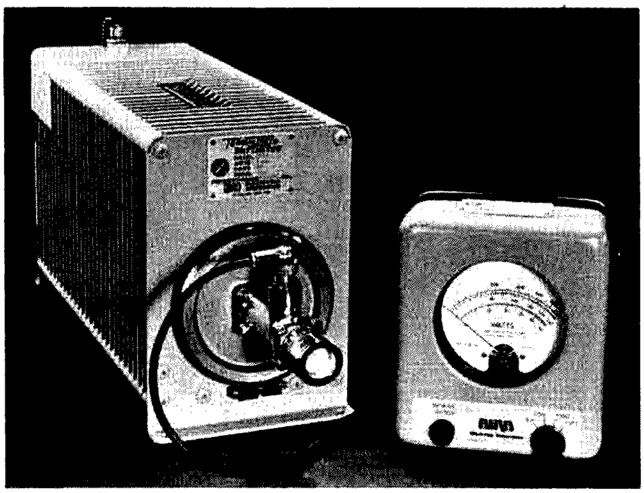
MORSE CODE PROGRAM AVAILABLE FOR THE TRS-80

Cost Effective Computer Services announces the AMCT-80, a program for the TRS-80 to teach and build proficiency in receiving Morse code. AMCT-80 (Automatic Morse Code Teacher) is the only Morse code program available that will automatically speed up or slow down depending on the student's proficiency in receiving code. Among the many options is the ability to receive in single or group character mode. Written in machine language, AMCT-80 is available for Level 1 and Level 2 TRS-80. *Cost Effective Computer Services, 728 S. 10th St., Suite #2, Grand Junction CO 81501.* Reader service number C124.

NEW MULTI-PURPOSE TERMINATION WATTMETER

A new-concept series of 10/50/250-Watt to 100/500/2500-Watt Rf Absorption Wattmeters/Line Terminations with convenience features suggested by communications users has been designed by Bird Electronics Corporation. The eight new models are direct-reading termination instruments for servicing 50-Ohm communications systems and for maintaining them at peak operation.

The new TERMALINE® wattmeters feature three power ranges selected by switch. This flexibility, without the need to transfer the crystal diode, frees one hand for equipment fine-tuning or troubleshooting. The new series 6730 wattmeters can be checked and calibrated *in the field* to a known standard. Frequency coverage has been



TERMALINE® Wattmeter, model 6736, 50/250/1000 Watts.

extended and the use of Schottky diodes increases long-term reliability.

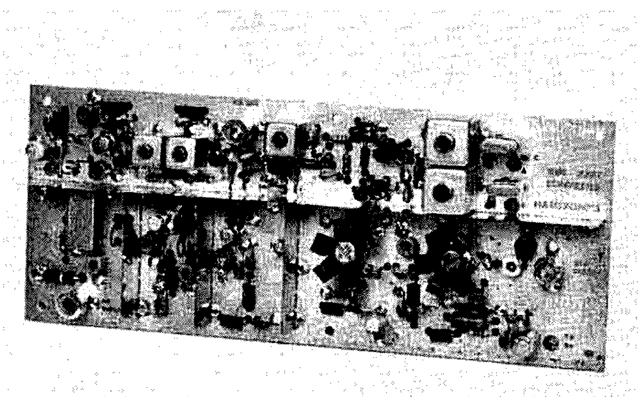
Wattmeter and load sections are joined with the patented quick-change QC feature, which allows easy separation. The load resistor can then serve as an independent termination.

The eight models have full-scale power values of 250, 500, 1000, 1200, and 2500 Watts and frequency coverage of 25 to 1000 MHz or 1.5 to 35 MHz. Vswr of the terminating loads is less than 1.15 from dc to 1000 MHz. The new series joins established TERMALINE Wattmeters with scales from 2 Watts to 150 Watts. Available from *Bird Electronics Corporation, 30303 Aurora Road, Cleveland (Solon) OH 44139; (216)-248-1200.* Reader service number B10.

NEW UHF TRANSMITTING CONVERTER FROM HAMTRONICS

Hamtronics, Inc., has done it again! In the tradition of other fine products, they have a new UHF transmitting converter, and just in time to gear up for the new OSCAR Phase III. Designed to convert 28-30 MHz to 435-437 MHz or 432-434 MHz, the new model SV4 requires 1 mW to 1/2 W of drive to give 1 W PEP output on SSB or up to 1-1/2 W on CW or FM. If you have one of the older 10m exciters which doesn't have a low power transverter output, don't worry, because instructions with the XV4 tell you how to make a simple attenuator. The best thing about the XV4 is the price—it costs much less than other types of equipment which have been available until now. Even adding an LPA 4-10 10-Watt linear power amplifier, a C432 UHF receiving converter, or a C144 VHF receiving converter to the system, you still save a bundle of money! The XV4 has an oscillator output to be used with a receiving converter if you like to transceive. It also has two oscillators, so it is easy to change frequency ranges without returning. For those who have a 2-meter multimode rig, an XV28 adapter is available to allow the XV4 transmitting converter to operate with a 2-meter input signal.

For more information, call or write for free catalog on these and other VHF and UHF kits, including preamps, converters, FM transmitters, and receivers. *Hamtronics, Inc., 65F Moul Rd., Hilton NY 14468; (716)-392-9430.* Reader service number H16.



The XV4 transmitting converter from Hamtronics.

A REVIEW OF THE ATLAS TX-110

Cute little box! That was my first impresssion as I sat down before the dark grey and black cabinet. I had come into Georgetown Communications only to browse, with not a thought of spending a dime, even less of falling in love. A very impressive price, indeed, but was it a receiver or a transmitter?

"It's both," a voice behind me said. Carl **N4AA**, the owner, handed me a key and told me to take it for a spin.

You see, the Atlas RX-110S is Atlas's hot new allband receiver, and with the addition of the TX-110 transmitting module, it's an all-solid-state SSB and CW transceiving package.

Well, OK, let's see what it'll do on the oval track. Ah, a CQ . . . WB2XXX DE N4KJ . . . Hey, instant reply, and a 589 to boot! Semi-automatic break-in keying, 800-Hz CW filter, and built-in sidetone—not bad at all!

When I finished with the QSO, I asked Carl for a mike and quickly switched to 20 SSB. A W7 answered my CQ, but a bit high in frequency; no problem, the RX-110S is equipped with receiver incremental tuning. I'm impressed . . . I'll drive it home.

In the shack, I gave the little box a real operator's shakedown. The transmitter runs 20 Watts input or, with the high power module added, a full 250 Watts is possible. The output is broadbanded, which requires no tuning, and it's fed to the antenna via an SO-239 connector (not a cheap phono plug). In addition to the relative output meter on the front panel, there's provision to monitor current to the solid-state final amplifier. There's plenty of mike gain, and audio quality is excellent. The CW note is likewise "clickless" and chirp-free.

As I mentioned before, this is a transmitting module; certain stages of the RX-110S are required to make a complete transmitter. All connections for this are supplied through a 12-pin connector plug.

Jarring the receiver around, I found the mechanical stability excellent. Drift also is well within the 500-Hz figure as quoted in the manufacturer's specifications. The tuning dial reads to 5 kHz with 1-kHz marks on the tuning knob skirt. The handy RIT control I mentioned tunes up and down 5 kHz from the transmit frequency. When I switched the 800-Hz filter on a CW signal, a clean note with little ringing was realized. The receiver uses no rf stage, but behold the .25 microvolts for a 10-dB S + N/N sensitivity figure. Selectivity on SSB is 2.7 kHz at 6 dB down with a 2.2 shape factor, provided by a 6-pole crystal ladder filter. Image rejection is better than 60 dB. There's also plenty of audio—2 Watts into the internal 3-inch speaker. Dynamic range is rated at a terrific 80 dB above a noise floor of 130 dB. On-the-air tuning is smooth, and with no backlash you get the feeling of operating a much more expensive rig. Key down, the low-power transmitter draws about 2 Amps, or 16 Amps with the high-power module addition. I used my home-brew supply, but Atlas makes a nice matching supply along with many other accessories. A bracket and hardware are supplied to join the receiver to the transmitting module, making a great compact station.

I travel quite a bit, so the Atlas will be a nice traveling companion. Hours of operating pleasure are ahead from my new-found friend. So, congratulations, Atlas! A cute little rig!

Atlas Radio, Inc., 417 Via Del Monte, Oceanside CA 92054; (714)-433-1983. Reader service number A16.

Jerry Robinson III N4KJ
Asheville NC

M80 USER REPORT

The Macrotronics M80 ham interface for the Radio Shack TRS-80 computer includes an interface board and software for RTTY and CW operation. The hardware employs one board which provides access to the computer through the expansion port (an expansion interface is *not* required). On and off pulses generated by the computer can be coupled by a relay with normally-open or normally-closed contacts (or an accessory optoisolator for keying RTTY loops), a PNP transistor, or an NPN transistor. These options permit keying of virtually any transmitter for CW or FSK or the RS-232 input of a TTY AFSK system. For receiving CW or TTY, the board transfers pulses to the expansion port of the computer. This can be accomplished by providing the board with receiver audio which is detected by a phase locked loop or by connecting the RS-232 leads of a demodulator to the board. With the optional optoisolator, the board can be keyed directly by the TTY loop supply.

The software includes machine-language routines for CW and TTY encoding and decoding and a BASIC program for running the system. The instruction manual supplied with

Continued on page 199

New Rig for 10 FM

—a review of the Comtronix FM80

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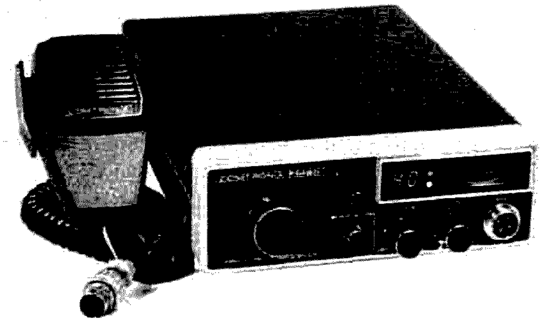
An exciting new frontier in amateur communications is presently being pioneered on the high end of 10 meters, and this field promises to gain widespread acceptance in the near future. Channelized FM operations similar to those presently enjoyed on 2-meter FM are producing worldwide communications for amateurs using small, low-power transceivers. DX propagation on 10 meters is on the upswing, and this condition shows no sign of diminishing in the near future. Meanwhile, 10 meter FMers are having the time of their lives working the world on this fascinating high-frequency band.

Although 10 FM supports a substantial amount of activity each weekday, this band becomes an absolute blowout of fun and pleasure every weekend. This super-excitement usually begins around midday Fridays and continues full blast until the band drops out Sunday evenings. During these periods, stations in all areas of the world frequent the internationally popular frequencies of 29,600 kHz or 29,620 kHz as activity booms and QSOs flourish. On numerous occasions, the DX activity on 10 FM resembles a gigantic 2-meter band opening with station signals stacking 5 or 6 layers deep.

Until recent times, most of the equipment used on 10-meter FM consisted of single-frequency business units which were usually retuned for operation on the International Direct Frequency of 29,600 kHz. As activity has increased, this "channel" has become quite busy, and secondary "channels" of 29,620, 29,640, and 29,680 kHz are also becoming popular. In order to assure the acceptance and future development of 10 FM, pioneering amateurs are now working toward the common goal of distributing on-the-air activities throughout the high end of 10 meters. Ultimately, this will divert mass pileups from 29,600 kHz during periods of intense activity. A substantial number of FM repeaters operate on the high end of 10 meters, and their performance is fantastic. Most of these repeaters employ 100 kHz input/output spacing, so that an input signal on 29,540 kHz would output on 29,640 kHz.

Several areas of the United States enjoy the pleasures of 10-meter-linking with their 2-meter repeaters to create "super machines". The Las Vegas machine, for example, permits HT-equipped amateurs to communicate with others thousands of miles away via a 2-to-10-meter link. An inestimable number of individually owned remote base units is active on 10 FM, and their operators truly have the world at their fingertips.

My first 10 FM rig was a single-frequency unit which ran 5 Watts on 29,600 kHz. I recently switched to the multi-frequency Comtronix FM-80, however, and the results have been a totally new ball game. Obviously, the Comtronix FM transceiver will prove to be a super-innovation for 10 FM.



The Comtronix FM80 with matching microphone. This compact unit places the wide world of 10 FM directly at one's fingertips.

The Comtronix

When UPS delivered the Comtronix package, the carrier dropped it approximately 2 feet to the floor (what else is new)! I quickly unpacked the unit and carried it to my car to check damage. When I connected the FM80 and switched on power, stations in Montana and Washington state came booming through. The FM80 is definitely a stout-hearted rig! A quick check with my trusty W4 wattmeter indicated 10-Watts output, which was exactly as Comtronix advertised. While mobiling home that evening, I worked California, Arizona, and Alabama. All stations agreed the FM80's audio sounded very good and its signal strength was quite ample (low power is very popular on 10 FM).

During the first weekend I used the Comtronix, some serious medical problems limited my on-the-air operations to a total of 2 hours—and much of this time was interrupted for handling chores. I did, however, manage approximately 12 contacts with 9 countries in four of the world's 7 continents. The FM80 was used barefoot during these operations, and the antennas used

were either a Hy-Gain TH3 triband beam or Newtronics 4-BTV vertical. One DX contact was also made from my car while using a Hustler mobile whip. Need I say more?

The Comtronix FM80 is a compact unit which operates directly from an auto's 12-volt battery or an external 12-volt power supply. Current requirements are approximately 350 mA during receive and 2.2 Amps when the unit is transmitting at high power. Frequency coverage is 28,910 kHz to 29,700 kHz in eighty 10-kHz channelized steps. 40 channels are covered with a front-panel switch "in" (CHA), and the additional 40 channels are covered when this switch is "out" (CHB). FM operations are not legally permitted on the first 9 positions of CHA (28,910 through 29,000 kHz), so the operator must remember merely to listen in this range. 10 FM activity is far removed from this range on either CHA or CHB, however, so no problems should be encountered. Transmission on frequency positions 6 through 25 of CHB (29,360 through 29,550 kHz) should also be avoided, as this range is used by OSCAR amateur satellites. Considering that the FM80 is capable of covering part of the *73* 10-meter band plan (provided the unit is modified for AM operation), plus receiving OSCAR satellite signals (provided a simple product detector and bfo are added), I suspect modification-oriented amateurs will make a mad dive for this rig. I'm already thinking of ways to use my FM80 on 29,150-kHz medium-scan TV, plus mating it with my similar-sized 2-meter rig for OSCAR mobile work. I have also used a 2-carrier operated relay interface between the FM80 and my TR-7600 for occasional remote base functions. A scanning adapter, priority channel, and memory function also are being considered, and a portable pack containing a motorcycle battery and short whip antenna are future considerations.

In addition to being an outstanding performer, the Comtronix FM80 is a beautifully engineered and packaged unit. A dark plastic sunscreen on the front panel's upper right corner covers the channel LED readout, illuminated S/output meter, and two function-monitoring LEDs. One LED is bipolar: green during receive and red during transmit. The other LED changes intensity according to audio input from the mike. This feature is particularly beneficial since FM signal amplitudes do not vary during modulation.

Since I also operate a Yaesu FT-901DM on 10 FM, I've received numerous requests for a personal comparison of the Yaesu and the Comtronix. Here is my opinion: The Comtronix is broadband—pretuned and all solid state, whereas the Yaesu uses 6146s and requires loading. I definitely prefer tube finals for low-band DXing and SSTV operations, but the FM80's "instant on" can't be beat for FM activity. Published specs rate the 901DM's receiver more sensitive than the FM80's, but I've found performance of both units identical. Yaesu suggests running the 901DM at 20-Watts output on 10 FM, and I think this is an excellent idea. Transmitted signal strength comparisons on the 901DM and the FM80 (10-Watt mode) are usually identical. Frequency/channel changes are easier with the FM80, but the 901DM's memory is great for repeater operations. Comtronix now has a split-frequency modification for repeater operation and Cushcraft just introduced a 10m FM Ringo.

10 FM Band Plan
29-MHz simplex operation on repeater output is OK if no intentional QRM is produced.

Repeater Inputs	Direct	Repeater Outputs
.520	.570	.620
.540	.600	.640
.560	.620	.660
.580	.640	.680
	.660	
	.680	

Table 1. 10 FM band plan.

In conclusion, I feel 10 FM is a fantastic frontier and the Comtronix FM80 is a superb little rig. The unit is easy to carry, it's great for mobile operations, and it doesn't represent a life's savings when gleaming under the dash of an automobile. It will never replace my low-band all-mode transceiver (FT-901DM), but it isn't intended for that purpose. The FM80's receiver is double-conversion with a first i-f of 10.7 MHz and a second i-f of 455 kHz. Its sensitivity is excellent (.5 microvolt for 20 dB quieting; squelch threshold also at .5 microvolt), and its selectivity is quite adequate (10 kHz at 15 dB and 20 kHz at 40 dB). Ultimate image rejection is better than −60 dB, and an rf output filter is included to eliminate spurious radiations.

If you would like to renew your interest in amateur radio and enjoy pioneering a great new frontier, grab one of these units and mobile to the nearest mountaintop. It's a grand experience. ■

Donald K. Reynolds
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Seattle WA 98136

The Black Art of Antenna Design

—shedding some light on the workings of vertical whips

The purpose of this article is to correct some widespread misconceptions about antennas. These misconceptions, as will be explained later, are not confined to certain users of an-

Fig. 1. (a) Zepp antenna with feedline. (b) Zepp with feedline removed. (c) The one-terminal impedance.

tennas, but evidently extend to some of the manufacturers as well. Unfortunately, there is a widely-held belief that antenna design is a "black art." While I do not wish to undermine the livelihoods of those well-qualified antenna engineers who thrive on perpetuating the notion that the operation of an antenna is incomprehensible to the layman, I do feel that some of the secrets should be revealed in the interest of the betterment of ham radio!

The Problem

The problem to be treated in this article is related to the way in which antennas are connected to transmission lines. We will exclude from the discussion microwave antennas such as horns or slots which are driven by waveguides. Practically all other antennas possess two terminals, the points at which one can say that the transmission line to the transmitter or receiver is connected, and the antenna begins.

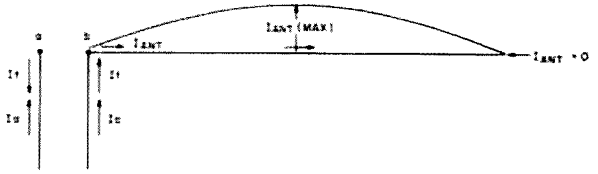

Fig. 2. Current distribution on the Zepp antenna.

The problem arises from what I shall call the "one-terminal impedance" misconception. As a starting point, let's take a look at an old and time-honored antenna, popular in the early days of ham radio, known as the "Zepp," and shown in Fig. 1(a). The Zepp consists of a half-wave wire, usually mounted horizontally, driven at one end by a two-wire transmission line. The feedline is normally one quarter-wavelength long, and is usually coupled inductively to a tuned circuit at the driving end. The antenna is said to be "voltage fed" because the extremity of a wire antenna is a point of high voltage and low current.

You must surely agree that terminals A and B in Fig. 1(a) are the input terminals of the antenna because this is where the two-wire transmission line is connected. If we concentrate on the antenna alone, we have the situation portrayed in Fig. 1(b), where point B is one end of the half-wave antenna, while point A is a disembodied point hanging in the air. What, then, is the impedance terminating the transmission line? It is evidently infinite, because an impedance is the ratio of an ac voltage to an ac current. An ac voltage, V_{ab}, applied across the two terminals of an antenna should certainly excite the antenna. If such a voltage generator is applied across terminals A and B, as shown in Fig. 1(c), no current can flow, because the same current which goes out of one terminal of the generator must come into the other, and in this case, terminal A is not connected to anything. But there *must* be a finite current entering the

antenna at the feed point, or there could be no power radiated by the antenna! Here lies the misconception which I have called "one-terminal impedance."

This dilemma was known to at least some of the early users of Zepp antennas, as can be verified by studying technical literature on the subject written 40 years ago. The truth of the matter is that the transmission line *must* also be a part of the antenna.

Since the horizontal part of the antenna is a half wave in length, there will be a standing wave of current along the wire with a magnitude of zero at the far extremity, maximum in the center, and small, *but finite*, at the driven end (see Fig. 2). The magnitude of this input current depends on the length-to-diameter ratio of the wire, and will be about 25 percent of the maximum current at the center for a length-to-diameter ratio of 100. The current on the transmission line wires will be composed of two components, the first of which is the ordinary transmission line component with equal and opposite currents on the two legs. This component is designated as I_t in Fig. 2. The second component is the antenna current, with equal amplitudes and equal directions on both legs, shown as I_a in Fig. 2. At point A, the total current must be zero. Thus, I_t and I_a must be equal in amplitude but 180° out of phase to add up to zero at A, and equal in amplitude but in phase to add up to the current entering the antenna at point B, labeled I_{ant}.

The transmission line currents are produced by the transmitter, usually through inductive coupling at the input end of the two-wire line. The antenna current is in the form of a standing wave on the antenna wire, but its distribution along the feedline is in some doubt. The electromagnetic field due to the transmission line currents alone is localized in the near neighborhood of the feedline, but the field due to the antenna currents is not so confined—in fact, it produces substantial radiation from the feedline. There will be coupling by this field to nearby objects such as to the building in which the transmitter is located, and to any electrical conductors nearby. The input end of the feedline will have inevitable capacitive coupling to the transmitter chassis, and the entire transmitter will be hot with rf, along with the house wiring. At higher power levels, the operator may receive rf burns when his lip brushes up against a metallic microphone! Frankly, the old Zepp antenna is a mess!

All of this is easily corrected by moving the feedline to the center of the half-wave dipole, which is a point of symmetry. The radiating antenna currents are now confined entirely to the antenna and no antenna currents are superimposed on the transmission line currents. Note, however, that this situation prevails only as long as a balanced transmission line is used to feed the antenna. If coaxial cable is used, then an appropriate "balance-to-unbalance" transformer, or balun, must be employed between the coaxial line and the antenna to inhibit currents from flowing on the outside of the coaxial cable.

While the old Zepp antenna is rarely used today, there are many other antennas in common use which must be driven from one extremity. These are the class of vertical whips in which the feedpoint is elevated above earth ground, highly popular for base station use in the VHF and UHF bands in amateur, commercial, and marine service. This class of antennas is used in an effort to obtain vertically-polarized radiation which is omnidirectional in azimuth. Unfortunately, the one-terminal impedance misconception, which should have been laid to rest 40 years ago, has reappeared with a vengeance!

Antennas are commercially available from a number of different manufacturers which consist of a vertical whip extending up from an impedance-matching network at the base, which is fed through a coaxial cable connector. The most popular lengths for the whip are 1/4, 1/2, and 5/8 wavelength. If this type of antenna is used on the outside metal surface of an automobile, there is no problem. One has a kind of highly-unbalanced dipole, one leg of which is the whip, the other being the outside metal surface of the car. The outer conductor of the coaxial cable is electrically connected (either conductively or capacitively) to the car body, while the center conductor couples to the whip. The

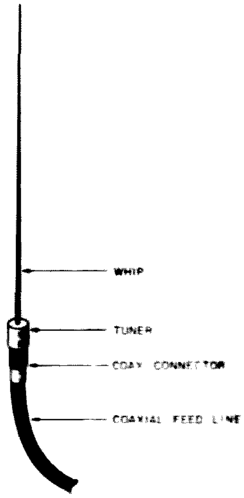

Fig. 3. Typical whip with base tuner connected to a coaxial line.

same magnitude of current which enters the base of the whip must also spill out over the car body. If the antenna is mounted *at a point* of symmetry, ideally at the center of the rooftop, current will flow radially out from the base of the whip, as in the case of a vertical broadcast antenna system. The car top is an elevated "ground plane" of finite size. The radiation pattern will show only minor variations in azimuth, but the maximum radiation inten-

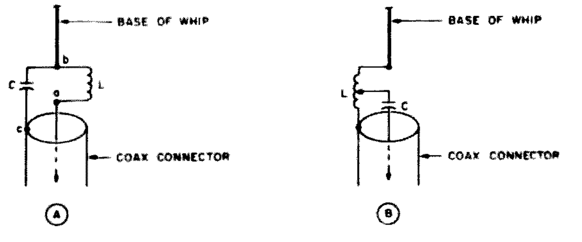

Fig. 4. Tuners for end-driven whips. (a) L-network. (b) Tapped-inductor.

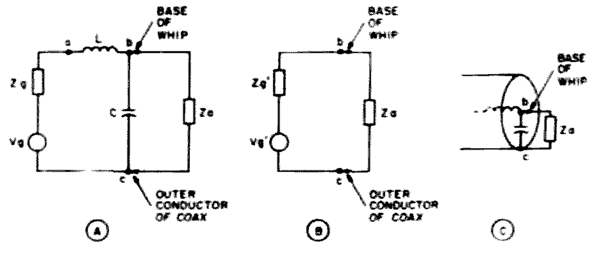

Fig. 5. Equivalent circuits of end-driven whip.

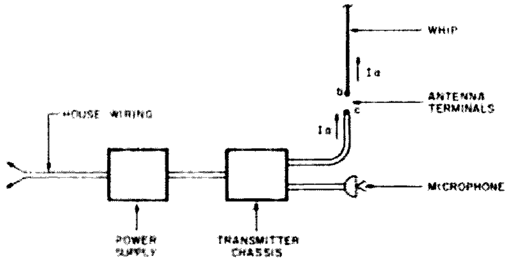

Fig. 6. The complete end-driven whip.

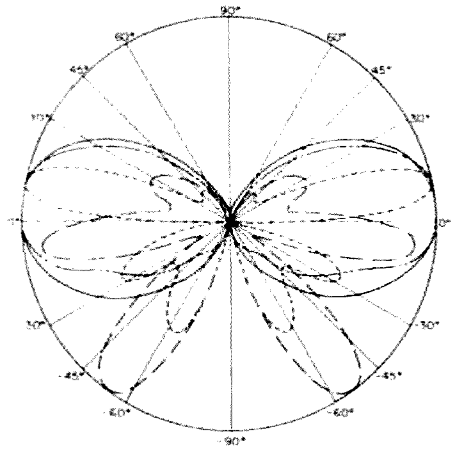

Fig. 7. Measured radiation patterns showing relative power vs. vertical angle: 1. —·— half-wave whip, no decoupling. 2. - - - - 5/8-wavelength whip, no decoupling. 3. — — — half-wave whip with quarter-wave decoupling sleeve. 4. —— reference half-wave center-driven dipole.

sity will typically occur at some vertical angle above the horizon. This effect is usually tolerated as the price to pay for the simplicity and economy of the simple vertical whip extending from the car body. (Incidentally, severe asymmetry in the mounting location of a VHF vehicular whip can result in a highly-irregular azimuthal radiation pattern.)

The great one-terminal impedance misconception rears its head again when an automotive-type whip antenna is connected to the end of a coaxial transmission line, with the automobile deleted. This situation is not uncommon. Many an amateur radio operator has bought an automobile whip for home use, stuck it out of the window, and connected it to his 2-meter base station through a length of coaxial cable. If he could only see where the rf was going, he would be shocked! (At the end of this article I will reveal the design of a handy device which actually *can* make the rf visible!)

For ham use, degraded performance is not usually a critical matter. The user may be unaware of the degradation because he is still able to work other stations. The user may be quite happy. Unfortunately, users rarely receive any technical guidance from either the manufacturer of the antenna or the dealer, both of whom are principally concerned with sales. A much more serious problem arises when the automotive-type whip antenna is used in other than ham radio service, for example, in the marine band of 156-162 MHz. If you happen to live in a coastal area where large marinas are located, look at the sailboats and see how many vertical whip antennas of the thin wire, automotive type are mounted on the mastheads. As will be explained below, this type of antenna system can produce severe degradation of the radiation pattern, caused by unwanted currents excited on the outside of the coax line as well as on the stays, shrouds, and the mast itself—all functioning as longwire antennas. The degradation in communications performance could result in tragedy because of the inability of the boater to summon help in an emergency situation. I cannot believe that the manufacturers and dealers of these antennas are aware of the problem; it is much more likely to be a matter of ignorance. It happens that there *do* exist well-designed vertically-polarized marine VHF antennas on the market, in which the radiating element is superbly decoupled from the coax line and mounting structure. It is unfortunate that in this consumer-oriented market, when the sailboater asks for a lightweight VHF antenna, the dealer happily sends him off to his (possible) doom with degraded communications capabilities!

Returning to the one-terminal impedance misconception, Fig. 3 portrays a typical coaxially-driven whip antenna with tuner in the base, connected to a coaxial cable. The antenna might be either a half-wave or 5/8-wavelength whip.

A popular network for impedance-matching the whip to the coax line is shown in Fig. 4(a). This is an L-network in a configuration useful for a load impedance whose resistive part is greater than 50 Ohms, as in the case of both the 1/2- and 5/8-wavelength whips. Another possible tuning network, using a tapped inductor, is shown in Fig. 4(b). Capacitor C in Fig. 4(b) is sometimes deleted, and the length of the whip is made variable in order to gain another tuning parameter.

We now come to another point about which I suspect there are misconceptions among many amateur radio operators. This concerns the respective roles of the *inside* and the *outside* of the coaxial line. The transmitter normally resides within a rather well-shielded box. The signal generated by the transmitter is conveyed *within* the coax line to the feedpoint of the antenna before it (the signal) emerges and first "sees the light of day." I like to call the shielded interior of the transmitter and the inside of the coax cable out to the antenna terminals the "inside world." The "outside world" consists of the whip antenna *and the outside surface of the outer conductor of the coax line!* This is the point missed by many users of antennas. They perceive of the coax line purely as a transmission line connecting their transceiver to the antenna, and fail to understand that it can also be a part of the antenna. Please understand that this is not a new or revolutionary concept, but has been well understood by antenna engineers during at least the last 35 to 40 years.

Looking down into the coax line between points A and C—see Fig. 4(a)—we can replace the "inside world" by a voltage source, V_g, in series with an internal impedance, Z_g. This is an application of Thevenin's theorem—well known to all electrical engineers. The voltage source drives the antenna impedance, Z_a, through the LC network, as shown in Fig.

5(a). The circuit can be simplified by including the tuner as a part of the effective source impedance, looking back toward the source at terminals B and C, as shown in Fig. 5(b). The effect of the tuner is to modify the source voltage to a new value, $V_{g'}$, and the source impedance to $Z_{g'}$. The tuner can properly be considered to be a part of the "inside world." You could just as easily mount the L and C elements just inside the coax line as shown in Fig. 5(c).

Aha! We now note that the load impedance terminating the coax line is connected across terminals B and C. If we disconnect the coax line with its tuner from the antenna, we are left with only one terminal (B), the other terminal having been carried away with the coax line! The one-terminal impedance problem has struck again.

We are led to the correct conclusion that the coax line must provide the other "half" of the antenna. Antenna currents *must* be carried on the outside of the coax line. Unlike the open-wire feedline of the Zepp antenna, where transmission-line and antenna currents were superimposed, the coax line forces the antenna currents to be entirely on the outside of the outer conductor. This results from the fact that a coaxial line forces currents *within* the line to be equal and opposite on the center conductor and inside wall of the outer conductor, respectively. The antenna current is forced to flow on the outside surface of the outer conductor.

The antenna is really a horrendously unbalanced dipole, as shown in Fig. 6, the two sides being (1) the whip itself, and (2) the outside of the coax line all the way to the transmitter, the outer box housing the transmitter, and, very possibly, many other conductors associated with the system, such as the microphone cable, leads to a power supply, house wiring, etc.

The magnitude of the antenna current at all points along the outside of the coax line is not easily predictable. One can be sure that at the feed point the instantaneous current, I_a, entering the whip must be exactly equal to the antenna current at the extremity of the outer conductor of the coax line (see Fig. 6). Below the feed point, the current on the outside of the coax will probably be in the form of standing waves produced by reflection processes at the bottom end of the coax-transmitter system. At the antenna terminals, the standing-wave amplitude on the outside of the coax could produce a current maximum (resonance), current minimum (anti-resonance), or anywhere in between. If there are many wavelengths of coax between the transmitter and the antenna terminals, there will be only a small percentage difference in frequency between resonance and antiresonance. The degradation of the radiation pattern is highest for antiresonance conditions on the cable, at which time the resulting radiation pattern in the vertical plane will be broken up into a mass of lobes. Additional degradation will result from power loss where the coax line is in close proximity to lossy materials, such as the wall of a house, the ground, etc. Also, horizontal runs of the coax between the antenna and the transmitter will radiate a component which is cross-polarized with respect to the radiation from the whip.

If you are skeptical, make up an rf sniffer like the one described at the end of the article, and convince yourself! Connect a 2-meter band, automotive-type whip at the end of a length of coaxial cable of arbitrary length—3 feet, 6 feet, 10 feet—whatever is available. Connect the other end to your 2-meter rig. Ten Watts of output power is a satisfactory level for good rf sniffing, but higher power produces more spectacular results.

First, while transmitting (on some unused frequency!), bring the coupling loop of the sniffer up toward the whip. For maximum coupling, the plane of the loop should lie in the plane containing the whip. Tune the loop with an insulated tuning tool to obtain maximum brightness in the indicator lamp. You can search along the whip and see the standing wave of current, since the loop is magnetically coupled and a point of maximum brightness means of a point of maximum current. Now search with the sniffer along the coax line below the antenna. Provided that your rig really is putting out the better part of 10 Watts, or more, the sniffer will light up merrily along the coax all of the way back to the rig!

I have performed this demonstration (with good effect) before a number of different ham groups. At one meeting, I also demonstrated a 2-meter model of a Zepp antenna, and showed how the feedline was strongly radiating. After the meeting was over, one of the old-timers present said to me, "That demonstration of the Zepp was like killing an old friend!" I prefer to think that I was helping kill an old bandit who had been

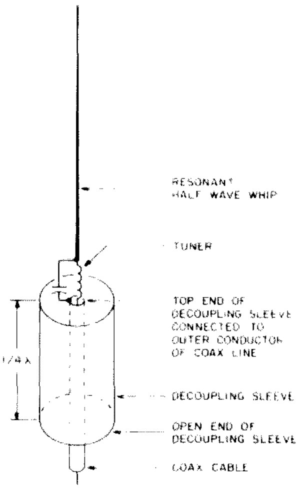

Fig. 8. Half-wave whip with quarter-wave decoupling sleeve.

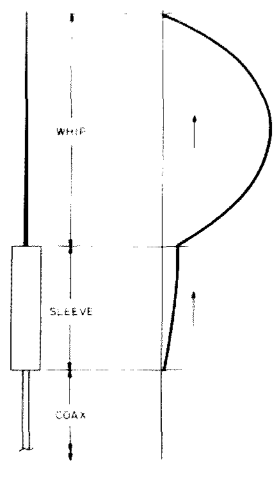

Fig. 9. Current distribution on a sleeve-decoupled half-wave whip.

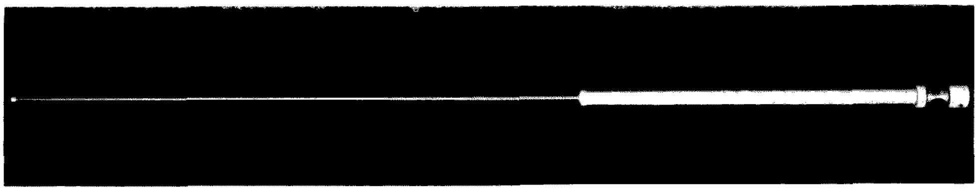

Fig. 10. Sleeve-decoupled half-wave whip designed for marine VHF use

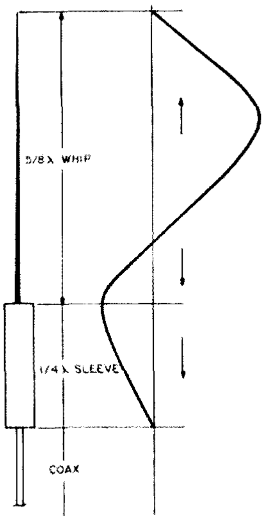

Fig. 11. Current distribution along 5/8-wavelength whip with 1/4-wave decoupling sleeve.

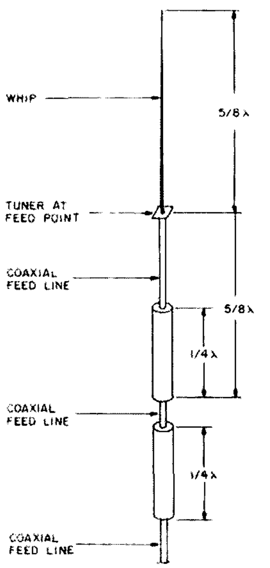

Fig. 12. A coaxially-fed, sleeve-decoupled 1-1/4-wavelength center-driven dipole.

robbing the hams of rf power for years!

Some representative measured radiation patterns of whips showing the effects of radiation from the coax line are shown in Fig. 7. The azimuthal pattern of a vertical whip is necessarily omnidirectional. The radiation pattern in the vertical plane is most easily measured by supporting the whip horizontally above a turntable, and rotating it in the horizontal plane at a fixed height above the earth. A signal generator on the turntable drives the antenna, and the radiated signal is picked up at some distance away on a horizontally-polarized antenna, amplified, detected, and plotted on an automatic chart recorder, the paper drive of which is synchronized with the rotation of the turntable. The vertical polar diagrams of Fig. 7 were obtained in this way, using a commercial antenna pattern recorder and facilities of the University of Washington. The original recordings were made in terms of a decibel plot on an X-Y recorder, and were carefully replotted in a polar diagram to make the result more generally understandable.

Fig. 7 shows the relative radiated power versus vertical angle for 3 different end-fed whip antennas, all patterns normalized to a maximum value of unity. Each of these antennas was mounted horizontally, with the coaxial feedline extending out in line with the whip for a distance of 8½ feet, and then coming vertically down to near ground level, and then back to the turntable.

Pattern 1 is that of a commercial half-wave whip with tuner in the base. Note how the pattern is of "butterfly" shape, with lobes above and below the horizon. This is a typical result of the radiation from the coax combining in and out of phase with the component from the whip. The pattern would be much worse if even a greater length of coax extended down from the base of the whip, the main effect being to break up the vertical pattern into a mass of lobes, with no assurance that there would be a maximum of radiation toward the horizon.

Pattern 2 is that of a 5/8-wavelength whip with base tuner, and it exhibits considerably more severe degradation than the half-wave whip. This arises from the larger base current of a 5/8 whip than in a half-wave whip, resulting in a correspondingly larger "spill-over" current on the outside of the coax.

Pattern 3 is that of a half-wave whip with a quarter-wavelength decoupling sleeve, to be described in the next section. Only slight pattern distortion is evident, this being due to the small current necessarily excited on the decoupling sleeve.

Finally, pattern 4 is that of a center-driven balanced dipole which is used as a test antenna to calibrate the antenna range.

The Cure

The conclusion to be drawn from the above discussions and test results is this: Use your mobile whip antenna where it belongs (on your car) and be skeptical of any commercially-available antennas which are claimed to be designed for base station use but which consist of an end-driven vertical radiator with no decoupling system evident.

How then can you radiate a clean, omnidirectional, vertically-polarized signal from an end-driven whip antenna, and know that it is performing correctly? Again, we turn to the old pros, the antenna engineers who have known how to design such antennas for the last 40 years, and have been furnishing them to the commercial trade, to the military services, the government agencies, the telephone company, etc. These are the sophisticated users, who are not fooled by advertising claims, and who insist on proof of performance, including measured radiation patterns under specified conditions and measured gain figures, before they buy.

The solution to the problem of end-driving the whip is to employ a suitable "decoupling system" to inhibit the antenna currents from flowing down the outside of the coax. For the VHF bands, one of the most widely used and (when properly designed) highly effective systems employs a 1/4-wavelength section of tubing, extending down from the base of the whip over the outside of the coax line, as shown in Fig. 8. This system is very effective for half-wave whips, very poor for 5/8 whips, and only fair for 1/4-wave whips. (This last design has been called a "sleeve dipole" for many years.)

Note in Fig. 8, which shows a half-wave whip, that the outer conductor of the coax line at the base of the whip is folded down and over the coax in the form of a quarter-wave sleeve, which is open at the bottom. For good decoupling, the diameter of the sleeve must be considerably greater than the outer diameter of the coax line, at least in the order of 5 or 10 to one. Looking up into the open end of the sleeve, one sees a coaxial line with the sleeve as the outer conductor, and the outer surface of the feed coax as the inner conductor. This coaxial line is open at the bottom end, but terminated at its top end in a short circuit. At quarter-wave resonance, there is a high impedance between the lower lip of the sleeve and the inner coax line. This impedance is in the path of the "spill-over" current, and forces a current minimum to exist at this point. There is a portion of a standing wave of current on the outside of the sleeve, with maximum amplitude at the top of the sleeve. This max-

imum amplitude is small, since it must be equal to the base current entering the whip. The other end of the standing wave is at the open end of the sleeve, where the current amplitude is practically zero. The outside of the coax line below the sleeve is now very effectively decoupled from the antenna. The current distribution along the entire structure is shown in Fig. 9. The small section of a standing wave on the decoupling sleeve is in phase with the current on the whip, but has little effect on the radiation pattern, as was shown in Fig. 7. A commercially-available version of this antenna, designed for the 156-162-MHz marine VHF band, is shown in Fig. 10. This antenna is particularly attractive for masthead mounting on sailboats, because the decoupling sleeve prevents the stays, shrouds, mast, etc., from becoming inadvertent parts of the antenna.

A 5/8-wavelength whip cannot be decoupled effectively with a quarter-wave sleeve, as can be seen by the current distribution shown in Fig. 11. The standing wave of current along the whip has a phase reversal one half wavelength down from the top. The feedpoint current amplitude is 70 percent of the maximum current, and the current at the top of the decoupling sleeve must have the same amplitude and phase as the current at the base of the whip. The result is that even though the coax line below the sleeve may be fairly well decoupled, the radiation pattern of the antenna will be poor. Radiation toward the horizon from the upper and lower halves of the system tends to cancel, with maximum radiation occurring in lobes at high and low angles.

A more intelligent way to drive a 5/8-wavelength whip is to place the quarter-wave decoupling sleeve down below the feedpoint so that the open end of the sleeve is 5/8 wavelength below the feedpoint, as shown in Fig. 12. The antenna now becomes a center-driven 1-1/4-wavelength dipole, which happens to be the "magic" length needed to produce power gain toward the horizon of 3 dB with respect to an ideal vertical half-wave dipole. This is the maximum gain attainable from a center-driven dipole, and is certainly worth getting.

Experimental measurements have shown that a single quarter-wave sleeve terminating the bottom end of the 5/8-wavelength antenna is insufficient to provide good decoupling of the coax cable below. Unlike the case of the decoupling sleeve on the base-driven half-wave whip, there is now an antenna current maximum at the top end of the sleeve. The decoupling is found to be only partial, and the radiation pattern shows degradation from the currents on the

Fig. 13. Commercial VHF version of marine antenna shown in Fig. 12. Here, the author provides temporary (and decoupled) support.

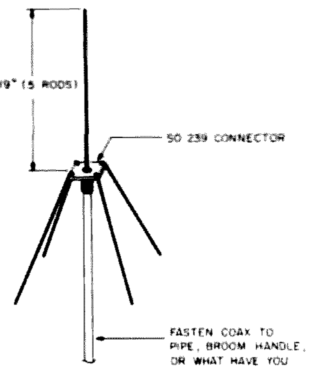

Fig. 14. The "famous" coat-hanger special.

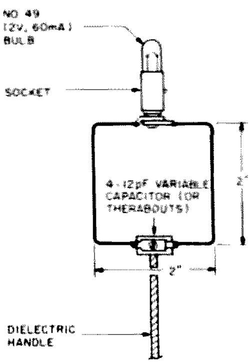

Fig. 15. An rf sniffer for the 2-meter band.

outside of the coax below the sleeve. The cure is to place a second quarter-wave sleeve below the first, as shown in Fig. 12. A commercial marine VHF antenna utilizing this construction is shown in Fig. 13. The upper 5/8 whip, the tuner, and the two quarter-wave sleeves are enclosed within a tapered fiberglass tube. The ratio of the diameter of the lower decoupling sleeve to the braid diameter of the coaxial line (RG-58A/U, in this case) is about 6 to 1, ensuring good decoupling.

This antenna produces a vertical radiation pattern very close to that of an ideal, isolated, center-driven 1-1/4-wavelength dipole in free space, unaffected by the feed cable at the bottom end. Another antenna based on the same principles has recently been announced for amateur radio service in the 2-meter band. It is designed for base station use and features twin decoupling sleeves of conical shape in order to obtain an adequately large mouth diameter in a rigid structure.

This article would be incomplete without a mention of the ideal antenna for the amateur who wishes to rush a 2-meter base station on the air on an absolutely minimal budget. This is the famous "coat hanger special," which actually *can* be made with coat hanger wire, and which performs spectacularly better than just about any automotive-type whip antenna when connected to the end of a length of coaxial cable. Fig. 14 shows the details.

This simple antenna, made on a UHF coaxial chassis connector, behaves like a vertical, center-driven half-wave dipole. Note that the 4 radial rods, referred to erroneously by many people as a "ground plane," are bent down at about a 45° angle from the horizontal. *Don't* mount these rods so that they extend out horizontally from the base of the whip. To do so will produce (1) a radiation pattern in which maximum radiation is lifted from the horizon, and (2) an input impedance of around 35 Ohms, resulting in a mismatch on a 50-Ohm cable. Bending the radial rods down at about a 45° angle (1) brings the maximum radiation intensity down to the horizon, and (2) brings the input impedance up to about 50 Ohms, giving an excellent impedance match. A low vswr over the entire 144-148-MHz band will be obtained.

Although a good antenna, the coat-hanger special is not the answer to all of the world's problems. It is driven at a point of current maximum, and there is no reason to believe that all of the spill-over current will be confined to the radial rods. Some current is bound to flow down the outside of the coax, and will produce standing waves of current, interfering with the radiation pattern of the antenna. The hope is that the 4 radial rods, being of resonant length, will hog the current, keeping the spill-over current along the outside of the coax small. To check your coat-hanger special, use your rf sniffer. If you detect appreciable rf on the coax below the antenna, try adding (or subtracting) about a quarter wavelength of coax to (or from) the feed cable. The reasoning behind this move is to try to make the outside of the coax change from an anti-resonant to a resonant condition.

The Rf Sniffer

The rf sniffer alluded to in the previous discussions is easy to build from junk-box parts. Even if one buys all of the components at a radio store, the total cost is unlikely to exceed $2.00.

The sniffer consists of a loop of wire, a pilot light, and a tuning capacitor all connected in series. The relative positions of the 3 components is immaterial. You can put the tuning capacitor right next to the lamp if you wish, or connect it in series with the loop on the side opposite to the lamp. I like to use a 2-volt, 60-mA bulb (No. 49) because this produces good sensitivity. The capacitor can be a compression mica-type, a ceramic variable, a tubular plastic variable, a miniature air variable, etc.

The dimensions of the loop shown in Fig. 15 are suitable for the 144-148-MHz band. The actual capacitance required to achieve resonance will be a function of the loop area and the wire size. By using No. 20 copper bus wire and the loop dimensions shown, resonance will be obtained somewhere within the range of 4 to 12 pF.

While the light bulb can be soldered into the loop, a socket is recommended. The bulb can easily burn out, especially when you are showing your friends how poorly their antennas are decoupled! It is also convenient to glue the sniffer to the end of a stick, plastic tube, or rod, to prevent your hand from detuning the loop.

Conclusion

This article can be summed up as follows: 1) There is no such thing as a one-terminal impedance; 2) A whip antenna cannot be end-driven successfully from a coaxial transmission line unless an appropriate decoupling system is incorporated in the design.

When the ham attaches an automotive-type whip to a length of coax line to serve as a base station antenna, he is doing so at his own risk. Ideally, the manufacturer or the dealer should call the attention of the buyer to the bad effects of this kind of misuse of the product. This is similar to the responsibility of a manufacturer of medicine to call the buyer's attention to the possibility of adverse side effects! A more serious situation exists in the case of some end-driven base station antennas, currently on the market, which totally lack any form of decoupling.

Armed with information gained from this article, and with your rf sniffer in hand, you should now be able to approach the marketplace with a more critical eye, asking the dealer embarrassing questions about spill-over and decoupling, and insisting on proof of performance! So much of the electronic equipment offered to the amateur radio buyer today is truly representative of the state of the art that it is high time that we elevate the antenna to this same status. ■

Introducing the 2m/220 Connection

—give crossband operation a try with this interconnection scheme

Carey I. Fisher WB4HXE
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With the introduction of 220 FM to the Atlanta area, I decided it was time to do some serious experimenting. I hope that the project described here will encourage others to use this fine band.

It all started when Neil Stone WB4UPC installed a 220 repeater and turned it into a remote base for 2m. While operating 220 through this system, a user can dial up, with a tone pad, any legal combination of 2m transmit and receive frequencies in 5-kHz increments. This capability, coupled with a good site, opens many possibilities!

After using this system a couple of times with a newly purchased Midland 13-509 from my home QTH, I wanted to be able to access it from my mobile. However, I also desired the capability of using a hand-held to achieve the excellent coverage afforded by the remote base.

Mounting the 13-509 in the mobile was no problem, but the question of using a hand-held required some thought since, owning a 2m hand-held, I did not want to purchase another. The solution appeared as if in a vision: Why not a crossband repeater?

With an IC-22S for the 2 meter end and the 13-509 on 220, all that was needed was some control and audio interfacing and my 2m hand-held could be used to get into the 220 machine. A block diagram of the system is shown in Fig. 1. This system was originally designed to be used in the mobile; however, it has also been used at the home QTH.

A look at the schematic in Fig. 2 will show how simple the audio interface is. Connections to the rigs' speakers are most easily made using the external speaker jacks. The mike connections can be made via either the front-panel connectors or the accessory jack on the back of each rig. The capacitor and pot values were chosen to fit the particular impedance and audio characteristics of the rigs involved. For interfacing to other rigs, general guidelines can be given. The pot should be approximately the same value as the mike impedance. The capacitor value can be experimentally determined for best audio quality.

Fig. 3 shows the schematic of the control section. While many variations of the transistor switches are possible, it seems that every time I designed one "by the book," it failed to operate properly. The circuits were finally debugged using a deterministic (read "cut-and-try") approach. One word about the use of relays instead of solid-state PTT is in order. While I am normally dead set against using relays in modern ham gear, two beautiful miniature relays were available in the junk box. Also,

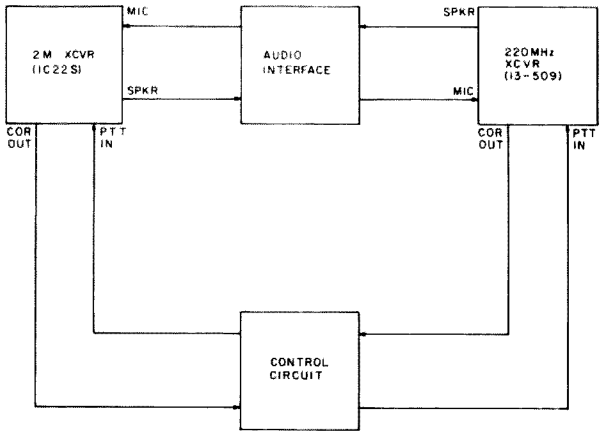

Fig. 1. Block diagram.

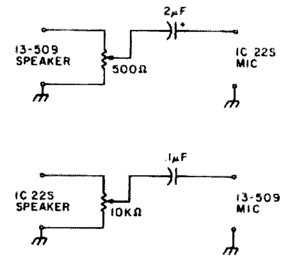

Fig. 2. Audio interface schematic.

"dry" relay contacts will switch any PTT system.

The connection for COR in the 22S was made at the low end of the signal light. When no signal is being received, this point is high, turning on Q1, which closes RY1, thus opening PTT to the 13-509. When a signal is being received, this point goes low, turning Q1 off, which opens RY1, closing PTT, thus repeating from 2m to 220. The "220 TRANSMIT" LED is also turned on by this relay.

COR from the 13-509 is taken from the collector of TR13. This is the noise amp switch and the collector is low when a signal is not present. This is the opposite of the operation of the 22S, so the relay, RY2, is wired oppositely, that is, the normally-open contacts are used on RY2 as opposed to the normally-closed contacts on RY1.

A bit of caution: Don't forget to include an on/off switch that disables both PTT lines or you will have one or the other rig transmitting when you don't want it to.

All connections to the rigs were made to the accessory connectors. This allows normal use of the rigs without cable swapping.

This crossband repeater controller has really added versatility to my 2m hand-held. I can park my mobile, turn this device on, and leave. From anywhere within simplex range of the mobile (I usually use 146.49), I can communicate through my hand-held, through this system onto 220, through the 220 to 2m remote base, and out on any combination of 2m frequencies. Using this system, I have worked over a hundred miles using a 5-Watt hand-held in North Georgia terrain that is almost impossible to communicate through in any other way.

220 has finally come to Georgia! ■

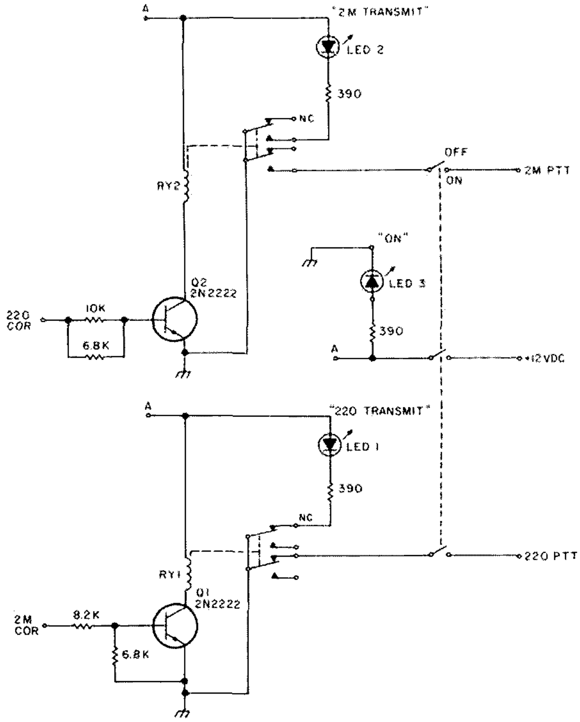

Fig. 3. Schematic of the control section.

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A Fresh Start for your Old Tx

—modernize it with grid-block keying

As a result of the most recent boom in amateur radio, many older pieces of tube-type equipment have been pulled out of the closet and placed into active service. My old Heathkit DX-40 occupies a prominent place in my shack and has been the workhorse of many hours of DXing and rag chewing. However, when I moved into the fast-paced Extra subbands, I found my hand key inadequate and decided to move up to electronic keying. I homebrewed the keyer with few complications. A reed relay was used to perform the main switching function. I plugged the keyer into the DX-40 and hunted my first victim on the receiver. Tragedy! The very first dit fused the relay contacts and the rig had to be turned off to terminate the transmission. I had obviously overestimated the power handling capability of the relay.

In cathode-keyed circuits, virtually the total input power of the transmitter is passed through the key (or keying relay). In the case of my DX-40, this amounts to about 150 mA at 600 V. The solution to the problem was obviously to use a relay with greater power handling capability (or was it?). A search for such a relay left me empty-handed. I could find no relay that was fast, cheap, fitted the voltage and power requirements, and was available locally.

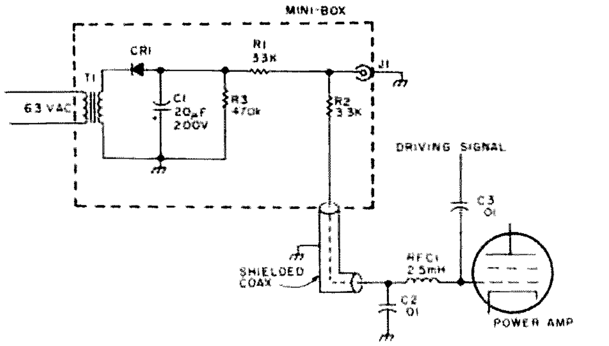

Fig. 1. Grid-block keying modification. C1—20-uF, 200-V dc electrolytic. C2, C3—.01-uF, 1-kV disc ceramic. CR1—200-V, 0.5-Amp silicon rectifier. R1, R2—1-Watt, 20%. R3—½-Watt. RFC1—2.5 mH. T1—filament transformer, 115-V primary, 6.3 secondary at 300 mA.

Finally, it dawned on me that there must be a way to key the transmitter without switching the full power of the transmitter directly. It did not take long to find a grid-block keying circuit in a old handbook. This type of keying requires the switching of only 150 V at a current of just a few milliamps. This was well within the limitations of my small reed relays and could even be handled by an inexpensive transistor. An important bonus in using grid-block keying is the reduction in potential shock hazards. Scrounging through the junk box, I found everything I needed for the project. In an additional hour and a half, I was on the air at 25 wpm.

The principle of grid-block keying is very simple. During key-up periods, the final amplifier is blocked by placing a strongly negative charge on the grid of the power amplifier tube. When the key is closed, this voltage drops across a resistor (R1 in Fig. 1). This removes the charge from the grid and the amplifier is free to run normally. Basically, the keying circuit is composed of a voltage source and dropping resistors. An isolated negative 150-V dc source can be inexpensively obtained by using a 6.3-V filament transformer as the main component. The transformer's 6.3-V winding is connected to the 6.3-V ac filament line of the transmitter. The original primary of the transformer then becomes the high voltage secondary. The transformer can be conveniently tapped into the filament line of the transmitter at the filament terminals of one of the tube sockets. Note that the rectifier is connected in such a manner that the ground is positive with respect to the negative keying voltage. It is important that filter capacitor C1 be connected properly with respect to this polarity. Also keep this in mind when making any voltage measurements. R3 is included as a bleeder resistor.

We now have a negative voltage source and a mechanism for turning it on and off. Getting the charge to the grid requires some special consideration. In my first grid-block keying circuit, none of the components was shielded. As a

a result, the transmitter emitted a signal during key-up periods. The emitted signal would gradually creep up in intensity until it reached almost full power. Placing the voltage source in a minibox and using coax to get the voltage to the power amplifier eliminated the problem. The driving signal is kept from entering the keying circuit by RFC1 and C2. The dc keying voltage is prevented from entering the driving circuitry by the .01 blocking capacitor, C3. If the grid is already dc-isolated from the driver by a capacitor, C3 is not needed.

It should be noted that the grid-block keying modification in my DX-40 disabled the "grid" function of the meter. This is only a slight hindrance in actual operation. Too much grid drive with grid-block keying will cause the transmission of a "backwave" or residual signal during key-up periods. Grid drive should be adjusted to the point where no plate current can be detected during key-up periods. The output could be checked with a sensitive rf power meter or an swr meter to detect any backwave that might be leaking through.

Most older cathode-keyed tube rigs are designed so that the transmitter is activated when the plug is removed from the original jack. Some designs may require that the jack be shorted. A word of warning: If you leave the original cathode-keying jack in the transmitter, cover it so that your keyer won't be accidentally plugged into this high voltage gap. I learned this lesson the hard way. You guessed it—I fused another relay. ■

An Inflation Fighter for 220

—join the fun . . . inexpensively

$18.50 and 90 minutes, and you're listening in.

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How would you like to be on 223.5 MHz for a nominal investment of $18.50 and an hour and a half of your time? Well, I think this article may help some people who are stymied right now about the whats and wherefores of how to get on, seeing that there is no surplus equipment available and "scanners," per se, don't cover that area of the frequency spectrum.

For some 6 months now, a few of us hams here in southwest Pennsylvania have been fooling around with 223.5 MHz. Even with the availability of some Midlands, Cobras, and FM 76s, the activity is very sparse. As many of you are aware, VHF Engineering sells rf decks for 10 through ¼ meters. These modules are easy to build and tune up, and they are inexpensive. They also have, as a standard feature, an output of 10.7 MHz as an i-f frequency. Now, think about that for a minute! What else uses 10.7 MHz as an i-f? Well, almost all scanners except Bearcat and some Lafayettes. Also, almost all 2 meter rigs do. So, if your already own some sort of scanner (and a lot of hams do), $18.50, and a little time, you are in the listening business on 220 or 440 or 50 or 144 MHz.

All you have to do is wire in the output of the VHF Engineering rf module to the 10.7 MHz i-f in your scanner or 2 meter rig and you are ready to go. This modification does not alter the performance of the scanner or 2 meter rig, but enhances it by adding, in this case, 220 MHz capabilities. You can even use an old portable AM-FM radio which has its i-f at 10.7 MHz. The gain in these sets is not very great, but they will work.

To be more specific, in my own practical application I bought a VHF Engineering 220 rf module, built it, and needed a 10.7 i-f—preferably another stage at 455 i-f—and an audio and squelch stage. So, considering what to do, I spied my much-experimented-with, obsolete, Radio Shack Pro 4 scanner, which is a pocket monitor for VHF frequencies. With a little investigation, the first i-f 10.7 MHz ceramic filter was found, and I injected the output of the rf module in there. "Voilà, it worked!" So for a very modest investment, I now hear quite well on 220.

Another idea would be to inject the output of the module into any 2 meter FM rig having an i-f of 10.7 MHz. I tried the above-outlined procedure on my own Icom 22S, and it works great, with very good sensitivity and gain.

A VHF Engineering 220 transmitter goes well with my setup. In fact, I am contemplating building a 220 walkie-talkie utilizing these ideas. ■

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Building Long Yagis for UHF

—some pitfalls to avoid

Beware of the "something for nothing" offer! With this thought in mind, the long yagi antenna is being placed under suspicion. Would you believe a 48-element collinear array (24 driven elements and 24 reflectors), whose gain is approximately 16 dB, could be replaced with a single 13-element long yagi? In addition, the long yagi has: 1. Less wind resistance; 2. More directivity per pound of aluminum; 3. Greater ease of fabrication; and 4. Excellent mechanical stability. Certainly there is a temptation to believe that the long yagi antenna offers something for nothing when compared with other antenna arrays. What must be sacrificed to obtain the aforementioned advantages? Followers of the "Collinear Clan," read on!

The cautious amateur constructing a beam antenna intended for application in the VHF and UHF range would exhibit a tendency to cut the elements longer than necessary. This stems from the old adage, "It is easier to cut 'em long than to add a piece on." This is the philosophy that has helped give the long yagi a questionable reputation.

In an attempt to reinstate the long yagi in its rightful position, antenna patterns of a 13-element yagi were made. Fig. 1 shows polar patterns of the long yagi in horizontal polarization. Fig. 2 shows patterns with the yagi vertically polarized. Fig. 3 shows the reference dipole in the horizontal plane. Curve A is plotted in the same relative gain scale as

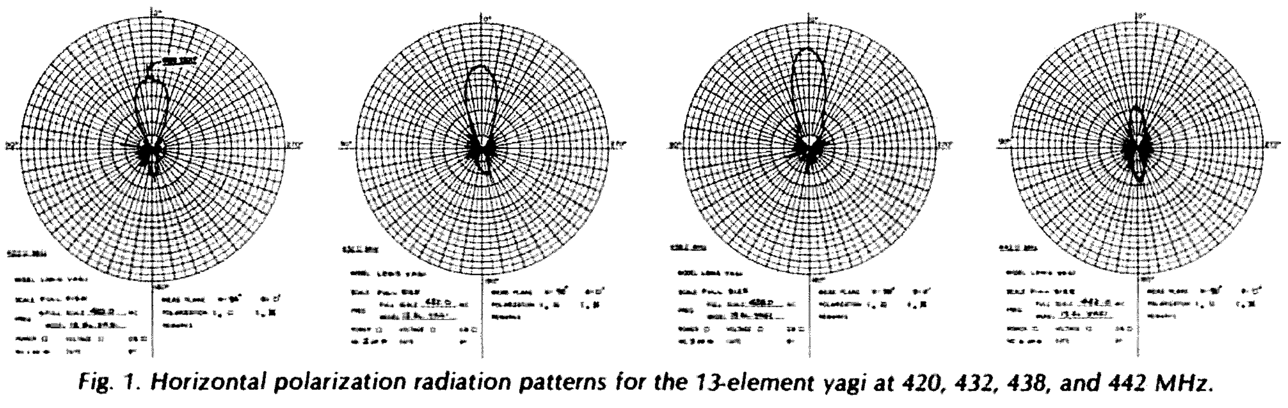

Fig. 1. Horizontal polarization radiation patterns for the 13-element yagi at 420, 432, 438, and 442 MHz.

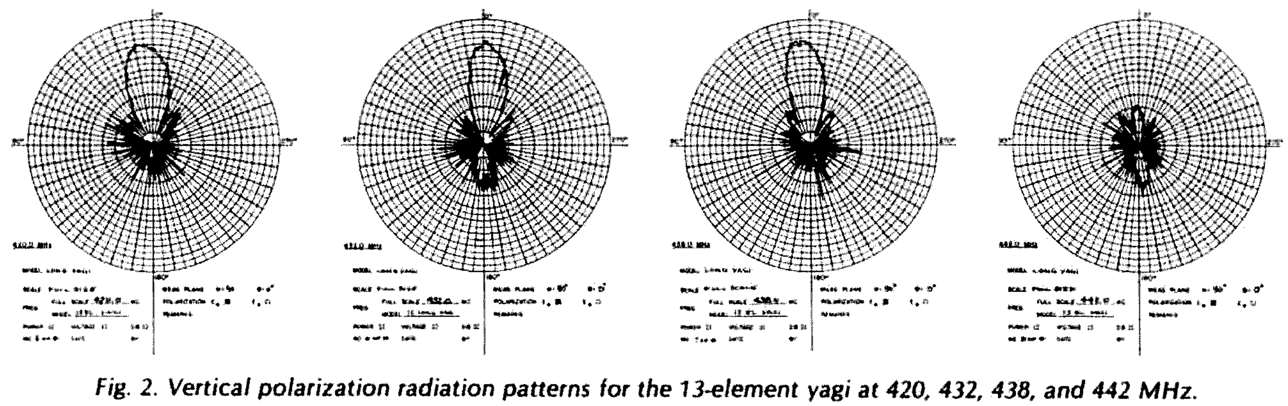

Fig. 2. Vertical polarization radiation patterns for the 13-element yagi at 420, 432, 438, and 442 MHz.

Figs. 1 and 2. Curve B is merely an expanded plot due to gain increase in plotting technique. The spike at the upper-left of Fig. 1 was produced by a search radar of an adjacent airport. A cool, windy fall day and the lack of more output from the signal generator kept the patterns from being of the picture-book variety. Fig. 4 shows the test setup.

Fig. 5 shows graphically the nonsymmetrical bandpass characteristics of the long yagi-type of antenna. The extremely rapid cutoff on the high side of the intended operating frequency has caused many an amateur to cast aside this type of antenna. This curve shows readily that it is unwise to cut the antenna to operate below the intended operating frequency.

The 438-MHz pattern in Fig. 1 indicates that the beam width at the half-power points is approximately 25 degrees. Gain measurements further revealed that 16 dB of gain can be realized without difficulty. This gain figure can be obtained over a frequency range of at least four megahertz. Four megahertz is approximately plus and minus 0.5% of 435 Hz, which is more than ample for ham frequencies. Just make sure that your beam design frequency is at or near the high end of the bandwidth desired.

Four long yagi antennas (Fig. 6) operating on 432 Hz, using 13 elements each, will yield a gain of 22 dB (assuming 16 dB per each 13-element yagi). To obtain this same gain with a collinear array, approximately 176 elements would be required (88 driven elements and 88 reflectors). At this point in comparison, does the singular feature of unnecessary bandwidth seem worthwhile?

If reasonable care is exercised during construction (Fig. 7) and *all* dimensions are adhered to within one sixteenth of an inch, then you can boast, "Have yagi, will radiate."■

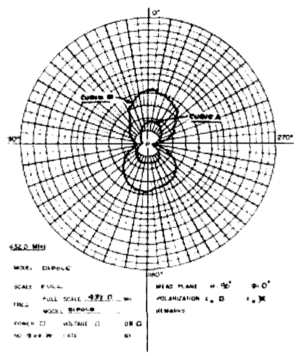

Fig. 3. Reference dipole radiation pattern in the horizontal plane.

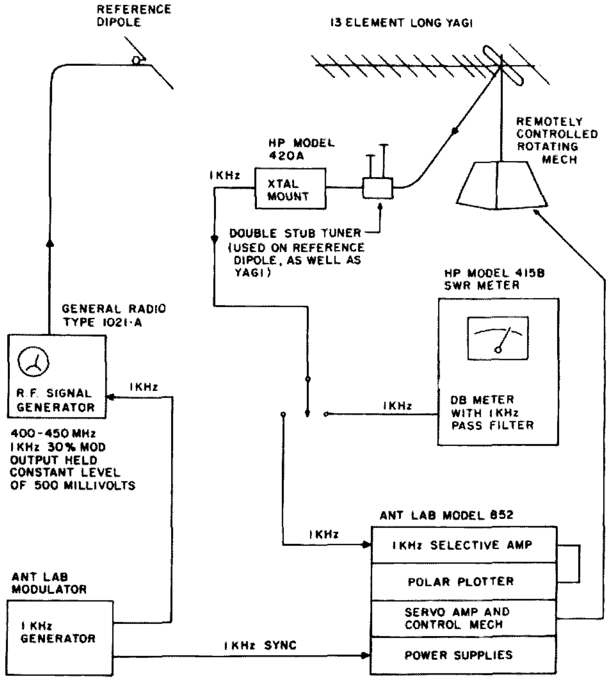

Fig. 4. Radiation pattern test setup.

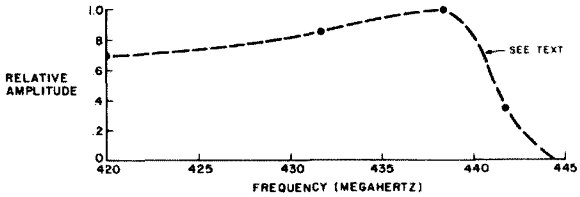

Fig. 5. Bandpass characteristics of 13-element yagi.

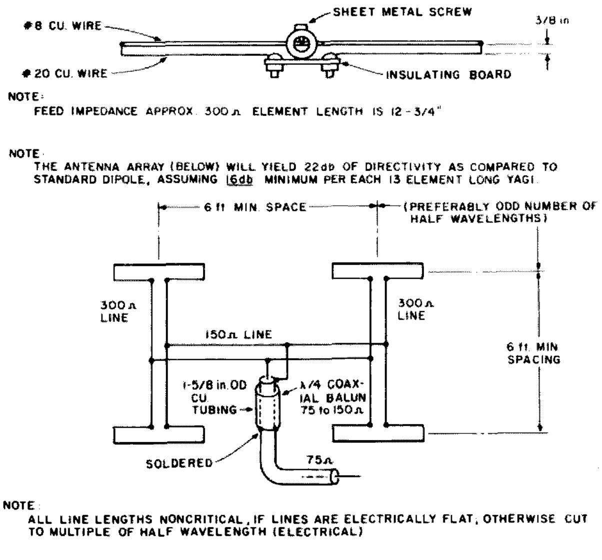

Fig. 6. Method of interconnecting four yagis.

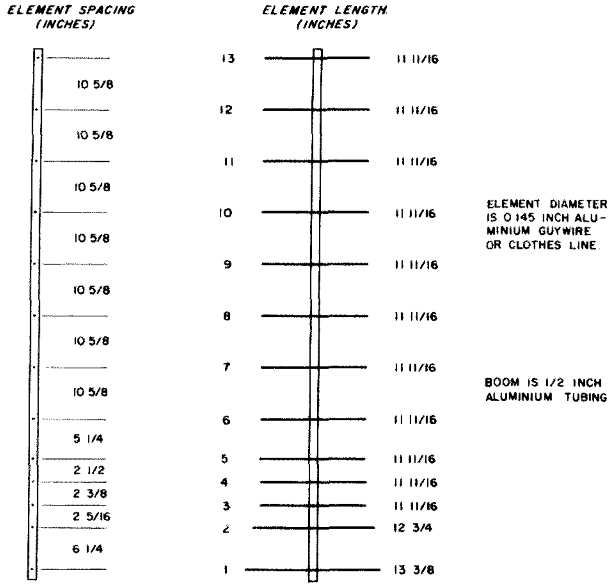

Fig. 7. Construction details for the 13-element yagi.

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Working with FETs
—part I

When it was introduced, the FET was billed as "the transistor that thinks it's a tube." There's been a lot of current through the gate since then, but there are a lot of similarities.

It is one of the few transistors that does give a hard-line tube man a fighting chance at making it work.

There are a few basic differences. The voltage, current, and power ratings are much less. You also lose one important tube advantage right off the bat. The trouble with thinking of the FET as just a teensy tube is that it really just thinks it is a tube; it really is a transistor.

As with almost all transistor situations, they are unforgiving of errors. With a tube, you can make a mistake and probably you won't hurt the tube if you were paying attention and correct it. Transistors either get treated right or they quit on you. That's it. There is rarely any middle ground.

In that one sense, the FET is a transistor, not a tube. While you probably can understand that the operating conditions are at a much lower level than a tube, it may be hard to get away from the tube thinking you are used to, which can harm the FET.

Circuit operation has a number of similarities between the FET and the tube. If you did much bench work with tubes, the circuits will not be far different. The thing you have to catch on to is the trick of treating it like a transistor. A few simple precautions should be enough to get you going.

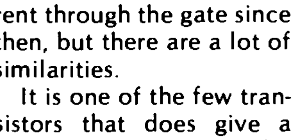

Fig. 1. Schematic symbols.

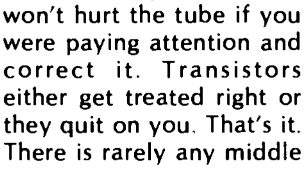

Fig. 2. Simplified tube AFSK oscillator circuit.

There must have been a time when you were told not to connect the plate supply to the filament, and what would happen if you did. Somewhere along the line you probably did it, too. That's how you learned not to for all time. FETs are much cheaper than the tubes were even then, so it's not too traumatic to lose a few learning. Let's just try and cut down on the number.

First, a few terms. Fig. 1 shows a triode tube schematic and an FET schematic, with a comparison of the terms for the elements.

While you probably did not have to think much about the safety of the tube while you worked, you did have to think of your own safety. Those high voltages could kill you if you didn't keep your wits about you. One of the unfortunate things about working with transistors is the tendency to forget about safety. At those low voltages, a serious accident is rare. You can still get hurt, though. There is also plenty of kick in the line voltage of your power supply. Still, most people tend to get careless working with transistors; and they usually get away with it. All this talk of safety has a purpose.

Besides saving your own hide, a little common sense safety-thinking can save your transistors. With FETs, there are things to watch for. Here I am speaking of the normal run-of-the-mill three-element FET, not the MOSFETs or other exotic breeds. Just your average FET. They have a few weak spots. Some of them I learned about the hard way. Let's start with a few of those nasty parameters.

The FET has a maximum safe voltage that can be applied to the drain (plate). It also has a maximum safe current; this is just about

the same as with tubes. There just is less chance of recovery if you go wrong. There is one other basic maximum. This is the safe voltage that can be applied between the source and the gate. There is a comparable safe grid voltage with a tube, but it was not something that you ran into often. What this all gets to is that it is often fairly simple to adapt a tube-type circuit to an FET if you just watch out for the ratings.

The FET audio oscillator to be described is almost an exact duplicate of a tube circuit. However, there are certain key factors in its design that are a direct result of its being an FET rather than a tube.

Some of the guidelines for working with the circuit were learned the hard way. Once learned, they can be adapted to working with other FET circuits, as the safety factor is the same no matter what the circuit function is.

The basic tube circuit started life as a simple AFSK circuit. A double triode was used as an oscillator buffer circuit. Since the oscillator part was so simple, it was chosen for the FET circuit. The basic circuit is shown in Fig. 2.[1] This is much simplified. The AFSK part was left out, and only the oscillator part is shown. This can be transferred to the FET, but, in fact, it was not done that way.

I like to see how many parts can be left out and have it still work. (It usually works better that way, too.)

What was first tried was something similar to Fig. 3. At some point, fiddling with values, it did work. Now my education began.

The output at the drain was not much to write home about, and the waveform was no great bargain. There were, however, two basic considerations working here. I was carefully monitoring the current the FET was drawing, the output waveform and voltage, and the dc voltage at the drain. The one thing I wanted to be sure of was that I was not exceeding the drain voltage or current. Since both were quite small, and well within limits, it was just a question of getting the waveform and output right.

Then the fun began. With a little more work, I managed to go through about ten bargain FETs. I kept my eyes glued to those meters and that scope; I never even got close to the ratings. What I did get was ten zapped trannies and a bad eye twitch. There had to be something I was missing.

Then the great light dawned. I was zapping the input. But how? With such a dinky current and output how could I zap the input?

There were two answers here. The el-cheapos did not have the same between-element ratings of the HEP801 I also was using, and the input circuit is where the action is.

This is going to sound strange, but when I got around the measuring it was startling. Even in the original tube circuit, the output was taken from the grid circuit. That's where all the signal is. That was where all the trouble was in my FET oscillator, too. A simple matter of peak-to-peak was killing me.

Now we have to go back a bit and see what is happening in the gate (grid) circuit. Let's start with my power supply. It is adjustable, and I was testing at 5 through 12 or more volts dc to the FET. That's a normal transistor range, and I even gave it a bit more for test purposes. It was about that time when I began to notice a distinct lack of functional FETs. Since I obviously (?) was not exceeding the ratings, it was quite upsetting.

Having nothing left to do, and only one FET left, I went and took a look at the gate circuit with the scope. It nearly knocked me off the chair. The scope had been set for a small signal, and the gate signal nearly punched a hole in the top and bottom of the CRT. Where did all the signal come from all of a sudden . . . and how do I get rid of some of it?

That was the problem, once I recognized it. Then a few facts filled in the rest. First off, I turned off the gear until my head cleared. While it was obvious that there was a walloping signal in the gate circuit, I had not fully pinned it all down. I could see that there was a probability that I was zapping the gate though, so I went back to the spec sheets. The specs for the 801 FET showed a maximum of 20 volts difference between the source and the gate. If this were exceeded, it would damage the FET. There went a handful of FETs.

That was what happened; but why, and how do I avoid it next time? It was obvious that more testing and measuring would have to be done, so there was going to be a risk.

The first obvious thing to do was lower the supply voltage. This was done and the scope watched while it was turned back on. At some lower voltage, the circuit started up again. A quick check of the scope showed that the signal voltage was safe. Then a few measurements gave me the data. The signal voltage is a peak-to-peak sine wave. A peak-to-peak signal also will count as the maximum value, too. Thus, even though the specs imply a dc difference of potential not to exceed 20 volts, a sine wave more than that also will be a difference exceeding 20 volts.

There is another factor here, too. The signal voltage can approach twice the value of the dc voltage to the drain. In an oscillator circuit, the coil and capacitor can store a charge that will add to the charge of the opposite swing of the wave. That means a nine-volt supply voltage can deliver almost an eighteen-volt peak-to-peak signal. Go up to 12 and you get 24 volts p-p. Test it at 15 volts, and your 30 volt signal zaps the transistor.

The first thing you can do is keep your power supply voltage low. But what if you want to run the oscillator at a higher voltage, say 12, for mobile use or to go with other circuitry?

The obvious thing would be to dampen its enthusiasm. There's a simple way to do this. Just add a resistor across the circuit as in Fig. 4. The value isn't critical. Just watch the scope as you play with values (an ideal place for a resistance substitution box).

By loading the circuit, you cut down its output. I settled on a value of 2.2k

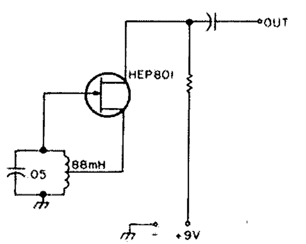

Fig. 3. Experimental FET oscillator.

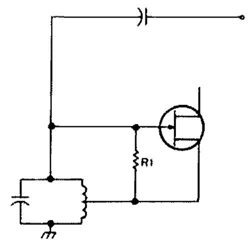

Fig. 4. Resistor added to cut signal.

for one circuit. That gave me an output of about 11 volts p-p with a drain current of 2.2 mA. My notes show a voltage of 9-12 volts, but that is just nominal. The circuit was tested and worked at both lower and higher voltages.

In the final circuit (Fig. 5), there was no load resistor. It seems to work well without one. There was one additional part that might be needed.

With some circuits there may be some TVI or RFI caused by the unshielded circuit or long test leads.

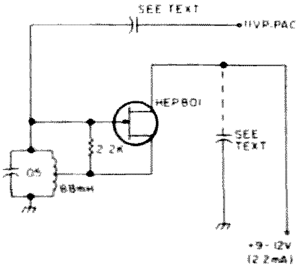

Fig. 5. Practical FET audio oscillator circuit.

When you get it going, try a few values of bypass capacitors at the drain. Too big a value will stop the oscillator from working. Too small will not filter, but there should be a range of values that will do the bypassing job. Start around 0.005 to 0.5 uF.

That brings up an important point. There are several performance characteristics you want to have in your oscillator. These are simple things that tell you the design is sound. You will hear a good tone, even if there is distortion that would be unacceptable for many purposes. The scope will show you the actual waveform of the output. What you want is a good clean sine wave output. Noticeable clipping of one or more peaks usually will give you harmonic content that can cause trouble. So for openers, it should look right.

It is not shown here, but break the source lead and put in a key. Then key the oscillator as a code oscillator. If it does not key well, your circuit is not the best. That's one reason I did not follow many standard designs; they did not key well. This one keys cleanly and starts right up. At the least you can use it for code practice.

There are some simple stability tests. Leave it on for a while. Does it drift as you listen? A low frequency tone is best for this; a slight frequency shift will be more noticeable at low frequencies than at higher. An obvious short-term drift is a sign of poor design or of circuit trouble. A hot or warm FET is another trouble signal. If you have a counter or some other standard, you can check also for long-term stability. However, make sure your standard does not drift, too.

If your circuit shows good form, does not change characteristics over a long-term test, and keys cleanly, you probably have a usable circuit.

Another tip-off is your tolerance factor. This circuit will work over a wide range of parts values and voltages. Beware of any circuit where values are critical for operation. That does not mean don't use precision where you want it—for example, to get an exact frequency—but if the oscillator is critical in operation, it will be trouble no matter how precise it is.

Remember that your output is taken from the gate circuit. Almost any normal coupling capacitor value will work. 0.05 uF to 10 uF would be median, although I have coupled the output with a gimmick capacitor of a few turns of wire.

The pitch is easily adjusted over the audio range by the choice of C1. A capacitance substitution box can help here, though I have used just a handful of caps and done as well.

While this is a simple circuit, there were a number of very important guidelines for working with FETs. These will be restated as rules of thumb.

1. Do not exceed the maximum drain voltage or current.

2. Do not exceed the maximum voltage between elements, particularly the source-gate junction.

3. Monitor all key voltages and signals.

4. Start at the lowest practical drain voltage and work your way up.

5. Leave yourself the largest margin for safety you can.

6. A critical circuit should be a tip-off of poor design.

I found the final circuit I used to be reliable for most of my purposes. I think it can be adapted easily for many ham uses. A little time working with that circuit should make you much more comfortable when working with FETs. The circuit is not the only one in the world; however, a great deal can be learned by trying other tube-type circuits with your test set up. Some will work right off, some you may have to fiddle with values or change the circuit around some.

In any case, there is no substitute for the pragmatic experience of actually working with these circuits, and having first-hand knowledge of what happens as you vary values or circuit configuration.

I hope these circuits and test methods shown will encourage experimentation with this and other published circuits. ■

References

1. *The New RTTY Handbook*, Byron H. Kretzman W2JTP, Cowan Publishing Corp., February, 1967, edition, p. 116.

✓ Reader Service—see page 243

The MARC Success Story

—your club can do it, too!

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Radio clubs can be fun. Radio clubs promote and increase the awareness of this great hobby of ours. Radio clubs generate goodwill and fellowship among our ranks. Radio clubs become effective and successful only in major cities with large populations.

All but one of the above statements are very true. The last statement will get blown to the wind as you learn more about MARC, the Marissa Amateur Radio Club. This club celebrated its first anniversary last May. It has a roster of almost ninety members. Its monthly meetings average fifty in attendance, and each month its programs and special events keep drawing the members closer and increasing the activity. The club owns a massive repeater system with wide-area 150-mile coverage. Every Monday night a highly successful "Swap Net" is activated by MARC on the 81/21 repeater. MARC has been active in two Field Days, has sponsored two March of Dimes Walk-A-Thons, and has graduated many through its license classes. A code practice session is run each evening on the repeater.

This scope of activities is remarkable for a club located in a small town like Marissa, Illinois, fifty miles southeast of St. Louis in the middle of the southern Illinois coal fields. The population of Marissa is 2400, when counting all men, women, children, and pets!

Humble Beginnings

In April of 1977, Dick Smith WB9VZE and I began discussing the idea of a club for the area. Steve K9SR had been holding classes in his home and had helped many in obtaining the knowledge necessary for them to get their licenses. Dick and I called an organizational meeting to see what kind of interest and support for an area-wide club would be generated. That first meeting was attended by Bernice WD9CXQ, Floyd W9ZVT, Windell K9ZQK, Bud WD9WFX, Scot K9SF, Dick WB9VZE, and me. As it turned out, the seven of us chartered the club.

Making It Happen

It was agreed that the best way to really promote MARC and give the area amateurs a gathering place on the air was to build a repeater. I took on the project. Hundreds of hours went into building not "just a repeater," but a complex system that turned out to be one of the finest repeater systems in the Midwest. Jim WA9FDP (builder of the 22/82 in Gillespie) gave Dick and me a new Motran receiver, Lloyd WØLLC gave us a new Sinclair antenna, Floyd W9ZVT donated a small power amp, Gus K9EBA supplied the rack, Paul WB9IGB aligned the transmitter, and Hank WØCZE donated a Midland link transceiver. The club continued to promote donations, gifts, and help. The Peabody Coal Company gave permission to use one of their 250-foot silos for a remote receiver site.

Dick and I got the biggest boost from the Village Board of Marissa. We attended a Board meeting to explain how this repeater would be effective in emergency communications, as well as in promotion of the city of Marissa. We left the meeting with a $250.00 check and a terrific repeater location, rent-free, atop the First National Bank Building. One final donation came from Dow Com, the southern Illinois Wilson distributor: a brand new 60-foot crank-up tower!

All the pieces were assembled, and 81/21 was on the air! Bernice, Floyd, and Windell were spreading the word. MARC was happen-

ing! Club meetings, OSCAR slide shows, demonstrations on antenna phasing, birthday parties. If you don't show up, you really miss something! The meetings *are* happenings!

A great help was Ernie WB9TDC, who set up a raffle of a new Hy-Gain HT. Many tickets were sold by all club members, but Ernie really promoted those tickets. With each ticket came more support for MARC. Membership increased and the meeting room at the bank was outgrown, so meetings were moved to the new Community Center. Memberships continued to roll in; each and every ham was proud to be a MARC member.

This same warm, country atmosphere was projected onto the repeater. The members of the "Double M" (Marissa Machine) are, without a doubt, one of the most friendly, fun-loving, and helpful groups on any repeater system.

Newsletters

In December, seven months after charter, our club trustee, Tania WB9TKC, and Bernice WD9CXQ produced the first monthly newsletter, *Harmonics*. The newsletter has become one of the key factors in keeping the present members informed, as well as introducing the club to prospective members. Tania has the cover page offset-printed, so pictures of club members and events can be published, as well as small construction articles, reports, and useful information normally not found in the regular magazines. No one element or person can be credited with the great success of MARC, but the promotion and communication constantly provided by the newsletter certainly help.

Maintaining Interest

What all of this can mean to your local club is that there is no need for a club to stay dormant. Amateur radio has so many facets to keep the members interested. It is up to each of your members to contribute something, even if it's a simple mention of the club on the air.

There are simple programs that can generate fantastic interest and enthusiasm. Here are a few ideas for your next club meeting.

Ask a local Motorola or GE sales office about a speaker to explain some new communications development or alignment technique.

Find a police department radio technician to come and explain its sophisticated radio system.

Your CD office, Civil Preparedness Office, armed services, or Weather Bureau will be pleased to explain disaster and evacuation techniques.

Railroads have fantastic slides and programs to explain hazardous materials handling, radio communications, or general routing.

Airline or FAA radio technicians can talk about their communications systems and control operations.

Look for a collector of antique radios to bring some of his collection for nostalgia night.

Local ham radio stores are always willing to demonstrate some SSTV, video RTTY, or video CW equipment.

AMSAT directors love to discuss OSCAR.

The list is endless! These are some of the things it takes, month after month, to promote those meetings. You must get the members into the habit of setting the second Tuesday (or whatever day) aside for that important radio club meeting. You must entertain or inform them. They must want to return. It's the activities director's job to see that this is done.

Home-Grown Programs

Sometimes clubs are unable to contact outside speakers to present a program. To fill a void, here are some ideas that members themselves can use to put programs together.

Have a Home-Brew Night (no Kentucky moonshine, please!). Ask any and all to bring their best attempts at building equipment. Award a ribbon or small trophy for the best—or worst.

QSL Night—see who has the most DXCC, VHF, counties, longest distance, oldest, etc. Again, give awards.

Antenna Gain Measurement Night—bring your home-brew VHF antennas, and award trophies for the best.

Fix It Night—bug a few radios or keyers and see who can find the faults.

Grid-Dip Night—wind some coils, check their frequencies, show how to check antenna resonance, and so on.

Those of us who have been around for awhile sometimes forget that the newcomers have not seen or heard a lot of the "take it for granted" things. These simple things can be turned into fantastic programs. Talk about feedlines, show them how different types of coax work better, or worse; discuss design. Be original. Be innovative. Keep it simple and *fun*! Always acknowledge the oldest license, the guest or member from farthest away, the one who can operate the most bands or modes.

For a surefire barn-burner meeting, celebrate a member's birthday, but keep it a surprise. A surprise party can really be a great amount of fun. Keeping the secret is difficult, but can be done. Just think of the crazy gifts you can rid your junk boxes of!

Selling donations to the club in the form of chances on handie-talkies, keyers, antenna systems, etc., can be very successful as well as a heck of a lot of fun. it gets to be an "in" thing for all of the members to buy their tickets so they won't get left out. With enough promotion, the meeting you select for the drawing can really be turned into a mini-hamfest.

Public Activities

The club has to keep the public informed of its existence. Local newspapers love to have articles about your meetings or activities. Exposure to the outside world can be achieved by setting up portable stations in shopping malls, grocery centers, schools, and service clubs (Lions, Rotary). Many times you can solicit donations at these outings, also. Try to have the local TV mini-cam, radio station, newspapers, and magazine reporters on hand to report on your activities. Traffic handling, OSCAR, phone patches, and, best of all, SSTV, can be effective in attracting attention. Don't forget to hang *big* signs with the club logo (You don't have one? Shame!) or name predominant, as well as names and phone numbers of those members who can sign up prospects for Novice classes. Advertise your local repeater frequencies. You won't believe how many VHF scanners are out there just waiting for amateur radio to inhabit the speaker!

It is up to you and your club. Do you really want bigger and better membership? Do you want to have more fun? Do you want to expand each member's awareness and knowledge? The MARC has proven that all of this can be done in a village of 2000 people. The best part of this is that the entire effort can only benefit amateur radio everywhere. ■

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Want to Upgrade? Take a Tip from a Ham Who Did!

—previewing the new code test

You should upgrade. It's easy. I'm writing this to encourage you. If I could pass and upgrade to the Advanced license, so can you. Let me explain.

In the Los Angeles area, one can attend Murphy's Radio Class. This class increases your knowledge and ability to pass the theory and regulation segments of the FCC tests. Also, Murphy's sells code tapes to help you pass the 13 wpm requirement. Other cities probably have similar classes and aids.

So now we are down to the crux of the problem: code, code, code, 13 wpm, 13 wpm, 13 wpm. That does not sound like much. But it takes study and time and effort and is well worth it.

I got up about one-half hour earlier each morning to study code. Also, a local repeater was broadcasting the Murphy tapes 3 or 4 nights a week. They were so helpful to me that I finally bought a set. Then I made progress to about 10 wpm. It took the 13+ wpm tape by *73 Magazine* to push me over the magic 13 wpm. The tape from *73 Magazine* was mind-stretching and of great help.

I was cool, man. Psyched up and all that. No way will the FCC cause me to falter. The 13 wpm will be a breeze.

On a nice Wednesday, I studied in the morning, ate a late brunch, and drove to Long Beach, Calif. I parked my pickup and walked about 3 blocks. Nice day. Nice sun. I was cool, man.

I arrived at the FCC reception area on time, about noon, and that's about an hour before anyone wants to get serious at the FCC. So now I cooled my heels. Being cool, man, I read a *Reader's Digest* and acted nonchalant. No code test is going to get me down.

While waiting, one episode was interesting. A young man asked if I was going for my Extra, probably because of my grey sideburns. No, I was not, but I could help because I am an electronics engineer. His question concerned microvolts at the half-power points from an antenna when given microvolts at the center of the lobe or beam. Be careful here to calculate in microvolts, not Watts. A factor of 0.707 enters. Such final reviews are common while waiting for the tests to start. Later I saw the young man taking the Extra written test, so he had passed the 20 wpm test. Good for him.

Finally, it was my time. The group for 13 wpm was called. We filed in, adjusted earphones, and waited. A young lady said we should copy down everything we could. Since the code test is one of comprehension, anything could help to select the correct multiple-choice answer. I found that to be very helpful and the FCC people friendly.

Then the palpitation commenced. My heartbeat went up. My breath came in short pants. My hand shook somewhat. And believe me, I'm serious. I had been psyched up. I had been cool. Yet the Funny Candy Company had reduced me to a driveling idiot and the test had not yet started.

During the one-minute warmup run, I copied about 50%. This indicated I was about to fail miserably. Naturally, this did not calm me. In fact, if anything, I was ready to quit then. But I was tangled up in the earphone wires, so I decided to stay.

The test began. W4— was talking to WA4— or close to that. Then there was something called RST. I figured that was CW short for RUST. The trouble was, some numbers followed RUST, so I dutifully copied them down. Lucky for me that I did. They had the nerve to ask me later how much RUST there was. So I picked 479's worth, and that was right.

Some guy named Fred was . . . and about there I blanked out and lost a whole string of stuff. But I did pick out two Rs in the middle. Keep them. May be useful later.

As things progressed, old Fred turned out to be 43 years of age and lived in Some City, USA. He

worked as a cowboy in Alabama or somewhere. Also, the weather was wet and windy.

The test proceeded to consider technical things like antennas, heights, tubes, rigs, etc. The rig I copied was an HQ-101 followed by something, something, something. I shifted my brain to zero and picked only an 8 out of the whole mess.

Finally, the pain subsided. Some 73s and old W4— signed with WA4—, but my palpitating heart did not slow. The FCC lady passed out the questions. Questions have never bothered me, but the answers do.

The first question said the two stations were W6— and W8— or W5— and W1—, etc. Not a mention of a W4 call. So I moved on to the second question. Aha! Weather! Once again I had four choices, but none was wet and windy. The third question also was from left field. It did not relate to my copy. Oh well, if I could answer all 8 of the remaining 7 questions, I could still pass.

I got up, not to leave in dejection, but to ask if I had received the correct questions. The kind FCC lady checked the cassette tape in use and told me #203 was correct and I should proceed.

Ready to quit, I stole a glance at the top of the question sheet at the next desk. The number at the top truly was #203 preceded by 12. My sheet had a preface of 20. So, back to the nice lady who finally gave me the correct 12-203. Aha! Now W4 and WA4 were involved, but by now my heart was more than palpitating.

The rest of the questions were straightforward. The other person's name was Randy, Rocky, Rory, or Rindy. I had copied only the name Fred plus two Rs in a monstrous gap. So obviously the two Rs had some relationship to Rory. So I marked it.

Later, I had to identify the rig transmitting. That should be easy. I had clearly copied HQ-101. Eagerly I searched for an HQ-101 answer. By golly, there was one—in fact, there were two. One had 14 tubes, while the other answer had 17 tubes. I had copied no tubes in my panic. But I did have the random 8 in the middle of a second tremendous gap. Well, 8 is fairly close to 7, and certainly a long way from a 4. So I guessed the answer as an HQ-101 with 17 tubes, which was correct. See how easy it is to pass?

Completed the test. Turned in the papers. Knew I had failed. Takes 8 out of 10 to pass. Heart still pounding. Oh well, I can come back in 30 days and try again.

Time clanked by and I was not thrown out on my ear. Maybe I had passed. Finally my name was called. I went into the next room to hear, "You passed."

The story above is true, but changes were made to disguise the FCC questions and answers. It had a happy ending. I qualified for the Advanced license. But the code test could have been a breeze if I had followed one simple rule: Concentrate on one character at a time. Worry about the words and the meaning after the test. Either of my lapses could have caused me to fail. Both occurred because I began to think about the words and lost my concentration. So concentrate and win your new license.

Remember, the people at the Funny Candy Company are okay and helpful throughout. So study and good luck. You, too, can upgrade. ■

Reader Service—see page 243

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A Microwave Primer

—waveguides, X-band, and other fun stuff

If one inspected the frequency assignments to amateur radio which lie in the spectrum above the ultra high frequency (UHF) region, one would find thousands of megacycles are available. Much of this spectrum is unused by radio amateurs; only small portions are occupied and then only sporadically. Some of these bands are shared by other services.

The thrill of communicating over very long distances on these frequencies is experienced by few amateurs and is reported and read by an equal few. What is it that makes this part of our hobby so compelling to those few that they will continue to experiment when there is little company on these bands? Why aren't there more experimenters? Perhaps you think that the equipment is expensive, or that construction is difficult, or maybe you can't find information on how to implement a microwave project.

The expense in implementation of a microwave station is not as great as some of the equipment costs for an HF or VHF station. The components are a little more difficult to acquire, but are available via surplus or from microwave component manufacturers. As for information on construction and operation, an abundance of information has been published in amateur radio journals for the last 40 years and much more is available from technical societies through the papers they present.

How does communication differ from that found on the lower bands, and why should you be inspired to try your hand at using these frequencies? These questions are easy to answer. A microwave QSO, depending on the mode used—and there are many modes available that can't be used on the lower bands—rarely if ever suffers from QRM. QSB and QRN, sure. (Anyhow, microwave QRM might even be a pleasure to hear sometimes!)

Most of the operations at W1SNN have been either FM or pulsed CW, and in most cases the signals were dead full quieting at each end of the circuit. It is true that the QSOs require an expedition to a high point, and a great deal of work goes into the project, but go out in the field on a Field Day and work five states and numerous sections with other stations and then see who has the highest multipliers. Most of all, the work is forgotten when you realize that the power levels transmitted are in the tenth of a Watt to a Watt level, into a three foot dish, and the guy you were talking to using similar equipment was forty or fifty miles away on top of a mountain that you couldn't even see.

Well, now that I have extolled some of the great things about working microwaves, I suppose you might like to know what microwaves are.

The name, microwaves, has been given to those frequencies which fall into and above the UHF spectrum. Who named it microwaves? I suspect, but cannot authenticate this, that it was so named during the early part of World War II when radar was coming into its own. Perhaps the

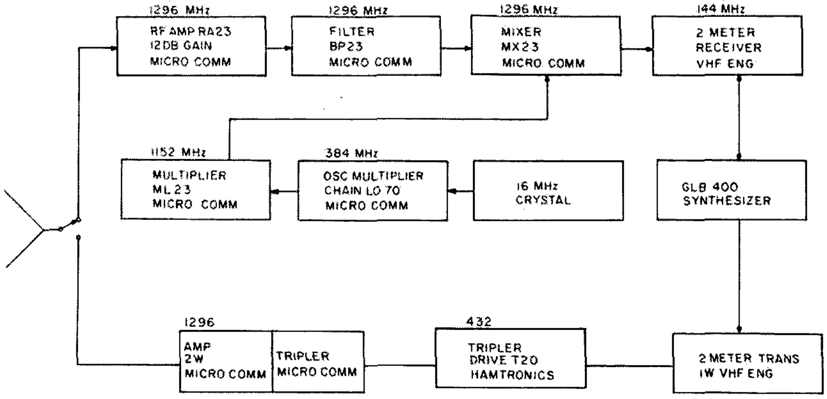

Fig. 1. 1296-MHz transceiver.

security measures which gave the *various* bands letter designations during this conflict brought the name into use. At any rate, it is a good name for the spectrum which, as we proceed to examine it, will be seen to include wavelengths of some frequencies we can use as amateurs which are hardly as long as the word microwave itself.

Let us examine how the Federal Communications Commission has assigned band nomenclatures to the radio spectrum and also how microwave equipment manufacturers have retained the WWII designations.

The FCC has assigned band numbers and lettered designations as nomenclature for all of the electromagnetic spectrum. The frequency allocations that are assigned to the ham bands are known to us by their designations, VHF, UHF, VLF and others. (See Table 1.)

The designations in Table 1 are found in the Rules and Regulations part of many of the commercial license examination question-and-answer books. Notice that the way they are grouped falls in line with the metric system, and that if the metric equation is worked out to become meters in wavelength, it falls in decades. Either way, it's easy to remember after a slight bit of study.

Further examination of the other tables may open your eyes to several facts about the bands that we occupy and rarely think about in terms of how they are located in the radio spectrum.

Table 2 shows how the HF spectrum adds up to the number of megacycles that we as *amateurs* occupy. When one examines the dial of the station HF receiver, the number of bands and the spread of them over the dial make it look vast. The frequency ranges are in very small steps from 160 to 10 meters in most receivers, but when the total number of amateur frequencies is added up it's only 3.5 MHz total coverage out of thirty—a little more than ten percent.

Some of the small nations that will attend the World Administrative Radio Conference (WARC) are of the opinion that, although they have a very small population in the vast high frequency sea, they now will need more. When they band together with their 1 vote-per-nation, they are going to be a formidable group, looking at our 10% as something they want—and may get.

Why bring this up? Let's look further at the number of megahertz we have available in the high frequencies. The total up to the end of VHF assignments, that stop at 1¾ meters, is 20.5 MHz. If we go on up into the microwaves, the total number of gigahertz that we have is 23.290 (see Table 2). Out of this, very little is used by amateurs. The ¾-meter band is used quite a bit for repeaters, and 1296 MHz is really catching on these days as are many of the frequencies up through 10 GHz, but not enough. It looks as if we could lose a lot of spectrum simply because we do not lay claim to it by enough use. These frequencies are very attractive to the 40 or more nations who will certainly exercise their combined single votes.

When you look at Table 2 again, you can see that the total number of gigahertz, not megacycles, is listed at 23.290, and the last assignment, which starts at 300 GHz, isn't listed in the table; that gives us all above that to play in.

Band 4	VLF Very Low Frequencies	Below 30 kHz
Band 5	LF Low Frequency	30 to 300 kHz
Band 6	MF Medium Frequency	300 to 3000 kHz
Band 7	HF High Frequency	3 to 30 MHz
Band 8	VHF Very High Frequency	30 to 300 MHz
Band 9	UHF Ultra High Frequency	300 to 3000 MHz
Band 10	SHF Super High Frequency	3 to 30 GHz
Band 11	EHF Extremely High Frequency	30 to 300 GHz

Table 1. Nomenclature of frequencies.

Well, I can hear some of the groans and moans from those who will say, "So what? How in the heck can we get up that high?" I'll tell you: These frequencies are in use commonly by commercial users right up to and well beyond the highest assignment.

The microwave spectrum is made up of bands, referred to popularly by designations such as "S"-band or "X"-band. An examination of Table 3 shows how these bands are designated today. The table was taken from a manufacturer's list of waveguides and waveguide components such as flanges and covers, and, later on, the Electronic Industries Association (EIA) gave additional references. There are many others, but those listed are the most popularly used. Table 3 designations are useful to amateurs who are scrounging the surplus market for components for microwave construction. Many of the components are marked with waveguide designations that may confuse them, however. For example, a waveguide section with an EIA WR designation of 90 will mate with other components that are marked RG-52 and (reading horizontally) can be cross-referenced so that pieces of copper guide or components made of aluminum can be mated.

Similar designations are found on flanges and covers of various dimensions. It is also a guide to square and round flanges which have holes arranged to preclude crossguide couplings.

Many of the older modes of communication are in use on the microwave bands, CW, MCW, and AM, and not too often, pulse-modulated signals are used. SSB has been used, but not without problems that embrace the fundamental stability of the equipment. These problems are being overcome however, and that mode is increasingly in use.

With the advent of the VHF repeater, microwave systems that have been used by amateurs are being pressed into service as control links for receivers and transmitters used to augment coverage of a particular repeater. X-band is being used for many of

160 ... 10 meters	3.5 MHz	High Frequencies only
160 ... 1¾ meters	20.5 MHz	High Frequencies and VHF
420-450 MHz	30 MHz	(20.5 MHz to 10 GHz totals up to 23.290 GHz)
1215-1300 MHz	85 MHz	
2300-2450 MHz	150 MHz	
3300-3500 MHz	200 MHz	
5650-5925 MHz	275 MHz	
10.0-10.5 GHz	500 MHz	
24.0-24.25 GHz	250 MHz	
48-50 GHz	2 GHz	
71-76 GHz	5 GHz	
165-170 GHz	5 GHz	
240-250 GHz	10 GHz	

Table 2.

these systems because of the availability of equipment and because the equipment can be made small. In the repeater system used by The Waltham Amateur Radio Astronomy Society, data is sent between three different sites via radioteletype on X-band, and reprocessed in a Southwest Technical Products 6800-2 computer system. Direct data also has been transmitted to control the WR1AJE repeater operated by the Society.

Present day amateur station equipment has reached a sophistication that makes even the modest frequency-controlling system incorporated in transceivers useful additions to the componentry needed to make up an amateur microwave station.

The frequency relation to the lower frequency equipment is easily mixed up with many of the MW frequencies, or in many cases it simply can be the start of a multiplier chain. An example is operation on the L-band assignment at 1296 MHz. By building a multiplier chain, the output of a low-powered two-meter transmitter can be utilized at 1296 and have the stability of a crystal-controlled or synthesized frequency source. The stability of the overall system, of course, is within the constraints of the frequency error multiplied nine times. But it is stabilized well within the needs of a communication system employing a reasonable receiving bandwidth. Multiplying by 16 of the same two-meter system will put you into 3204 MHz with the same general constraints. Starting with a 432-MHz transmitter will make things easier to construct, but in either case it puts the beginnings of an excellent transmitting system within the realm of any amateur possessing the driving source.

Receiving equipment for these bands can be constructed around lower frequency station equipment and provide excellent companion sections for the method of constructing a transmitter previously described. There are several manufacturers who produce multiplier chains, mixers, and other components made precisely for amateur use at a cost which is within the size of most pocketbooks.

To move up into the higher microwave frequencies one must improvise upon components which are available through the surplus markets, or construct one's own. In many cases the latter approach is easier. Most of the real great steps in microwave communication have been taken by amateurs, and they were using equipment of their own design. In many cases, this departed from classic methods only because componentry was not available. Much has been written about this equipment, and many good DX records and firsts still remain in the realm of amateur radio because of ingenuity prompted by component unavailability.

This same approach must be applied to antennas for microwaves. There are many articles available on the construction of dish antennas if you choose to make one. Several are listed in the references. They can be constructed from plyboard for the ribs and fine mesh for the reflecting surface, and will be as sturdy as your craftsmanship makes them. Some amateurs have made them of aluminum, and these units are certainly as good as the "commercials" make them. They also may be found as surplus or, for that matter, may be purchased as new goods. In any event, it will be important to know the focal

EIA WR No.	Microlab /Fxr Band Prefix	Former Microlab Code	Former Bogart Code	Frequency Range (GHz)	Waveguide Brass	Waveguide Aluminum	Waveguide Silver	Waveguide Size (in.) i.d.	Waveguide Size (in.) o.d.
650	L	05	L	1.12-1.70	RG-69/U	RG-103/U		6.500 x 3.250	6.660 x 3.410
430	R	15	R	1.70-2.60	RG-104/U	RG-105/U		4.300 x 2.150	4.460 x 2.310
284	S	25	S	2.60-3.95	RG-48/U	RG-75/U		2.840 x 1.340	3.000 x 1.500
187	H	35	H	3.95-5.85	RG-49/U	RG-95/U		1.872 x 0.872	2.000 x 1.000
137	C	45	C	5.85-8.20	RG-50/U	RG-106/U		1.372 x 0.622	1.500 x 0.750
112	W	50	B	7.05-10.0	RG-51/U	RG-68/U		1.122 x 0.497	1.250 x 0.625
90	X	55	X	8.20-12.4	RG-52/U	RG-67/U		0.900 x 0.400	1.000 x 0.500
62	Y	65	KU	12.4-18.0	RG-91/U	RG-349/U		0.622 x 0.311	0.702 x 0.391
42	K	75	K	18.0-26.5	RG-53/U	RG-121/U		0.420 x 0.170	0.500 x 0.250
28	U	85	KA	26.5-40.0			RG-96/U	0.280 x 0.140	0.360 x 0.220
22	Q			33.0-50.0			RG-97/U	0.244 x 0.112	0.304 x 0.192
15	M			50.0-75.0			RG-98/U	0.148 x 0.074	0.228 x 0.154
12	E			60.0-90.0			RG-99/U	0.122 x 0.061	0.202 x 0.141
8	F			90.0-140			RG-138/U	0.080 x 0.040	0.156 diam.
5	G			140-220			RG-135/U	0.051 x 0.025	0.156 diam.

EIA WR No.	Brass Cover		Brass Contact		Brass Choke		Aluminum Cover		Aluminum Contact		Aluminum Choke		CPR Flat		CPR Grooved		CMR	
650			UG-417A/U	R					UG-418A/U	R			650	R	650	R		
430			UG-435A/U	R					UG-437A/U	R			430	R	430	R		
284	UG-53/U	O			UG-54B/U	O	UG-584/U	O			UG-585A/U	O	284	R	284	R	284	R
187	UG-149A/U	O			UG-148C/U	O	UG-407/U	O			UG-406B/U	O	187	R	187	R	187	R
137	UG-344/U	O			UG-343B/U	O	UG-441/U	O			UG-440B/U	O	137	R	137	R	137	R
112	UG-51/U	S			UG-52B/U	S	UG-138/U	S			UG-137B/U	S	112	R	112	R	112	R
90	UG-39/U	S			UG-40B/U	S	UG-135/U	S			UG-136B/U	S	90	R	90	R	90	R
62	UG-419/U	S			UG-541A/U	S	UG-1665/U	S			UG-598/AU	S						
42	UG-595/U	S	UG-425/U	O	UG-596A/U	S	UG-597/U	S										
28	UG-599/U	S	UG-381/U	O	UG-600A/U	S												
22			UG-383/U	O														
15			UG-385/U	O														
12			UG-387/U	O														
8			FXR Special	O														
5			FXR Special	O														

Table 3. O = circular flange. R = rectangular flange. S = square flange.

length of these devices for reasons which will become apparent when you design or follow another's design for the "feed" antenna that illuminates the dish. This part of the project is one of the most interesting and will require that you bone up on the subject.

How much gain does the antenna have to have and does a dish have it? Well, I am assuming that you will use a dish, but there are other reflector-type antennas that will work, like the helical, and corner reflectors. They will have gains dependent on how elaborate you make them. These antennas also will work at the microwave frequencies, but with much less efficiency. So, back to the parabolic antenna. As you can see from the plot shown, the gain of a dish is proportional to its size: as the diameter goes up, the gain goes up.

Table 4 was taken from an antenna gain calculator and neglects many factors that this article does not have the space to treat. It does show that from a diameter of 12 inches to six feet, the gain goes up tremendously, and that the reason is that the beamwidth becomes very narrow. The beamwidth scale shows that at 1.3 GHz the angle is 7.5 degrees wide, and that as we move up to X-band, it is only .79 degrees wide at the half-power points for a 96-inch dish. Move the diameter down to 36 inches, and the 1.3-GHz beamwidth is quite wide (nearly 20 degrees) and the X-band beamwidth is 2.7 degrees. You can see that depending on what frequency range you are in, you may either have an antenna that works like a flashlight beam or one that is about like having a multi-element linear array. It also shows that if you choose to make an antenna like a parabolic reflector to be used at the lower frequencies, a dish of 72 inches would be most practical, while at the S- to X-band assignments, a 36-inch reflector will have a power gain of 25.1 decibels at 2.4 GHz, and at X-band, 37 decibels. This is where you make a decision dependent upon the amount of work you must do.

Antenna feeds are another part of the problem and will require great care in construction. They are not very hard to make, however, and most of the work can be done in your shop with hand tools, which makes the rewards even more worth the trouble.

Several manufacturers make excellent equipment for use in amateur bands L and S, which require multipliers to these two assignments. These manufacturers are owned for the most part by radio amateurs who have designed the equipment so that it meets the rigid requirements for the job. The price of the gear is moderate.

Activity in the higher S-band and C-band assignments has been moderate. The S-band frequency is the most used of the two since the equipment available is mostly from wartime radar. The C-band frequency, which is a very interesting one, is quite inactive, probably because of the equipment availability problem. Several interesting reports by amateurs using each of these assignments have appeared in amateur magazines, and should be of interest to those who plan to use them.

Activity in the X-band range (10-10.5 GHz) at the present time is very high. This is because of the availability of much equipment that has been showing up in the surplus area in the past year. Radar-measuring equipment, STL link equipment, and, yes, even police radar sets are showing up as surplus. Several microwave manufacturers make police radar oscillators which easily can be retuned from the police band (10.525 GHz) to the amateur band.

The bands above X-band offer unlimited possibilities. The amount of spectrum available in these frequencies is so large that it becomes hard to compare except to say that considerably more space is available than within all of the other amateur bands combined. ■

Dish Diameter	E-H Plane Beamwidth at 65% Efficiency Frequency (GHz)			Power Gain, dB		
	1.296	2.4	10.2			
120 inches	5.5	2.7	.7	31	35	47.5
96 inches	7.5	3.5	.79	28	33.5	45.5
72 inches	9	4.5	1.25	26	31	43
36 inches	18	10.2	2.7	20	25.1	37
24 inches	27	14	3.5	16.5	21	33
12 inches	60	30	7	12.5	17	23

Table 4.

References

Microcomm, 14908 Sandy Lane, San Jose CA 95124—microwave modules.

Texas RF Distributors, 4800 West 34th St., Houston TX 77092—UHF equipment.

RIW Products, Box 191, Babylon NY 11702—UHF and MW antennas.

Microwave Associates, Inc., Burlington MA 01803—X-band amateur gear.

"A Brass Horn For X-Band," S. M. Olberg, March, 1978, *73 Magazine.*

"A Complete X-Band Transmitter," S. M. Olberg, August, 1978, *73 Magazine.*

Microwave Bibliography, Cliff Buttschardt, January, 1978, *Ham Radio.*

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CB to 10

—part XX: converting the Royce I-655

Shortly before the deadline for the sale of 23-channel CB sets, a local department store ran a special sale to get rid of an overstock of the Royce 23-channel sets. Since the price was so low, I could not resist buying one of the Model I-655s. Although I didn't know exactly what I would do with the thing, I thought the PLL synthesizer was worth at least the purchase price of the unit.

The radio sat in the closet until I saw an ad in *73 Magazine* for conversion kits to put CB sets on 10 meters. Unfortunately, after checking the catalog of kits, I found that none was available for the I-655. The company offered to make a special kit for a $15.00-an-hour engineering fee, but, although this is a reasonable fee, it easily could have cost me more than for the rig itself.

Not easily discouraged, I sent a letter to Royce requesting information on the PLL unit. I received a brief, but polite letter informing me that the unit was sealed and no information was available. Being told this was enough to prompt me to tear into the unit and convert it myself. The project turned out to be extremely easy and straightforward. I will describe now the conversion procedure used on the rig.

It is worth mentioning that the Royce is not the only CB that uses this particular PLL unit. The I-655 is a 23-channel set, but the PLL unit itself is capable of generating 64 ten-kilohertz channels due to the 6-bit binary input that sets the divider chain. I imagine the unit is also used in the newer 40-channel sets as well. By adding only one SPST switch, the extra channels available on a converted 40-channel unit may be obtained on the cheaper 23-channel units.

The block diagram included with my I-655 indicated the rig has three oscillators: 37.38 MHz, 10.24 MHz, and 10.695 MHz. When I opened the unit I found a 36.190 MHz oscillator instead of the indicated 37.38 MHz one. I do not know why the diagram is wrong, but if your unit has the 36.190 MHz crystal, the conversion will work. I cannot say what the results would be on a unit with the oscillator frequency indicated on the block diagram—so be careful.

In order to work on the PLL unit, you must first remove the box that encloses it (I guess this is what is meant by sealed unit). The box is removed by unsoldering the two ends and then snapping it off. Once the cover is removed, you should see a 36.190 MHz crystal roughly in the center of the PC board. Directly below the crystal is an adjustable coil of the metal can type. The two 10-MHz crystals are off to either side. Each oscillator has a trimmer capacitor to touch up the crystal frequency. You will adjust only the coil and trimmer for the 36 MHz crystal, so do not touch the others.

The new crystal frequency is simply 36.190 MHz + the amount you wish to move the transceiver up by. Since I converted my set according to the *73* plan, I moved it exactly 2.0 MHz, giving a new crystal frequency of 38.190 MHz. I ordered my crystal from Jan Crystals, and they were quite helpful in providing the necessary correlation information for me. Table 1 gives the information needed to order a new crystal. Using the 2.0 MHz shift gives coverage from 28.965 MHz (channel 1) to 29.255 MHz (channel 23). If you in-

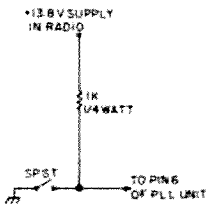

Fig. 1. The switch is closed for normal operation, open for extended frequency operation. (See text.)

Crystal frequency: 38.190 MHz
Type: Third overtone
Holder type: HC-18/U
Equivalent series resistance: < 30 Ω
Load capacitance: 25 pF
Tolerance: 0.0025% or better
Temperature: 25° C (non-oven)

Table 1. Crystal correlation data for the Royce I-655 PLL unit. The indicated crystal frequency moves the output up by 2.0 MHz.

stall the range-extending switch, you will have coverage to 29.575 MHz. The frequencies generated are listed in Table 2 for reference.

Once you obtain the new crystal, solder it in where the original crystal was and connect the rig to a dummy load. When you key the radio, you will have no output. This is because the drive is cut off if the PLL is not locked up. With the rig keyed, carefully adjust the coil directly below the new crystal. At some point the output meter will suddenly jump up, indicating the unit has locked. You will probably need to adjust the coil slightly more in order to get lock over the entire range of available frequencies. My unit would lock over the entire expanded frequency range with no problems.

There are two coils at the end of the PLL board nearest the front of the radio that should be touched up for the best output at midband. In order to set the operating frequency exactly, you will need to couple a counter to the output by an appropriate means, and adjust the trimmer for the 38-MHz oscillator to put you on the right transmit frequency. This also will take care of the receive frequency.

Tuning the *transmitter* and receiver strips are a bit tricky in the I-655, due to the mounting configuration of the PC boards. Since the individual boards are mounted at right angles to the main PC board, you probably will need to make a very short alignment tool to fit the coils. The transmitter board is located next to the PLL unit. There are only three coils to adjust when tuning the transmitter section. These are T401, T402, and L403 on the schematic diagram supplied with the radio. I found that my unit would put about 5 Watts into a 50-Ohm load when properly tuned up. Do not try to adjust L404 since it is fixed (the slug is glued in).

The receiver has only two transformers to adjust in the rf stage. The i-f uses ceramic filters that require no alignment. Using whatever signal source you have, touch up the tuning on T101 and T102. T101 is located at the back of the PC board, above the keying relay. You may want to remove the speaker to adjust T102, since it is partially under the speaker frame. Once you have tuned up the front end, the rig is ready for use. My set checked out with less than 0.3-uV sensitivity for 10 dB (S + N)/N over the entire band.

You might want to add the simple modification to give you the extra channels of a 40-channel rig. As I mentioned before, the PLL unit itself can generate 64 channels. This will cover all the frequencies from 28.965 MHz to 29.605 MHz in 10-kHz steps. Although I did not install the necessary 6 switches to accomplish the full conversion, it is only a simple extension of the single-switch conversion that I will describe. If you install the single switch and use it in conjunction with the channel selector, you will have the 46 channels listed in Table 2. You might want to attach this table to the radio for easy reference.

Turn the radio over and you will see that there are 24 pins which come from the PLL unit and extend through the main PC board. I will refer to these pins as numbers 1 through 24, with number 1 starting at the rear of the radio. Pins 5 through 10 program the frequency of the PLL. On the 23-channel rigs, pin 6 is permanently grounded, disabling the input. To reactivate pin 6, cut the traces on either side of the pin and connect the pin to an SPST switch as shown in Fig. 1. Since you are only switching dc here, you can mount the switch wherever you feel is most convenient. When the switch is closed, the unit operates normally; when the switch is open, the higher 23 frequencies are produced starting with channel 1 on the selector.

If you want to have all 64 channels, simply install six switches in the same manner as given in Fig. 1, one switch for each of pins 5 through 10. With six switches, the channel selector will be nonfunctional and you must program the frequency with the individual switches. It should be an easy matter to make a table of the resultant channels.

I made one final modification that has proven quite useful while operating the rig. I installed a BNC jack on the back of the radio just below the power jack. I coupled the BNC jack to the rf output jack with a gimmick capacitor so that I could monitor the output frequency of the rig.

Although the specific instructions given here are intended for the Royce I-655, they should be broadly applicable to many CB sets which use the same PLL unit. The fact that only a single crystal is needed for the conversion makes the PLL rig a much better value than the heterodyne-type sets requiring several crystals for the same or smaller number of channels. Since the 23-channel PLL sets often can be obtained quite cheaply, this also makes them attractive for conversion when the extra channels can be obtained easily, as I have described. If you opt for the extra channel switch or switches, I would suggest discretion in their use to avoid interference with OSCAR, etc. I will do my best to answer any questions if an SASE is included with your inquiry.■

	Operating Frequency (MHz)	
Channel Selector	**Switch Closed**	**Switch Open**
1	28.965	29.285
2	28.975	29.285
3	28.985	29.295
4	29.005	29.305
5	29.015	29.325
6	29.025	29.345
7	29.035	29.355
8	29.055	29.375
9	29.065	29.385
10	29.075	29.395
11	29.085	29.405
12	29.105	29.425
13	29.115	29.435
14	29.125	29.445
15	29.135	29.455
16	29.155	29.475
17	29.165	29.485
18	29.175	29.495
19	29.185	29.505
20	29.205	29.525
21	29.215	29.535
22	29.225	29.545
23	29.255	29.575

Table 2. Operating frequencies available with normal operation (switch closed) and extended operation (switch open). See text for explanation.

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Something New: the MVM

—"most versatile meter" measures capacitance and frequency

Building the Heathkit function generator was easy—and it worked when I turned it on. I soon realized, however, that if I wanted to know the output frequency more accurately, I would have to have a separate instrument that would give me a quick and easy-to-read value. I could, of course, have built a digital counter, a harmonic crystal oscillator, or any of a number of exotic frequency-measuring devices, but all I wanted was a simple device that would be easy to build, simple to calibrate, and easy to read. Little did I realize what I was about to find out!

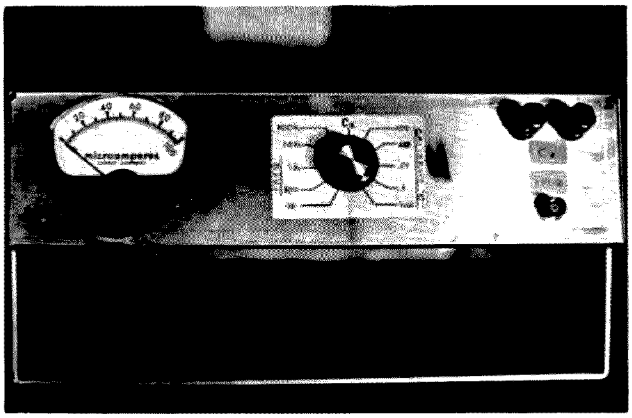
Some years ago, when atomic physicists required a device that would measure pulse rates from radioactive materials, they came up with the simple circuit shown in Fig. 1.

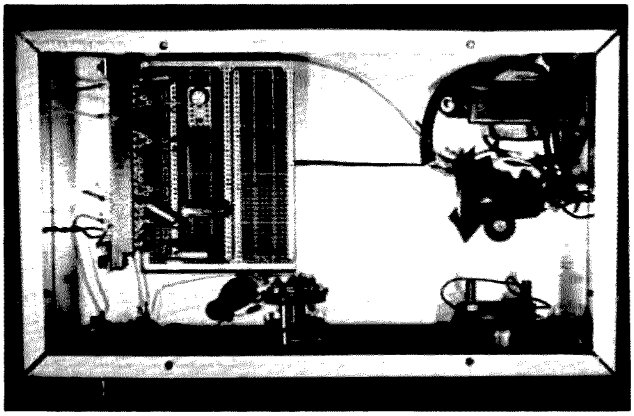
Before we get into the operation of this device, however, it is necessary to know that the pulse input to the circuit must be shaped. This is called "signal processing." The pulse required must have a fast rise and fall time and also a specific duration time. What I'm describing is a pulse like the one in Fig. 2(a), where t_r is the rise time, t_f is the fall time, and t_d is the pulse duration. If t_r and t_f are very short, then the pulse will look rectangular, as in Fig. 2(b). This is the kind of input signal needed by the circuit in Fig. 1.

Keep in mind that the input signal—the frequency of which we want to measure—can be a sine wave, triangular wave, square wave, or something in between these shapes. To turn these wave shapes into rectangular pulses, we need a trigger circuit, a squaring amplifier, or a zero-crossing comparator.

The RCA 3130S, a fairly new operational amplifier with differential input, was selected as a zero-crossing comparator. This device has an excellent frequency response which allows a rapid output voltage rise as the input voltage crosses the zero or reference point. This is true even if the input voltage is rising very slowly, because, as the input voltage crosses the reference point, the gain of the amplifier snaps the output voltage toward saturation, which is approximately the dc supply voltage—in this case, 12 volts.

The RCA "Solid-State Devices Manual SC-16" states that small amounts of positive feedback and symmetrical supply voltages would allow the device to operate satisfactorily to over 1 MHz. The maximum frequency we are interested in, however, is only 100 kHz. To preserve circuit simplicity, I decided to stay with the single supply voltage and no frequency compensation or bias control. This can be seen in the complete circuit diagram of Fig. 3. Note that a low-impedance driver circuit was added to ensure that the pulse shape would not





be degraded by the meter circuit.

Meter Circuit

Now refer to Fig. 4. Many people, when writing about this circuit, describe it as a rectifier and let it go at that. It is a rectifier, but without the input capacitor and the pulse-type waveform of input, we will learn that this circuit would not be so useful.

If you ask how much electric charge moves into the capacitor when a particular constant voltage is applied, you will find that the following relation holds: Q = VC, where Q is the amount of charge that has moved into the capacitor, C is the capacitance in farads, and V is the applied constant voltage. I keep using the words "constant voltage" because I want to be sure that the charge reaches a specific value and does not change.

Remember, too, that a capacitor does not charge instantly but takes an amount of time that depends on the resistance in series with it. The mathematical shorthand t = RC is used to describe the phenomenon, with t the time in seconds, R the resistance in Ohms, and C again being in farads.

The graph in Fig. 5 shows the amount of time represented by RC. If we multiply the equation by ten, however, we come very close to the time it takes for the capacitor to reach full charge. So, let t = 10RC, where t is now the time it takes the total charge (Q) to move into the capacitor through the resistor (R).

Now we can get back to our measuring circuit. We have just learned that in order for the charge to reach a constant value, the time that the voltage is constant must be greater than 10RC. To ensure this, all we have to do is make the duration of the input pulse, t_d, greater than 10RC. This is written: $t_d > 10RC$.

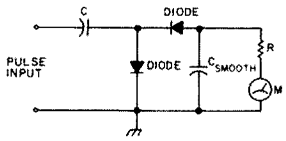


Fig. 1.

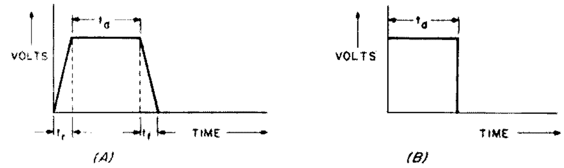


Fig. 2.

Look at Fig. 4. Assume that the pulse is at +V, S1 is closed, and S2 is open. C is, therefore, charging through R and the meter. Now assume that the pulse has passed and the input is at 0 volts. This is the same as saying that we have a wire connected from the capacitor to the ground wire. At this time, we also open S1 and close S2. This completes the discharge circuit, and C discharges very rapidly because the discharge resistance is usually very small. Now if we bring the next pulse along, close S1, and open S2, another charge cycle occurs—and so on.

Also, notice that more charge will move through the meter if the input pulse rate or frequency is increased. This charging current always moves through the meter in the same direction, so the meter reads a pulsating dc value. This is why it is referred to as a rectifier, or, in the mathematical sense, an integrator.

Now that we know how the circuit works, we have to answer only two major questions. First, what can we use for the switches, and second, how can the circuit be used for measurement purposes?

The switching can be handled by mechanical relays or semiconductor FETs. Both of these devices require some kind of circuitry synchronized with the incoming pulses. The simplest switches, however, are diodes. The potentials (voltages) occurring in the circuit cause the diodes to switch automatically to the proper position. With no need for synchronizing circuitry, let's use diodes.

The second question, how to use the circuit for measurement purposes, is best answered by some simple arithmetic. Remember that the capacitor is fully charged during each pulse if the voltage reaches a value, V, and remains constant for a time, t_d. If we multiply the charge by the frequency, (or by the number of pulses per second), we get: FQ = FCV, where F is the frequency.

If we realize that FQ is equal to the total charge that flows each second and we remember that "charge per second" is the way current is defined, it is easy to see that we can rewrite our equation as: I = FCV, where I is the current in Amperes—and there you have it!

What this equation says is that if V (the pulse height) and C (the input capacitor) are kept constant, we can use this circuit to measure frequency, F. If, on the other hand, F and V are held constant, we can

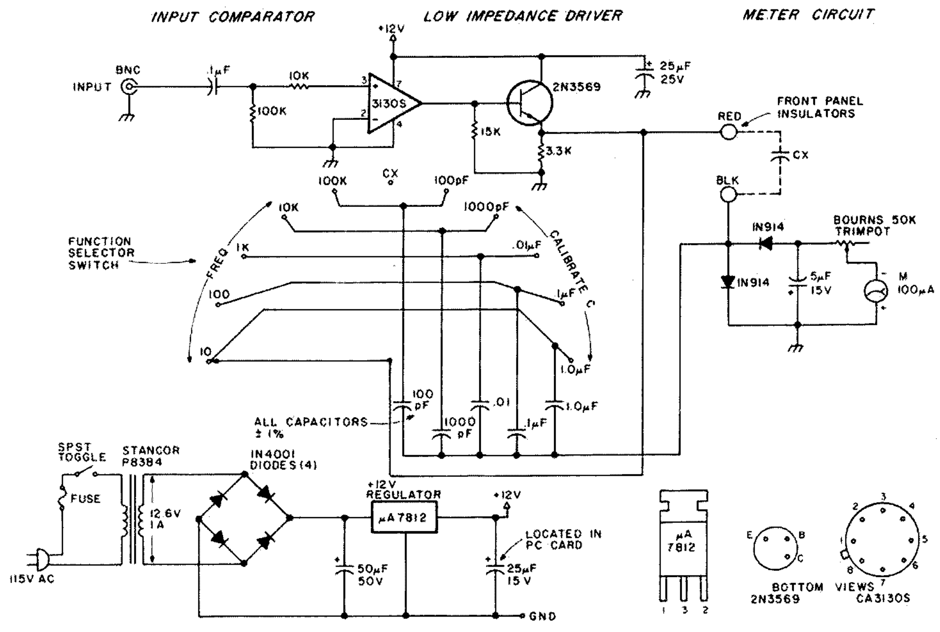


Fig. 3.

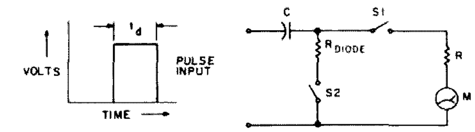


Fig. 4.

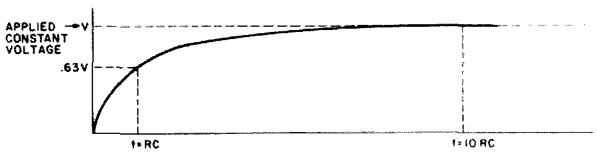


Fig. 5.

measure capacitance, C.

As an example, if we let the pulse height (V) = 10 volts, F = 100 kHz, and C = 100 pF, then I = 100 × 10^{-12} × 10 × 10^5 = 100 × 10^{-6} = 100 microamps. With a capacitor of 100 pF and a 100-microamp meter, we now can measure any frequency from 0 to 100 kHz.

One interesting twist to the circuit (see Fig. 6) is that if we multiply the average current (I) by the resistance (R), we get (from Ohm's Law) a voltage, e. Our equation now becomes: IR = e = RFCV.

If we measure the voltage across the resistor with a high input impedance voltmeter, we now can measure not only F and C, but also R or V, the pulse height.

One last point: Since the metered values I and e are linearly related to the values we are measuring — R or C or F or V — calibration is very simple. It is necessary to calibrate at one point only.

The instrument I've finally ended up with can measure both capacity and frequency when used with the Heathkit function generator.

Construction

The photos give an indication of how this instrument was assembled. Most of the electronics were mounted on a 4½" by 4½" printed circuit card. The power supply and regulator components are mounted on a "cut to fit the chassis" perfboard, seen just above the transformer. The power-on switch, meter, function-selector switch (frequency or capacity), input BNC connector, and "unknown capacitor" (C_X) terminals are all on the front panel. The PC card is plugged into a 22-pin edge connector that is mounted on two metal brackets. Everything is enclosed in an aluminum 3" × 12" × 7" chassis with a bottom plate. Incidentally, a PC card that I find very useful is the Vero DIP board no. 06-0147B. It handles integrated circuits as well as discrete components and can be clipped to fit tight quarters with a hacksaw or, better yet, a jeweler's saw.

Operation

Switch the instrument on and set the function selector switch to 100 on the frequency side of the switch. Connect a 50-to-100-picofarad capacitor (ceramic or mica) to the hot side of a 115 V ac line, and connect the other side of the capacitor to the center lead of the BNC connector. Connect a .1-microfarad capacitor (paper or ceramic) from the ground side of the 115 V ac line to the chassis or ground side of the BNC connector. Adjust the 10-turn pot in series with the meter so that the meter reads 60 Hz. These capacitors are necessary to reduce the 115 volts to a level that will not burn out the input circuit. (They are not necessary if you use the output of a 6-volt filament transformer.)

The instrument is now calibrated. You can use any frequency that you are sure is accurate on any of the ranges from 10 Hz to 100 kHz to do this calibration. Notice that the frequency side of the function-selector switch is connected to the "capacitor calibrate" side of this same switch. This puts the proper capacitor in series with the measuring circuit. In order to be sure that this accuracy is maintained in the frequency measurement, these capacitors should have a tolerance of not more than ±1.0%. Since these capacitors are available, we can use them to calibrate the instrument to measure capacity.

For example, suppose we want to measure capacity between 0 and 100 pF. Set the function selector switch to 100 pF on the capacitor-calibrate side of the switch. Connect the input BNC connector to an audio generator, or to your Heathkit function generator, and set the generator to 100 kHz (the frequency value on the frequency side of the switch). Increase or decrease this frequency so that the meter reads full scale. Now flip the function selector switch to the C_X position. The capacity meter is now ready to measure values of capacitance between 0 and 100 picofarads. The same procedure is used on the other ranges. ■

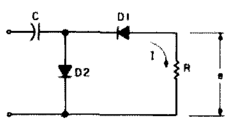


Fig. 6.

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Amplify Your 6-Meter Fun

—a cheap but effective linear

After I managed to scare up enough cash for a new FT-620B, I was amazed at the good results that I was obtaining with a puny 14 Watts output. After a few modifications (S-meter circuit, alc, etc.) and super-tweaking, I was able to cough up 17 Watts —not bad. Even then, the FT-620B was not able by itself to work the long-haul ground wave which I was accustomed to with my previous 6 meter SSB rig.

I decided that it was time to construct an afterburner for the 620. Next came the problem of what to use for parts and tubes. In northeast Georgia, electronic parts are as scarce as hen's teeth; so it must be simple. So, now I had 17 Watts of drive available—too much for a 4X250B tube and too little for a 3-500Z. Then I remembered our old friend the 811A (or 812A, even). According to the specs, it's good for 170 Watts output to 60 MHz with 12 Watts drive and 1400 volts on the plate. People laughed when they heard me on the air discussing an old 811 on 6 meters. Now everyone in the local area is building one, especially when 811As can be obtained at our not-so-local parts store for 3 bucks a throw, including 4-pin socket!

Construction

I built the amplifier on a chassis and cabinet which once used to be a WRL 6 & 2 MTR Hi-Bander transmitter. I was able to use the same power transformer, meter, switches, and the 2 coax SO-239 connectors for antenna and transceiver. However, after construction, I realized that the whole amplifier could have been built on a smaller 7" x 9" x 3" chassis with front plate, back plate, and top covers.

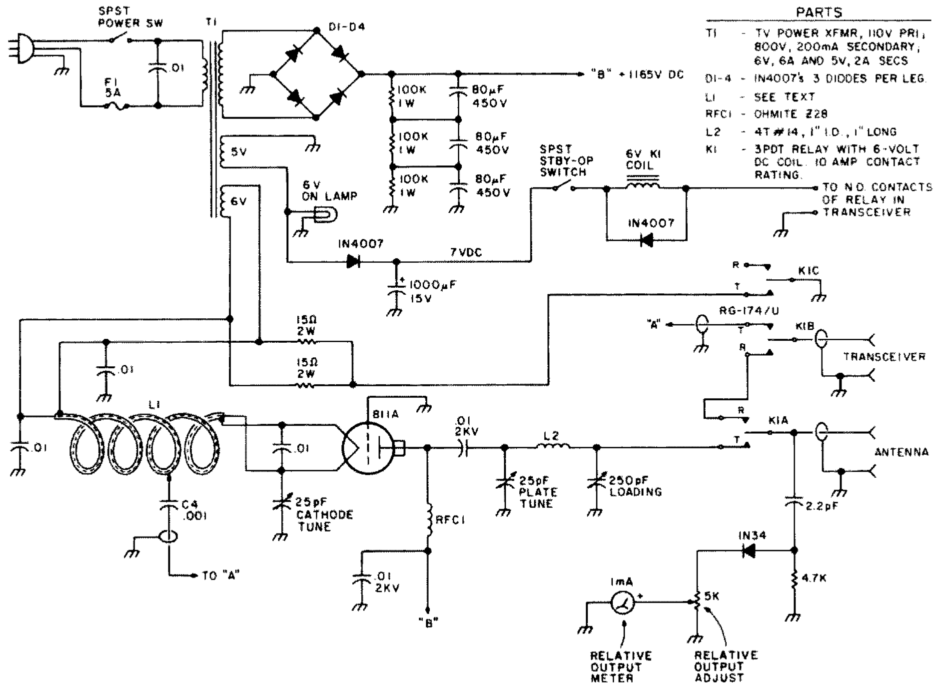

Fig. 1. 6 meter linear amplifier.

As the schematic shows (Fig. 1), T1 is a TV power transformer, with an 800-volt secondary at 200 mA, 6 volts at 6 A, and 5 volts at 2 A. A transformer with voltage higher than 800 volts can be used, maybe to 900 volts ac maximum. A rating lower than 800 volts ac will not give enough plate voltage. My transformer yielded 1165 volts with no load and 1080 volts under load, measured at the top of the filter capacitor bank. The ac line cord is a 3-prong unit, with the ground pin going to chassis ground. The rectifier bank, D1-D4, is made of 4007s with three diodes in each leg. Relay K1 is a 3PDT P & B relay with a 6-volt dc coil and 10-Amp contacts. One pole of the relay grounds the cathode circuit during transmit and the other two poles control

the antenna circuits. The standby/operate switch applies 7 volts dc to the relay coil in the operate position; the other side of the coil gets grounded by the normally-open relay accessory part of the transceiver during transmit. It should be noted that plate voltage appears on the 811A at all times, but it draws no plate current unless relay K1 is energized. I have found that smaller relays do not like 1165 volts on their contacts, so interrupting the cathode circuit between was a logical move since there is only a small amount of voltage in the cathode circuit.

The 25-pF cathode tuning capacitor can be any small air variable or ceramic trimmer. The 25-pF plate capacitor is a small double-spaced air variable and the 250-pF loading capacitor is a modified 365-pF variable salvaged from an old bc-band table radio. The plate tank circuit was built with short leads as close as possible around the 811A. I had my 811A countersunk in the chassis to facilitate shorter leads in the tank circuit.

The relative-output meter circuit is simple and adjustable. I have it wired so that it can measure transceiver output or amplifier output, depending on whether the amplifier is on or off.

Coil L1 is the heart of the whole amplifier. It consists of 4 turns of 1/8" copper tubing wound to produce a coil 1½" long and with a ¾" i.d. However, before the tubing is bent into a coil, insert a piece of #18 teflon™-covered wire. Now we have a 2-conductor coil. Attach the coil to the 4-pin tube socket on one end. The other end should go to a terminal strip mounted on the chassis. Mount the two .01-uF filament capacitors and two 15-Ohm resistors on the terminal strip.

Tack-solder the .001-uF cathode coupling capacitor (C4) approximately 1 turn from the filament end of the copper coil. The rest of the construction should be simple and straightforward.

Testing and Use

After construction, carefully check for shorts and cold solder joints. Check for a short in coil L1. If you used teflon™ inner conductor, you should have no problems. Rubber or vinyl wire used for L1 will melt when soldering the copper tubing. Fire up the amplifier and check for HV and filament power. Temporarily break the HV line and insert a milliamp meter. Energize relay K1 and check the idling plate current. It should be about 20 mA. Now apply a small amount of drive and peak the cathode tuning for maximum plate current and tune the tank circuit for maximum output. Now, note the drive power and experiment with the location of the C4 capacitor tap on L1. Adjust the tap placement and cathode tuning capacitor for maximum efficiency. There will be a certain tap placement of C4 which couples the most drive power to the filament/cathode circuit.

With about 14 Watts of drive and the tank circuit fairly loaded, the plate current will be about 175 mA with 1100 volts on the plate. This produces 120 Watts dc output. Your amplifier should now be ready for service. I built my amplifier for a grand total of about $25, including scrounged and begged parts. Besides using an 811, I also plugged in an 812A with similar good results. ■

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CB to 10

—part XXI: the Johnson Viking 352

Here it comes folks, another CB rig converted to ten meters—the Johnson Viking 352. This rig has a great deal of flexibility when properly modified. It can offer more features than the average CB-to-ten-meter conversion, and this means more QRP contacts for you.

The 352 is an SSB/AM eleven-meter 23-channel transceiver. The logical place to convert it seems to be 28.5 MHz to 28.8 MHz, so the SSB can be used at the lower end and the AM section will cover the upper end where there is activity in this mode.

At this point, it would be wise to pick up the Sams Photofact® no. CB-112 on the rig if you don't have the schematic for it already.

The rig has a standard four-by-six crystals synthesis scheme, so the bank of four crystals is changed in the interest of economy. The bank of crystals was changed from the 7 MHz range to 9.065 MHz, 9.045 MHz, 9.035 MHz, and 9.025 MHz for crystal positions Y610 to Y607 respectively. While awaiting delivery of your crystals, you can perform the following modifications to attain greater frequency coverage (fill in the "holes" between channels) and add one more channel.

First, we will activate the mysterious "blank" channel between channels 22 and 23. Locate the pink wire which runs from S1, deck C, pin 14 to R608 and disconnect it from the switch deck. Tape the end so that it will not short to anything else, and *voila*, 24 channels.

Next, we switch the fine tune from a receive-only function to a receive-and-transmit function. Cut the green wire at relay K1's swing arm and reconnect it to the fine-tune potentiometer (R625) wiper. This produces approximately 2 kHz of transmit-and-receive fine tune which is usually not enough for serious QRP work on ten meters. The fine tune can be expanded to 10 kHz and more by adding a variable inductor (Miller 4204) between the anode of CR606 and ground. Note that this is a variable inductor; a frequency counter should be used to adjust it to allow a maximum of 12½ kHz of fine tune. Any more than this will cause excessive non-linearity and fast tuning in the fine-tune knob.

When these modifications are complete and operating well, your new crystals should be well along the way. When you get them replace Y607 through Y610 with 9.025, 9.035, 9.045, and 9.065 MHz, respectively. Connect a frequency counter to TP1; with the Johnson Viking 352 on channel 11 AM, adjust T601, T602, and T603 for an output of 20.845 MHz. Be sure that 17 or 24 MHz are not present, or the synthesis won't come out right. This part can be done with an oscilloscope, using a hand calculator to determine freculator to determine frequency. (This is how I do it.) After you have the 20.845 MHz, adjust T601, T602, and T603 for maximum rms voltage at TP1. Now change the controls to channel 13 and USB; with the VTVM rf probe or scope still connected to TP1, adjust T604, T605, T606, T501, and T502 for maximum.

The synthesis is now producing 28 MHz rf and the receiver needs to be aligned. Set up a low-level signal source at approximately 28.6 MHz. If you have obtained and installed the previously-mentioned crystals, 28.6 MHz should be at channel 7 with the fine tune at 9 o'clock position. Couple the weak signal source to the antenna jack and adjust T401 through T409 for maximum signal indication on the S-meter. (Be sure to reduce signal strength as you align the receiver, to avoid overload and false tuning.) The transmitter alignment is done by using an output indicator and a 52-Ohm dummy load which is capable of handling 5 Watts or so. Adjust T701 through T705 for maximum output power.

Now, that was easy, wasn't it? Whatever your answer, you now have a rig which will perform very well and provide the flexibility to work QRP on ten meters. I have converted four of these rigs, and all of the operators (including myself) are doing very well with modest antenna systems. I am presently 8 states away from my WAS QRP 10m SSB, have worked all continents, and have 48 countries worked (including a JT1, a 5N2, and a VP2S). Not bad for an obsolete CB rig. See you on ten meters QRP.■

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Exploring Uncle Sam's Bookstore

—what's for you at the GPO

"Oh yes," I kept telling myself. "One day I'll find the time to study so I might earn my amateur radio license." That was my total commitment for a period of at least twenty years, until about one year and a half ago. At that point, I decided to devote the necessary time to some honest study toward that end.

My first task was to locate reference materials in order to accumulate the information that would aid in preparing for the written examinations. Although I am employed at what some consider to be the world's largest printing establishment, the US Government Printing Office (GPO), I did not realize initially that the GPO bookstore would be a ready source and a prime repository for such specialized literature. This discovery was made one day when I walked in to purchase a current copy of the FCC Part 97, Amateur Radio Service Regulations.

There, to my amazement, on the bookshelf beside Part 97, were many publications relating to the general categories of communications and electronics. Some further investigating on my part revealed a number of relevant publications that are both informational and useful to the radio amateur. The wide range of topics and titles

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available were extremely helpful to me, and can serve your needs also, if you are in search of additional study or reference books to place in your home or club library.

As a convenience to the reader, I present an abstracted listing of US Government publications of general interest to radio amateurs. Shown in the listing are the document title, publication date, number of pages, GPO stock number (necessary for ordering), and current selling price. (Prices and availability are subject to change.) Also shown is a listing of 20 GPO bookstores located in major US cities. You may wish to contact your local GPO bookstore for ordering or if you desire you may place your order with the Superintendent of Documents, Washington DC 20402. Prices shown are for domestic mailing. Add 25% for orders mailed outside the US and its possessions. Any specific questions you may have should not be directed to me but to the Superintendent of Documents.

I'm sure that you will find, as I did, many helpful and interesting publications here for both beginners and experienced radio amateurs.■

FCC Rules and Regulations

- Part 95, Sub-part A, May, 1977, General Mobile Radio Service. 19 pp. 004-000-00340-3 $1.00
- Part 95, Sub-part C, May, 1977, Radio Control Radio Service. 13 pp. 004-000-00341-1 $0.80
- Part 95, Sub-part D, August, 1978, Citizens Band Radio Service Rules. 56 pp. 004-000-00356-0 $1.25
- Part 95, Sub-part E, May, 1977, Technical Regulations, Personal Radio Services. 13 pp. 004-000-00343-8 $0.80
- Part 97, Amateur Radio Service, January, 1979. 28 pp. 004-000-00357-8 $1.40
- Part 99, Disaster Communications Service, May, 1976. 10 pp. 004-000-00326-8 $0.75

Broadcast Operator Handbook. 1976. 103 pp. 004-000-00329-2 $3.00

Estimated Effective Ground Conductivity in the United States: Maps.

- Eastern United States. Reprinted 1976, 48 x 39 inches. 004-000-00279-2 $2.75
- Western United States. Reprinted 1976, 48 x 39 inches. 004-000-00280-6 $2.75

How To Identify and Resolve Radio-TV Interference Problems. 1977. 31 pp. 004-000-00345-4 $1.50

Broadcasting Stations of the World (excluding US)

- Part 1, Amplitude Modulation Broadcasting Stations, According to Country and City. 1974. 261 pp. (out of print)
- Part 2, Amplitude Modulation Broadcasting Stations, According to Frequency. 1974. 261 pp. (out of print)
- Part 3, Frequency Modulation Broadcasting Stations. 1974. 216 pp. 041-005-00011-4 $2.40
- Part 4, Television Stations. 1974. 444 pp. 041-005-00012-2 $4.25

Basic Electronics

- Vol. 1. 1971. 566 pp. 008-047-00134-7 $7.70
- Vol. 2. 1971 323 pp. 008-047-00142-8 $3.85

Basic Electricity. Reprinted 1978. 490 pp. Ill. 008-047-00069-3 $6.25

Electronics Technician 3 & 2, Vol. 1. 1973, reprinted 1975. 309 pp. Ill. 008-047-00156-8 $7.60

Electrician's Mate 1 & C. 1970. 155 pp. 008-047-00066-9 $2.70

Fundamentals of Electronics (All missing volumes are out of print.)

- Vol. 1a. Basic Electricity, Direct Current. 1966, reprinted 1976. 147 pp. Ill. 008-047-00097-9 $2.15
- Vol. 1b. Basic Electricity, Alternating Current. 1967, reprinted 1977. 210 pp. Ill. 008-047-00098-7 $2.80
- Vol 2. Power Supplies and Amplifiers. 1965, reprinted 1976. 144 pp. Ill. 008-047-00099-5 $3.50
- Vol. 3. Transmitter Circuit Applications. 1965, reprinted 1978. 138 pp. Ill. 008-047-00100-2 $4.25
- Vol. 4. Receiver Circuit Applications. Reprinted 1970. 200 pp. Ill. 008-047-00105-3 $3.95
- Vol. 5. Oscilloscope Circuit Applications. 1964. 133 pp. Ill. 008-047-00101-1 $2.00
- Vol. 6. Microwave Circuit Applications. 1965, reprinted 1976. 123 pp. Ill. 008-047-00102-9 $1.90
- Vol. 7. Electromagnetic Circuits and Devices. 1964. 181 pp. Ill. 008-047-00103-7 $1.45
- Vol. 8. Tables and Master Index. 1965. 162 pp. Ill. 008-047-00104-5 $3.60

Engineering Design Handbook: Reliable Military Electronics. 1976. 452 pp. 008-020-00602-5 $7.25

Basic Theory and Application of Electron Tubes (includes changes 1 and 2). 1952, reprinted 1976. 215 pp. 008-020-00048-5 $3.05

Theory and Use of Electronic Test Equipment. 1952, reprinted 1975. 158 pp. Ill. 008-020-00050-7 $2.45

- Change 1 to above. 1958. 2 pp. 008-020-00049-3 $0.35

Higher Frequency Techniques (Excluding Microwaves). 1952, reprinted 1978. 129 pp. Ill. 008-020-00577-1 $2.75

FM Transmitters and Receivers (change 1 inserted). 1952, reprinted 1976. 198 pp. 008-020-00052-3 $3.65

Transients and Waveforms (includes change 1). 1951, reprinted 1975. 90 pp. Ill. 008-020-00053-1 $1.65

Cathode Ray Tubes and Their Associated Circuits. 1951, reprinted 1971. 218 pp. 008-020-00379-4 $3.55

Pulse Techniques. 1951, reprinted 1978. 102 pp. Ill. 008-020-00056-6 $1.85

Electrical Fundamentals (Alternating Current) (changes 1 through 3 inserted). 1951, reprinted 1977. 231 pp. Ill. 008-020-00060-4 $4.10

Principles and Applications of Mathematics for Communications-Electronics. 1961, reprinted 1975. 248 pp. 008-020-00061-2 $3.30

Interior Wiring. 1968, reprinted 1977. 120 pp. Ill. 008-020-00401-4 $2.40

Electric Motor and Generator Repair. 1972, reprinted 1975. 233 pp. Ill. 008-020-00456-1 $3.10

Troubleshooting and Repair of Radio Equipment. 1958, reprinted 1973. 180 pp. 008-020-00040-0 $4.40

Communications Electronics Fundamentals Basic Principles (Direct Current). 1974. 296 pp. Ill. 008-020-00581-9 $3.75

Field Wire and Field Cable Techniques. 1970, reprinted 1975. 350 pp. Ill. 008-020-00558-4 $3.15

Electrical Engineering Units and Constants. Revised 1976. 2½" x 3½" wallet-size plastic card 003-003-01665-9 $0.35 ($4.65 per 100)

Survey of Ground Fault Circuit Interrupter Usage For Protection Against Hazardous Shock. 1976. 13 pp. Ill. 003-003-01591-1 $0.45

Electric Current Abroad, 1975 Edition. 1975. 81 pp. 003-025-0046-2 $1.15

Air Frame and Powerplant Mechanics—General Handbook. Revised 1976. 549 pp. Ill. 050-007-00379-0 $6.75

United States Frequency Allocations: Map. 1975. 32 x 55 inches. 003-000-00469-4 $1.35

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Computerized Slow Scan . . . Revisited

—further enhancements for the K6AEP system

SSTV is probably one of the most exciting means of amateur radio communications.

In what other mode of amateur communications can you see the person you are talking to even though the amateur may be thousands of miles away?

Interest in SSTV is growing daily, and one of the easiest ways to experiment with it is by using a microprocessor. Never before have amateurs been provided with such a flexible, powerful tool. The microprocessor provides a means of changing its function by loading into its memory a series of instructions called a program, or software.

This article was written to upgrade the software package described in my previous article.[1] It will explore the effect of digitizing SSTV pictures with more picture elements (pixels) and gray levels. It also will tell how to rotate pictures and title pictures in computer memory. For those of you who are not aware of my previous article, I think a short review might be appropriate.

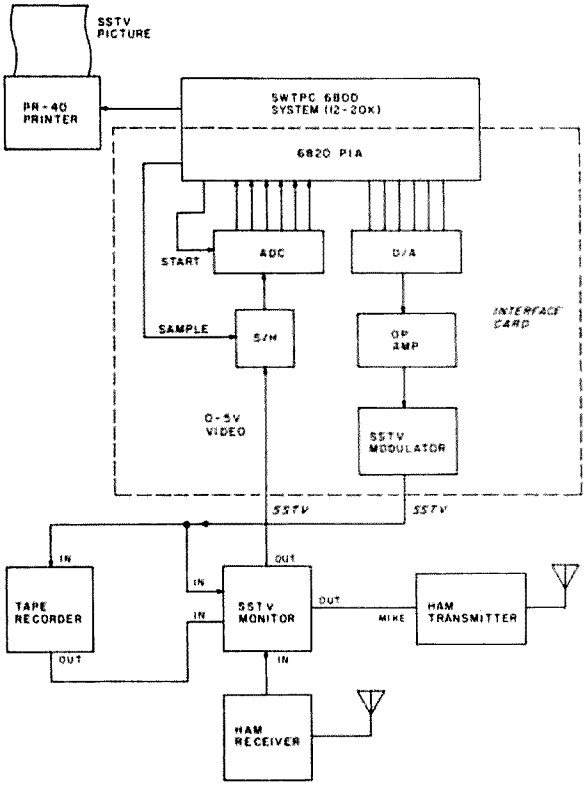


Fig. 1. Computer interface.

The SSTV Enhancement Program

In my article, I provided an interface between an SSTV monitor, a ham transmitter, and an SWTPC 6800 computer system. Fig. 1 provides a block diagram of the interface card. The interface card accepts sync pulses and video which have been previously demodulated and scaled to a 0- to 5-volt swing from the SSTV monitor. The video input portion of the card consists of an analog-to-digital converter (ADC) and a sample-and-hold (S/H). The computer output consists of a digital-to-analog (D/A) converter, an amplifier, and a SSTV modulator. All of the analog devices are connected to a 6820 PIA which allows the computer control.

The software package in the article made it possible to (1) receive and transmit SSTV from the SWTPC 6800; (2) print hard-copy SSTV pictures on an SWTPC PR-40 printer; and (3) enhance the picture in computer memory, since it would remove noise by averaging pictures received, add contrast to pictures, zoom in on 5 areas of the picture in memory by 2 times, reduce the gray level content of pictures on transmit from 16 to 2, and produce negative or inverted pictures. All of these pictures were digitized to 128 pixels on 128 lines with 16 gray levels.

Picture Quality

When I determined the picture density for my original article, the above seemed like a good idea at the time for two reasons. First, only 12K of memory was required for the SSTV picture and control program; second, the Robot 400[2] used this format with the same number of picture elements and gray levels as I planned.

During the initial stages of the project, I discussed my idea with knowledgeable people. They warned me that more picture elements would produce better results. Despite these warnings I proceeded, and, sure enough, they were right. My results were

Photo 1. Analog SSTV picture.

Photo 2. SSTV picture digitized to 128 pixels with 16 gray levels.

marginal.

After a little prodding by others. I decided to perform a few experiments to determine the effect on picture quality of changing the picture elements per line and gray level.

Since the control of the SSTV picture reception is accomplished by constants in the software, the experiment was easy to conduct. I decided to increase the pixels per line in gradual steps to see the effect. I had a few concerns relative to computer overhead, since all of my routines were fine-tuned for 128 pixels per line. If I tried to digitize the picture with too many pixels, the memory requirements would be high. Additionally, I would reach a point where the software would not function due to execution speeds. I decided that the maximum memory requirements for the picture would be 16K. With this requirement in mind, I decided to experiment by (1) varying the pixels/line from 128 to 176, 224, and 256, and (2) keeping the format at 128 pixels by 128 lines and increasing the gray level content of the picture to 64.

The pixel variation experiment took only a few hours to perform. It was quite easy, since only 7 memory locations had to be altered in the enhancement program. I found that the 256 pixel/line rate was the maximum rate which my systems would support. If I had had a faster clock, a higher picture density could have been achieved.

The gray level variation experiment took a little longer. It involved the writing of an entire routine, which ended up with about 256 bytes of object code. No hardware changes were required, since I planned ahead on my initial design of the interface card and placed six bits of the ADC and D/A on the PIA (6820). The results were interesting. Photos 1 through 4 show my results:

Photo 1. Normal SSTV Picture. This picture was produced by a TV camera and a scan converter. The SSTV picture was displayed on an MXV 100 (P7 CRT) monitor.[3]

Photo 2. Digitized Picture (128 pixels). This picture was digitized to 128 pixels/line on 128 lines with 16 gray levels. The picture has some 60-Hz ripple in the monitor/computer interface, due to a ground loop which I have not found. The picture also contains some software jitter which I will discuss later.

Photo 3. Digitized Picture (256 pixels). This picture was digitized with 256 pixels/line on 128 lines with 16 gray levels.

Photo 4. Digitized Picture (64 gray levels). This picture was digitized with 128 pixels/line on 128 lines with 64 gray levels.

After close scrutiny of the pictures and analyzing the results on my monitor, these conclusions were drawn:

1. The picture density of 128 pixels on 128 lines, with 16 gray levels, produced marginal results. If the 60-Hz noise and jitter were removed, the results would be somewhat better.

2. A density of 128 pixels on 128 lines, with 64 gray levels, produced better results. However, the problem of contouring would appear if a zoom feature were added.

3. The best all-around digitized picture tested had 256 pixels on 128 lines, with 16 gray levels.

This selection was not based entirely on picture quality, but also on memory size and the amount of contouring experienced. The contouring could be reduced even further by averaging pixels together before they were transmitted. I did not try to program this feature, since my system overhead was so

Photo 3. SSTV picture digitized to 256 pixels with 16 gray levels.

Photo 4. SSTV picture digitized to 128 pixels with 64 gray levels.

high that it might not have been possible with the standard SWTPC cycle-time of approximately 1 MHz. A faster CPU card would have been desirable in this application.

The implementation of the 256 pixels/line feature required numerous changes in my enhancement program software package. I decided to use code, which modified the basic program for the selection of either 128 or 256 pixels/line. The effect of higher picture densities thus can be observed quickly by the selection of program options. The process of modifying all of the enhancement algorithms for the additional density was complex. I found that everything but the noise routine could be modified for the higher density. This routine has high overhead even at 128 pixels per line.

I decided to include the software in this article for the 128 pixels on 128 lines, with 64 gray levels, as an optional program. The program was assembled on a boundary greater than 20K and allows for further experimentation.

Additional Features

For some time I have felt a need existed to add titles to SSTV pictures received. Since all the SSTV inputs are routed through the SSTV monitor, the software now allows titling of pictures received over the air, outputted from a tape recorder, or generated by a scan converter. The applications of this feature are endless.

I decided to make the letters small and allow a total of 9 lines to be displayed with 9 characters on each line. This size was found to be very adequate and visible under QRM conditions. I additionally decided to add the letters with and without background and to select the lettering with and without gray level. I assembled into my program only the selection of white or black characters, but a gray level selection can be made by changing program constants.

The titling feature is available for only 256 pixels/line for two reasons. I felt that the character resolution would not be sufficient with 128 pixels/line, and I did not have enough memory available in the remaining lower 4K to support the luxury of switching between 128- and 256-pixels-per-line lettering. Photo 5 is an example of the various modes of titling.

Another feature added to the package was the ability to rotate pictures on transmit. The overall effect has been dramatic and demonstrates the power of microprocessors. Imagine receiving an SSTV picture over the air, adding titling to the picture, and then sending it back to the originator rotated at either 90° or 180°. With more memory available, it would be fun to code the routine to rotate the picture by any 45° angle between 45° and 315°. I'll leave this exercise for some future date.

Software Concepts

To understand the software, it is important to first know how an SSTV picture is formatted in computer memory. Fig. 2 depicts a typical SSTV picture in memory, formatted to 128 or 256 pixels on 128 lines, with 16 gray levels.

As you can see from Fig. 2, two pixels are packed into one byte. This allows the picture to be stored efficiently into memory, since all bits in each byte contain picture information. However, this software format was considerably more difficult to write, since bytes must be separated or packed into nibbles (4 bits) prior to each operation. Part of the

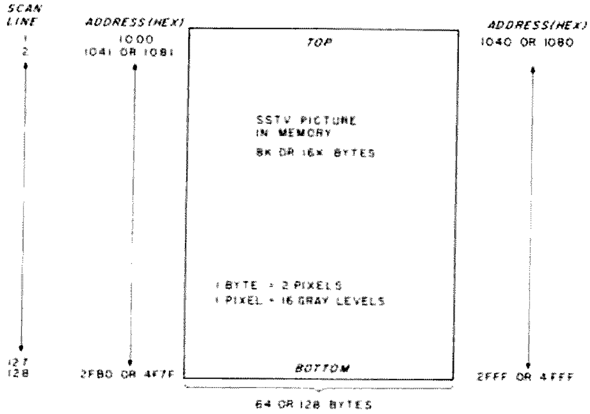


Fig. 2. Digitized SSTV picture memory map.

so-called 60-Hz noise shown in the preceding pictures is due to the unpacking of the nibbles on transmission to the SSTV modulator on the interface card. This noise, or jitter, is due to unequal cycle times in the software which was used to unpack each nibble. If I had been aware of this problem during my initial coding of the program, I would have eliminated this condition.

The 64 gray level pictures were formatted in a different manner. Since six bits were available on the ADC and the D/A, I decided to pack all bits into a single byte. This process made the coding of the software much easier. A side benefit was that I took more care in my software to eliminate jitter, and the results show an improvement in this regard. The 64 gray level picture requires 16K of memory and does not use 2 bits of each byte to store picture information. One bit is not used and the other is used for sync.

The Software

Fig. 3 contains a complete source listing of the program. Fig. 4 contains a listing of the dot and translate tables for the character dots. I'll discuss the software by function, and describe each routine used or called for by the main line program.

Pixel Selection

The pixel selection of 128 or 256 pixels was made by modifying the code of the SSTV enhancement program.[1] Five routines were modified in the enhancement program: receive SSTV, xmit SSTV, zoom, contrast enhancement, and print. The modifications consisted of two types: address changes and constant changes. The address changes were used to tell the software where parts of the picture are located in memory. The constants were used to tell the software how many pixels are contained in each line of the SSTV picture, and also for delay constants.

I will not go into detail on how these constants were selected, but two points are important. The noise routine of the enhancement program will not function at 256 pixels/line due to program overhead, and the 256 pixels per line is the maximum rate at which the software will function. This is due to a combination of software overhead and ADC conversion time.

Picture Rotation

The picture rotation was divided into two types—180° (upside down) and 90°. I'll discuss the simplest one first, the 180° rotation.

Photo 5. SSTV picture with computer titling.

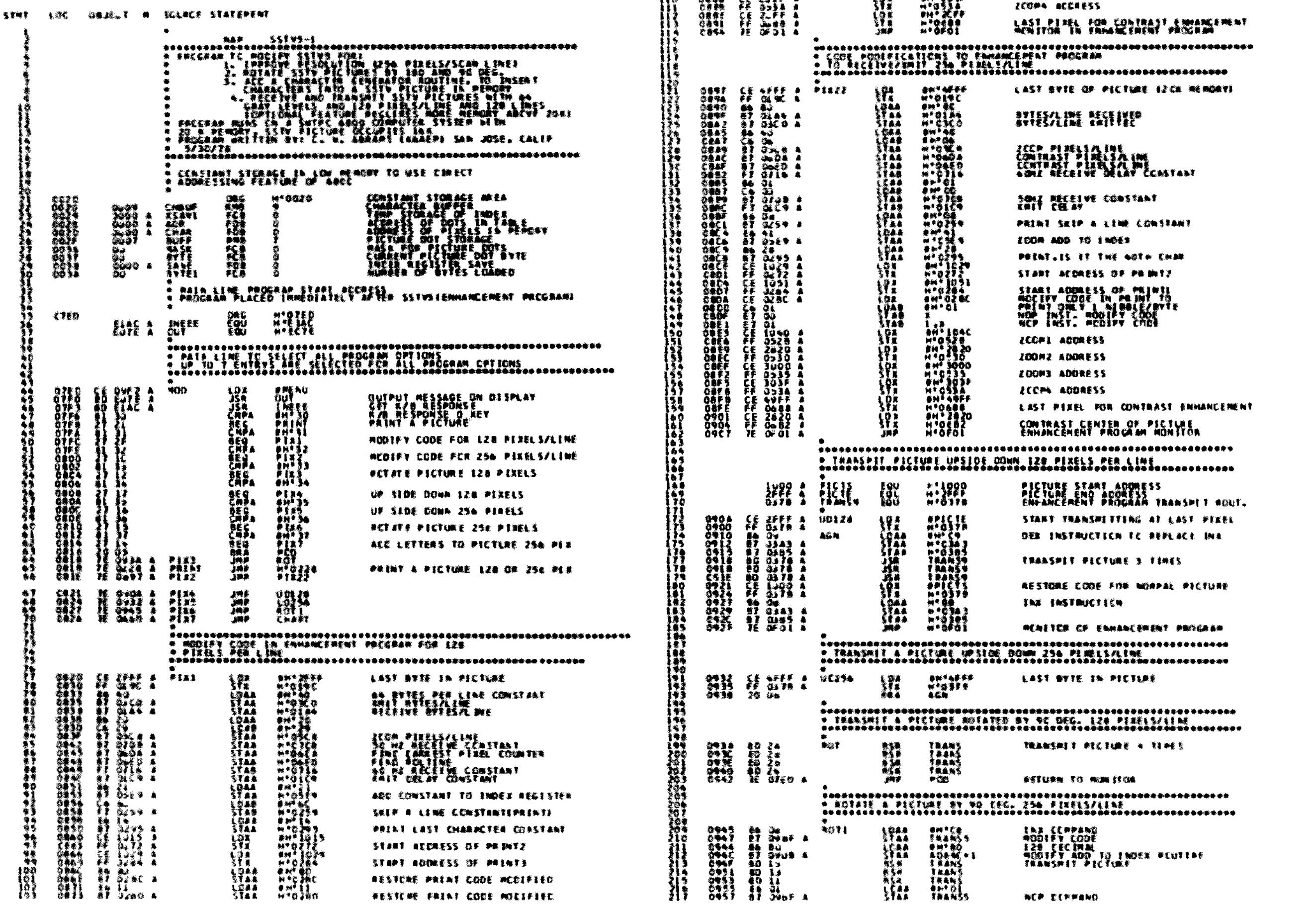
Two routines are used to accomplish this, UD128 and UD256. The number in the label refers to the picture density. These routines modify two instructions in the transmit routine of the enhancement program for an INX (increment index register) to a DEX (decrement index). The transmit routine in normal operation is entered with the first byte of the picture start address. Each byte then is transmitted, and the index is incremented until the last byte is transmitted. To transmit a picture upside-down, all that has to be done is to load the index with the last byte of the picture and decrement the index register. This trick was easy and took only 50 bytes of code.

The 90-degree rotation took a little more code. The main line routine is ROT and ROT1. A flowchart was not provided for this routine, since all lines of code are well commented. I took care in this routine to remove all software jitter. This was accomplished by transmitting each nibble of the byte in the same number of CPU cycles. At address 0972-5, four NOP instructions were assembled. These instructions compensate for the four ASLA instructions at address 099A-D which are required to format the byte for the transmission of the 2nd pixel.

The operation of the routine is quite simple. All that has to be done is to load the index with the start address of the picture, transmit the high-order nibble, and then add 64 or 128 to the index register. The index is now pointing at the first byte on the next line. If you repeat this process for all bytes and nibbles, the SSTV picture will be transmitted at 90 degrees.

After writing this routine, I found that I scanned the picture backwards. Wow! What the software produced was a mirror-image

Fig. 3. Program source code.



of the picture at 90 degrees. After much thought, I decided not to rewrite the routine. The effect was very dramatic and has caused some interesting discussions over the air. The solution requires a few patches to the program and the writing of a routine to subtract 64 or 128 from the index register. Since my memory requirements were tight and it might be tricky to implement a change, I left the routine alone.

```
D00 40 47 4E 55 5C 63 6A 71 78 7F 86 8D 94 9B A2 A9
D10 B0 B7 BE C5 CC D3 DA E1 E8 EF F6 40 40 40 40 40
D20 04 5F 66 6D 74 7B 82 89 90 97 9E A5 04 04 58 0B
D30 12 19 20 27 2E 35 3C 43 4A 51 04 04 04 04 04 04
D40 00 00 20 50 88 00 00 20 50 88 88 F8 88 88 F0 88
D50 88 F0 88 88 F0 F0 88 80 80 80 88 F0 F0 88 88 88
D60 88 88 F0 F8 80 80 F0 80 80 F8 F8 80 80 F0 80 80
D70 30 78 80 80 30 98 88 78 88 88 88 F8 88 88 88 70
D80 20 20 20 20 20 70 08 08 08 08 08 88 70 88 90 A0
D90 C0 A0 90 88 80 80 80 80 80 80 F8 88 D8 A8 A8 88
DA0 88 88 88 88 C8 A8 98 88 88 70 88 88 88 88 88 70
DB0 F0 88 88 F0 80 80 80 70 88 88 88 A8 90 68 F0 88
DC0 88 70 A0 90 88 70 88 80 70 08 88 70 F8 20 20 20
DD0 20 20 20 88 88 88 88 88 88 70 88 88 88 88 88 50
DE0 20 88 88 88 A8 A8 D8 88 88 88 50 20 50 88 88 88
DF0 88 50 20 20 20 20 F8 08 08 20 40 80 F8 F8 F8 F8
E00 F8 F8 F8 F8 00 02 00 00 00 00 00 00 08 10 20 40
E10 80 00 70 88 98 A8 C8 88 70 20 60 20 20 20 20 70
E20 70 88 08 30 40 80 F8 F8 08 10 30 08 88 70 10 30
E30 50 90 F8 10 10 F8 80 F0 08 08 88 70 38 40 80 70
E40 88 88 70 F8 08 10 20 40 40 40 70 88 88 70 88 88
E50 70 70 88 88 78 08 10 E0 00 00 00 00 00 00 20 00
E60 38 00 20 00 F8 00 20 20 20 20 20 20 20 00 00 00
E70 F8 00 00 00 00 F8 20 F8 20 F8 00 08 10 20 40 80
E80 78 00 A8 50 A8 50 A8 50 A8 00 C0 30 08 30 C0 00
E90 20 50 A8 20 20 20 20 50 00 F8 88 88 88 F8 00 00
EA0 00 38 20 20 20 00 00 00 70 20 20 20 00 00 00 00
```

Fig. 4. Dot and translate table.

Picture Titling

This routine was the most complex portion of the program to write. I considered future expansion in the writing of the character generator routines. What I needed was a general-purpose character generator which could be modified for any dot matrix size or gray level. I started by using the concepts described in my June, 1977, article.[4] The problem, however, was a little more complex, since the characters are inserted in a 16K block of memory. I decided that the characters should be quite small and consist of the following format:

Character Dot = 2 bytes (horizontal) or 4 pixels.

Character Dot = 2 scan lines (vertical).

The next job was to program the beast. I decided to use the dot and translate table contained in my October, 1977, article.[5] I relocated this table to address 0D00 and 0E00 to reside within the lower 4K of memory. Since I was running out of available memory, I decided to use the lower 256 bytes of memory which use the direct addressing mode of the 6800. You can save a lot of memory by this technique, since many instructions require only two bytes to address this portion of memory.

To give you a blow-by-blow account of how the

```
0958  86 40            LDAA   #H'40          64 DECIMAL
095C  B7 0908 A        STAA   AD64C+1        MODIFY ADD TO INDEX ROUTINE
095F  7E 0FE0 A        JMP    #00            RETURN TO MONITOR
                 *
                 ***********************************************************
                 * TRANSMIT PICTURE ROTATED AT 90 DEG. ROUTINE
                 * CODE IS WRITTEN TO TRANSMIT PICTURES WITH 128 PIXELS
                 * ON 128 LINES. PICTURE WILL BE SCANNED BACKWARDS
                 ***********************************************************
                 *
          8010 A PIA     EQU    H'8010         ENHANCEMENT PROGRAM SPECIAL CARD
0962      00     PIXCT   FCB    0              PIXEL COUNTER BYTE
0963      00     LINCT   FCB    0              LINE COUNTER BYTE
0964      0000 A XSAV    FDB    0              TEMP INDEX REGISTER STORAGE
                 *
0966  8D 5D      TRANS   BSR    LOPL           INITALIZE COUNTERS
0968  CE 1000 A          LDX    #PICTS         START OF PICTURE SCAN
096B  FF 0964 A          STX    XSAV           SAVE FOR TEMP. USE
096E  A6 00      TRANS1  LDAA   X              GET 2 PIXELS FROM MEMORY
0970  84 F0              ANDA   #H'F0          MASK OUT 2ND PIXEL
0972  01                 NOP                   DELAY FOR ASLA INSTRUCTIONS
0973  01                 NOP                   WHICH WILL BE EXECUTED
0974  01                 NOP                   DURING FORMATTING OF NEXT
0975  01                 NOP                   NIBBLE
0976  8A 01              ORAA   #H'01          TURN OFF SSTV SYNC FREQ
0978  B7 8010 A          STAA   PIA            EXECUTE INSTRUCTION
097B  8D 6E              BSR    DELAY          DELAY 1 PIXEL TIME
097D  8D 55              BSR    AD64           FIND PIXEL ON NEXT LINE
097F  7A 0962 A          DEC    PIXCT          DECREMENT PIXEL COUNTER
0982  27 02              BEQ    TRANS2         LOOK FOR LAST PIXEL
0984  20 E8              BRA    TRANS1         COMPLETE FOR ALL PIXELS
0986  86 80      TRANS2  LDAA   #H'80          RESET PIXEL COUNTER
0988  B7 0962 A          STAA   PIXCT          SAVE IN COUNTER
098B  7A 0963 A          DEC    LINCT          DECREMENT LINE COUNTER
098E  27 3E              BEQ    TRANSE         END OF PICTURE TRANSMISSION
0990  BD 03C6 A          JSR    H'03C6         XMIT HORIZ SYNC PULSE
0993  FE 0964 A          LDX    XSAV           GET LAST ADDRESS
0996  A6 00      TRANS3  LDAA   X              TRANSMIT OTHER NIBBLE
0998  84 0F              ANDA   #H'0F          FORMAT OTHER NIBBLE
099A  48                 ASLA                  SHIFT LEFT 4 TIMES
099B  48                 ASLA
099C  48                 ASLA
099D  48                 ASLA
099E  8A 01              ORAA   #H'01          TURN OFF SYNC BIT
09A0  B7 8010 A          STAA   PIA
09A3  8D 46              BSR    DELAY          DELAY 1 PIXEL TIME
09A5  8D 2D              BSR    AD64           ADD A LINE OF PIXELS TO INDEX
09A7  7A 0962 A          DEC    PIXCT          DECREMENT PIXEL COUNTER
09AA  27 02              BEQ    TRANS4         IS IT THE LAST PIXEL ?
09AC  20 E8              BRA    TRANS3         DO IT AGAIN
09AE  7A 0963 A  TRANS4  DEC    LINCT          DECREMENT LINE COUNTER
09B1  27 1B              BEQ    TRANSE         END OF TRANSMISSION ?
09B3  86 80              LDAA   #H'80          128 DECIMAL
09B5  B7 0962 A          STAA   PIXCT          SAVE IN PIXEL COUNTER
09B8  BD 03C6 A          JSR    H'03C6         XMIT HORIZ SYNC PULSE
09BB  FE 0964 A          LDX    XSAV           LOAD INDEX REGISTER
09BE  08                 INX
09BF  01         TRANS5  NOP                   BYTE FOR PROG MODIFICATIONS
09C0  FF 0964 A          STX    XSAV           SAVE INDEX REGISTER
09C3  20 A9              BRA    TRANS1
                 *
                 * INITALIZE COUNTERS FOR XMIT 90 DEG PROG
                 *
09C5  86 80      LOPL    LDAA   #H'80          INITALIZE COUNTERS TO 128
09C7  B7 0962 A          STAA   PIXCT
09CA  B7 0963 A          STAA   LINCT
09CD  39                 RTS
                 *
                 * TRANSMISSION END
                 *
09CE  BD 03E1 A  TRANSE  JSR    H'03E1         XMIT A VERTICAL SYNC PULSE
09D1  39                 RTS
                 *
                 * ADD 64 OR 128 TO INDEX.ROUTINE IS ENTERED WITH
                 * THE ADDRESS IN X AND THE VALUE TO ADDED AT
                 * AD64C+1
                 *
09D2      0000 A TEMP    FDB    0              USED FOR X TEMP STORAGE
                 *
09D4  FF 09D2 A  AD64    STX    TEMP           SAVE INDEX
09D7  B6 09D3 A          LDAA   TEMP+1
09DA  8B 40      AD64C   ADDA   #H'40          ADD 64 TO ACCUM
09DC  B7 09D3 A          STAA   TEMP+1         STORE IN INDEX SAVE
09DF  25 04              BCS    AD64A          CHECK FOR CARRY
09E1  FE 09D2 A  AD64B   LDX    TEMP           NEW INDEX VALUE
09E4  39                 RTS                   RETURN
09E5  7C 09D2 A  AD64A   INC    TEMP           ADD 1 TO HIGH NIBBLE
09E8  20 F7              BRA    AD64B          BRANCH TO RETURN
                 *
                 * DELAY ROUTINE FOR 90 DEG XMIT
                 *
09EA      39     DEL     FCB    H'39           DELAY CONSTANT
09EB  B6 09EA A  DELAY   LDAA   DEL
09EE  4A         DEL1    DECA
09EF  26 FD              BNE    DEL1
09F1  39                 RTS
                 *
                 ***********************************************************
                 * MENU FOR ROTATE ROUTINES
                 ***********************************************************
                 *
09F2      1016 A MENU    FDB    H'1016         CLEAR SCREEN HOME UP
09F4      3030           FCC    /0=PRINT,1=128 PIX-LINE/
09F6      5052
09F8      494E
09FA      542C
09FC      3130
09FE      3132
0A00      3820
0A02      5049
0A04      5820
0A06      4C49
0A08      4E45
0A0A      0A0D A         FDB    H'0A0D         LF/CR
0A0C      3230           FCC    /2=256 PIX-LINE/
0A0E      3235
0A10      3620
0A12      5049
0A14      5820
0A16      4C49
0A18      4E45
0A1A      0A0D A         FDB    H'0A0D
0A1C      3330           FCC    /3=ROTATE 128 PIX-LINE/
0A1E      524F
0A20      5441
0A22      5445
0A24      2031
0A26      3238
0A28      2050
0A2A      4958
0A2C      204C
0A2E      494E
0A30      45
0A31      0A0D A         FDB    H'0A0D
0A33      3430           FCC    /4=UPON 128,5=UPON 256/
0A35      5550
0A37      4F4E
0A39      2031
0A3B      3238
0A3D      2C35
0A3F      3D55
0A41      5044
0A43      4E20
0A45      3235
0A47      36
0A48      0A0D A         FDB    H'0A0D
0A4A      3630           FCC    /6=ROT 256 PIX-LINE/
0A4C      524F
0A4E      5420
0A50      3235
0A52      3620
0A54      5049
0A56      5820
0A58      4C49
0A5A      4E45
0A5C      0A0D A         FDB    H'0A0D
0A5E      3730           FCC    /7=LETERS 256/
0A60      4C45
0A62      5445
0A64      5253
0A66      2032
0A68      3536
0A6A      0A0D A         FDB    H'0A0D
0A6C      04             FCB    H'04
                 *
                 ***********************************************************
                 * MAIN LINE PROGRAM FOR ADDING A LINE OF CHARACTERS TO
                 * A SSTV PICTURE. CHARACTERS ARE ADDED TO THE PICTURE
                 * WITH OR WITHOUT BACKGROUND. UP TO 9 LINES OF 9
                 * CHARACTERS CAN BE ADDED ( 81 TOTAL ) TO A SSTV PICTURE
                 * ROUTINE USES A DOT AND TRANSLATE TABLE WITH LOWER CASE
                 * DOTS EXACTLY LIKE SSTV3,4 PROGRAMS ONLY LOCATED AT ADDRESS
                 * 0D00 THROUGH 0F00
                 ***********************************************************
                 *
0A6D  CE 0AF4 A  CHART   LDX    #MENU1         ENTER 9 CHAR MENU
0A70  BD E07E A          JSR    OUT            PRINT MENU ON CRT
0A73  CE 0020 A          LDX    #CHBUF         ADDRESS OF CHARACTER BUFFER
0A76  C6 09              LDAB   #H'9           SET B TO 9
0A78  BD E1AC A  CHAR1   JSR    INEEE          GET A K/B INPUT
0A7B  A7 00              STAA   X              STORE RESPONCE IN BUFFER
0A7D  08                 INX                   SETUP FOR NEXT CHARACTER
0A7E  5A                 DECB                  DEC CHARACTER COUNT
0A7F  26 F7              BNE    CHAR1          GET ANOTHER CHAR
0A81  CE 0B51 A          LDX    #MENU6         BACKGROUND YES OR NO ?
0A84  BD E07E A          JSR    OUT            OUTPUT MESSAGE
0A87  BD E1AC A          JSR    INEEE          GET K/B RESPONSE
0A8A  81 59              CMPA   #H'59          CHECK FOR A Y CHARACTER
0A8C  27 5F              BEQ    CHARB          IF A Y BRANCH,ENTER A LINE OF BACK
0A8E  4F                 CLRA                  IF NOT CLEAR A
0A8F  20 5E              BRA    CHAR9          ANYOTHER RESP. ? BRANCH
0A91  CE 0B23 A  CHAR7   LDX    #MENU3         BACKGROUND BLACK OR WHITE ?
0A94  BD E07E A          JSR    OUT            OUTPUT MESSAGE
0A97  BD E1AC A          JSR    INEEE          GET K/B RESPONCE
0A9A  81 42              CMPA   #H'42          IS IT A B ?
0A9C  27 42              BEQ    CHAR2          IF SO BRANCH TO CHAR2
0A9E  81 57              CMPA   #H'57          IS IT A W ?
0AA0  27 44              BEQ    CHAR3          IF SO BRANCH TO CHAR3
0AA2  CE 0B35 A  CHAR5   LDX    #MENU4         ENTER LINE # 0 TO 8
0AA5  BD E07E A          JSR    OUT
0AA8  BD E1AC A          JSR    INEEE
0AAB  81 38              CMPA   #H'38
0AAD  22 F3              BHI    CHAR5          BRANCH IF LINE # > 8
0AAF  84 0F              ANDA   #H'0F          MASK OUT HIGH NIBBLE
0AB1  CE 0B60 A          LDX    #CHAR10        ADDRESS OF LINE JUMP TABLE
0AB4  48                 ASLA                  MULTIPLE LINE NUMBER BY 2
0AB5  B7 0AB9 A          STAA   CHAR6+1        MODIFY CODE OF STAA X
0AB8  EE 00      CHAR6   LDX    X              FIND ADDRESS OF LINE IN PICTURE
0ABA  FF 0B73 A          STX    ENTER+1        MODIFY CODE OF LDX INSTRUCTION
0ABD  CE 0B10 A          LDX    #MENU2         IS ENTRY OK MENU
0AC0  BD E07E A          JSR    OUT
0AC3  BD E1AC A          JSR    INEEE
0AC6  81 59              CMPA   #H'59          IS RESPONSE A Y (YES)
0AC8  26 A3              BNE    CHART          IF NOT A Y GET A NEW LINE OF CHAR
0ACA  BD 0B47 A          JSR    BACK           ADD BACKGROUND TO PICTURE
0ACD  BD 0B72 A          JSR    ENTER          ENTER CHARACTERS INTO PICTURE
0AD0  CE 0B42 A          LDX    #MENU5         ASK FOR ANY MORE CHARACTERS ?
0AD3  BD E07E A          JSR    OUT
0AD6  BD E1AC A          JSR    INEEE
0AD9  81 59              CMPA   #H'59          IS K/B ENTRY A Y ?
0ADB  27 90              BEQ    CHART          IF Y BRANCH TO BEGINNING
```

Continued

program works would be very complex and take many pages. As you can see from the source code, I have included many comments on each subroutine and on how they function. I suggest that if you wish to convert my code to another processor, you should study the code very carefully. A brief description of each routine follows:

1. *CHART*: This is the main line routine for the selection of all titling. The routine prompts the operator by asking questions. All responses are either numbers, y for yes, or n for no. If you wish to experiment with gray level lettering, the byte at OAE7 can be changed from FF (white) to another gray level. Photo 6 is an example of the routines menu-displayed on the TV monitor.

2. *CHAR10*: This is a jump table which tells the program where, in the 16K picture region, the lines of titling are to be inserted.

3. This routine is the main line for the entry of picture dots into the SSTV picture in computer memory. The 9 characters to be entered are stored in ASCII in a small buffer *(CHBUF)* at address 20. The routine loops nine times to enter each character's dots into the picture.

4. *FSLA*: This is the first routine called by *ENTER*. The routine is entered with an ASCII character in the A accumulator and exits with the address of its picture dots in ADR. The routine uses self-modifying code to add the offset of the translate table to the index register, to find the character dot's address.

5. *FILL*: The next routine called by *ENTER* is *FILL*. This routine takes the seven bytes of the character 5 x 7 dot matrix and places it into a 7-character buffer *(BUFF)* located at address 2F.

6. *LOAD*: This routine is the most complex of the character generator routines and calls for two other subroutines. *LOAD* increments through *BUFF* one byte at a time, calling *PLACE* and *DOTX*. *PLACE* ANDs a mask over the byte, which contains the character dots of one character scan line. After ANDing the mask, *DOTX* is called and a test is made

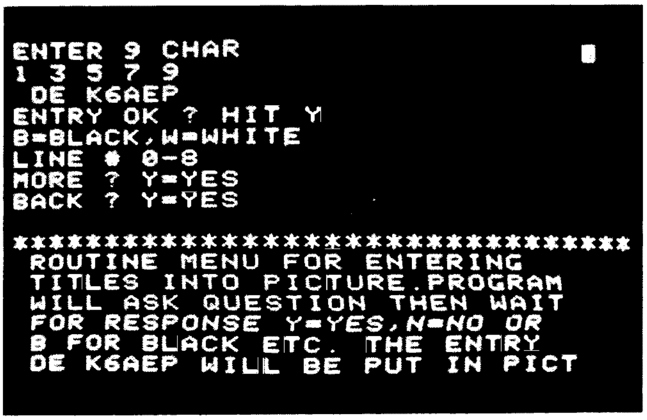


Photo 6. TV menu for titling routine.

```
0AD0  7E 02F5 A           JMP    H'02F5         IF SO BRANCH TO TRANSMIT SSTV PICTURE
                   *
                   * CONSTANT MODIFICATION ROUTINES
                   *
0AE0  4F           CHAR2  CLRA
0AE1  B7 0033 A           STAA   DOTG           GRAY LEVEL OF PICTURE DOTS
0AE4  20 0C               BRA    CHAR5
0AE6  86 FF        CHAR3  LDAA   #H'FF          WHITE DOTS
0AE8  B7 0033 A           STAA   DOTG           GRAY LEVEL OF PICTURE DOTS
0AEB  20 05               BRA    CHAR5
0AED  86 FF        CHAR8  LDAA   #H'FF          DOT MASK
0AEF  B7 0034 A    CHAR9  STAA   DOTM           DOT MASK CONSTANT
0AF2  20 90               BRA    CHAR7
                   *
                   ****************************************************************
                   * MENU OF MESSAGES FOR ENTRY OF CHARACTERS INTO SSTV PICTURE
                   ****************************************************************
                   *
0AF4     1C16 A    MENU1  FCB    H'1C16         HOME UP CLEAR SCREEN
0AF6     454E             FCC    /ENTER 9 CHAR/
0AF8     5445
0AFA     5220
0AFC     3920
0AFE     4348
0B00     4152
0B02     0A0D A           FDB    H'0A0D         CR/LF
0B04     3120             FCC    /1 3 5 7 9/
0B06     3320
0B08     3520
0B0A     3720
0B0C     39
0B0D     0A0D A           FDB    H'0A0D
0B0F     04               FCB    H'04           END
0B10     0A0D A    MENU2  FDB    H'0A0D
0B12     454E             FCC    /ENTRY OK ? HIT Y/
0B14     5452
0B16     5920
0B18     4F4B
0B1A     203F
0B1C     2048
0B1E     4954
0B20     2059
0B22     04               FCB    H'04
0B23     0A0D A    MENU3  FDB    H'0A0D
0B25     4230             FCC    /B=BLACK,W=WHITE/
0B27     424C
0B29     4143
0B2B     4B2C
0B2D     573D
0B2F     5748
0B31     4954
0B33     45
0B34     04               FCB    H'04
0B35     0A0D A    MENU4  FDB    H'0A0D
0B37     4C49             FCC    /LINE # 0-8/
0B39     4E45
0B3B     2023
0B3D     2030
0B3F     2038
0B41     04               FCB    H'04
0B42     0A0D A    MENU5  FDB    H'0A0D
0B44     404F             FCC    /MORE ? Y=YES/
0B46     5245
0B48     203F
0B4A     2059
0B4C     3D59
0B4E     4553
0B50     04               FCB    H'04
0B51     0A0D A    MENU6  FDB    H'0A0D
0B53     4241             FCC    /BACK ? Y=YES/
0B55     434B
0B57     203F
0B59     2059
0B5B     3D59
0B5D     4553
0B5F     04               FCB    H'04
                   *
                   ****************************************************************
                   * JUMP TABLE TO DETERMINE ADDRESS IN THE PICTURE WHERE
                   * PICTURE LINES ARE TO BE INSERTED
                   ****************************************************************
                   *
0B60     1102 A    CHAR1C FDB    H'1102         LINE 0 ADDRESS
0B62     1802 A           FDB    H'1802         LINE 1
0B64     1F02 A           FDB    H'1F02         LINE 2
0B66     2602 A           FDB    H'26C2         LINE 3
0B68     2D02 A           FDB    H'2C02         LINE 4
0B6A     3402 A           FDB    H'3402         LINE 5
0B6C     3B02 A           FDB    H'3BC2         LINE 6
0B6E     4202 A           FDB    H'4202         LINE 7
0B70     4902 A           FDB    H'4902         LINE 8
                   *
                   ****************************************************************
                   * ENTER A LINE OF CHARACTERS INTO A SSTV PICTURE MAIN LINE
                   ****************************************************************
                   *
0B72  CE 1C00 A    ENTER  LDX    #H'1C00        START ADDRESS OF PICTURE
0B75  DF 20               STX    CHAR           SAVE IN CHAR
0B77  DF 3A               STX    SAVE           ALSO SAVE IN SAVE
0B79  CE 0020 A           LDX    #CHBUF         ADDRESS OF CHARACTER BUFFER
0B7C  DF 29               STX    XSAV1          SAVE FOR USE LATER
0B7E  C6 09               LDAB   #H'C9          9 CHARCATERS/LINE
0B80  D7 3A               STAB   BYTE1          SAVE IN BYTE1
0B82  DE 29        ENR1   LDX    XSAV1          FIND ADDRESS IN BUFFER
0B84  A6 00               LDAA   X              GET CHARACTER (ASCII CODE)
0B86  08                  INX                   SET UP FOR NEXT CHARACTER
0B87  DF 29               STX    XSAV1          STORE ADDRESS
0B89  8D 19               BSR    FSLA           FIND ADDRESS OF PICTURE DOTS
0B8B  8D 3E               BSR    FILL           LOAD CHARACTER DOTS IN A BUFFER
0B8D  BD 0C05 A           JSR    LOAD           LOAD DOTS IN PICTURE
0B90  7A 003A A           DEC    BYTE1          DEC BYTE COUNTER
0B93  27 0E               BEQ    ENR3           TEST FOR LAST BYTE
0B95  DE 3A               LDX    SAVE           GET CHARACTER ADDRESS IN PICTURE
0B97  86 0E               LDAA   #H'0E          14 DOTS FOR A CHARACTER SPACE
0B99  08           ENR2   INX                   ADD 14 TO X
0B9A  4A                  DECA
0B9B  26 FC               BNE    ENR2
0B9D  DF 20               STX    CHAR           NEW CHARACTER ADDRESS
0B9F  DF 3A               STX    SAVE
0BA1  20 DF               BRA    ENR1           STORE NEXT CHARACTER IN PICTURE
0BA3  39           ENR3   RTS                   RETURN TO MAIN LINE
                   *
                   ****************************************************************
                   * FSLA - FIND ADDRESS OF PICTURE DOTS AND PLACE RESULTS
                   * IN ADR. ACCUM A IS LOADED WITH ASCII CHARACTER PRIOR
                   * TO EXECUTION OF THE ROUTINE. ROUTINE ASSUMES THAT THE
                   * TRANS/DOT TABLE IS LOCATED AT ADDR 0000 THRU 0F00
                   ****************************************************************
                   *
         0000 A    LETAC  EQU    H'0000         START OF TRANSLATE/DOT TABLE
         0E00 A    NUMAD  EQU    H'0E00         ADDRESS OF NUMBER DOTS IN TABLE
                   *
0BA4  97 37        FSLA   STAA   BYTE           SAVE A IN BYTE
0BA6  84 3F               ANDA   #H'3F          MASK OUT TWO HIGH ORDER BITS
0BA8  CE 0000 A           LDX    #LETAC         ADDRESS OF TABLE
0BAB  B7 0BAF A           STAA   FSLA1+1        MODIFY CODE OF FSLA1
0BAE  E6 00        FSLA1  LDAB   X              FIND OFFSET IN TABLE
0BB0  96 37               LDAA   BYTE           RESTORE ASCII CHARACTER IN A
0BB2  84 40               ANDA   #H'40          MASK OUT ALL BUT ONE BIT
0BB4  81 40               CMPA   #H'40          IS CHARACTER A LETTER
0BB6  27 0A               BEQ    FSLA2          BRANCH IF A LETTER
0BB8  F7 0BBD A           STAB   FSLA3+2        ADD DISPLACEMENT TO MODIFY CODE
0BBB  CE 0E00 A    FSLA3  LDX    #NUMAD         FIND ADDRESS OF NUMBER DOTS
0BBE  DF 28               STX    ADR            SAVE ADDRESS IN ADR
0BC0  20 08               BRA    FSLA5          RETURN
0BC2  F7 0BC7 A    FSLA2  STAB   FSLA4+2        MODIFY CODE TO FIND ADDRESS
0BC5  CE 0000 A    FSLA4  LDX    #LETAC         ADDRESS OF LETTER DOTS IN TABLE
0BC8  DF 28               STX    ADR            SAVE RESULTS IN ADR
0BCA  39           FSLA5  RTS
                   *
                   ****************************************************************
                   * FILL - PLACE CHARACTER DOTS IN A BUFFER
                   ****************************************************************
                   *
0BCB  C6 07        FILL   LDAB   #H'7           NUMBER OF BYTES OF CHAR DOTS
0BCD  CE 002F A           LDX    #BUFF          ADDRESS OF BUFFER
0BD0  FF 0964 A           STX    XSAV           SAVE  ADDRESSS
0BD3  DE 28        FILL1  LDX    ADR            LOAD ADDRESS OF DOTS IN X
0BD5  A6 00               LDAA   X              FIND FIRST BYTE OF CHAR DOTS
0BD7  08                  INX                   NEXT BYTE ADR
0BD8  DF 28               STX    ADR            SAVE IN ADR
0BDA  FE 0964 A           LDX    XSAV           GET BUFFER CHAR ADDRESS
0BDD  A7 00               STAA   X              SAVE IN BUFFER
0BDF  08                  INX                   NEXT BUFFER ADDRESS
0BE0  FF 0964 A           STX    XSAV           SAVE ADDRESS
0BE3  5A                  DECB                  DECREMENT BYTE COUNTER
0BE4  26 ED               BNE    FILL1          IF NOT ZERO DO IT AGAIN
0BE6  39                  RTS                   RETURN
                   *
                   ****************************************************************
                   * CHARACTER GENERATOR PLACE DOTS IN SSTV PICTURE
                   * PLACE ROUTINE HANDLES TWO SCAN LINES AT A TIME
                   * AND PLACES 5 CHARACTER DOTS ACROSS THE HORIZONTAL
                   ****************************************************************
                   *
0BE7  86 80        PLACE  LDAA   #H'80          LOOK AT HIGH ORDER BIT
0BE9  8D 11               BSR    PLACE1         PLACE IT IN THE PICTURE IF BIT=1
0BEB  86 40               LDAA   #H'40          NEXT BIT
0BED  8D 0D               BSR    PLACE1
0BEF  86 20               LDAA   #H'20
0BF1  8D 09               BSR    PLACE1
0BF3  86 10               LDAA   #H'10
0BF5  8D 05               BSR    PLACE1
0BF7  86 08               LDAA   #H'C8
0BF9  8D 01               BSR    PLACE1
0BFB  39                  RTS
                   *
                   * PLACE1 SUBROUTINE
                   *
0BFC  97 36        PLACE1 STAA   MASK           STORE BIT MASK
0BFE  96 37               LDAA   BYTE           GET DOTS OF BYTE TO BE LOADED
0C00  8D 31               BSR    DOTX           LOAD DOTS IN PICTURE
0C02  08                  INX                   NEXT PICTURE ADDRESS
0C03  08                  INX
0C04  39                  RTS                   RETURN
                   *
                   ****************************************************************
                   * LOAD DOTS IN PICTURE
                   * CHAR DOTS IN THE BUFFER AND PLACES ITS DOTS IN
                   * THE SSTV PICTURE ON THE CORRECT POSITION AND LINE
                   ****************************************************************
                   *
0C05  96 2F        LOAD   LDAA   BUFF           LOAD A WITH THE CHAR DOTS
0C07  8D 19               BSR    ADD            ADD TO PICTURE
0C09  96 30               LDAA   BUFF+1         NEXT VERT LINE OF CHAR DOTS
0C0B  8D 15               BSR    ADD            ADD TO PICTURE
0C0D  96 31               LDAA   BUFF+2
0C0F  8D 11               BSR    ADD
0C11  96 32               LDAA   BUFF+3
0C13  8D 0D               BSR    ADD
0C15  96 33               LDAA   BUFF+4
0C17  8D 09               BSR    ADD
0C19  96 34               LDAA   BUFF+5
0C1B  8D 05               BSR    ADD
0C1D  96 35               LDAA   BUFF+6
0C1F  8D 01               BSR    ADD
0C21  39                  RTS
                   * ADD SUBROUTINE
0C22  97 37        ADD    STAA   BYTE           STORE BOTS IN BYTE
0C24  DE 20               LDX    CHAR           LOAD INDEX WITH CHARACTER ADDR.
0C26  8D BF               BSR    PLACE          PLACE DOTS IN THE PICTURE
0C28  DE 20               LDX    CHAR
0C2A  BD 0904 A           JSR    AD64           ADD 128 TO INDEX REGISTER
0C2D  BD 0904 A           JSR    AD64
0C30  DF 20               STX    CHAR
0C32  39                  RTS
                   *
                   ****************************************************************
                   * ROUTINE TO STORE DOTS IN A PICTURE - GRAY LEVEL OF DOTS
                   * IS STORED IN DOTG AND DOT MASK IS STORED IN DOTM PRIOR TO
                   * CALLING THIS ROUTINE
                   ****************************************************************
                   *
0C33        FF     DOTG   FCB    H'FF           WHITE DOTS (2 PIXELS)
0C34        00     DOTM   FCB    0              MASK TO BE OVERLAYED ON DOT BYTE
                   *
0C35  94 36        DOTX   ANDA   MASK           AND MASK WITH DOTS
0C37  26 01               BNE    DOT1           IF NOT ZERO ADD DOTS TO THE PICTURE
0C39  39           DOT11  RTS                   RETURN
```

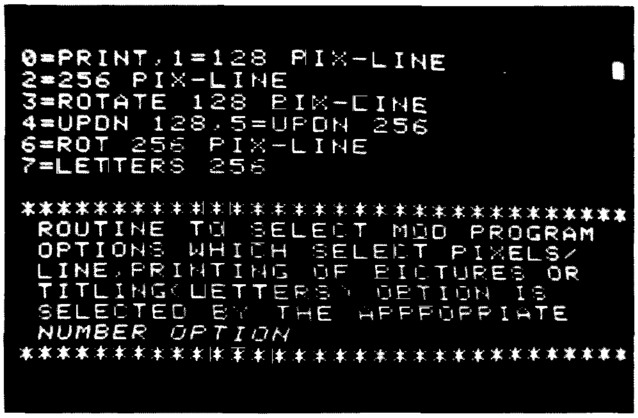


Photo 7. TV menu for program option selection.

for zero. If the results are zero, a return from subroutine is executed. If the results are not zero, the gray level byte *DOTG* is loaded in the A accumulator and stored indexed at 4 locations (X, X+1, X+128, and X+129). This is the format of one picture dot. The mask is then placed over scan line dot byte 5 times for each horizontal dot position and *DOTX* is called. The whole process is repeated for all 7 bytes of character dots.

7. *BACK*: The *BACK* routine is used to insert scan lines of background into the picture, onto which characters can be overlaid. This routine is selected by use of the *CHART* routine.

64 Gray Level Program

For those of you interested in duplicating my experiment with picture gray levels, the software is included in Fig. 3. The routine was assembled to run in more than 20K of memory. The routine includes a mini-monitor, and four program options can be selected to allow coresident operation with the other software. The software is well commented and requires no additional discussion. One patch must be included if you plan to use the routine. The jump-to-print option of the MOD routine must be changed to jump to this routine (see statement 766) of the source code.

The routine options can be selected by typing:

R = Receive a picture into memory (64 gray levels).

X = Xmit a picture from memory 4 times (64 gray levels).

P = Print a picture from memory formatted by 128/128 or 256/128 with 16 gray levels.

M = Jump to the monitor at location 0F01.

System Requirements

Fig. 5 is a memory map of the entire programming

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```
0C3A  E6 0C33 A  DOT1     LDAA  DOTG        LOAD GRAY LEVEL OF THE DOTS
0C3D  A7 00               STAA  X           STORE AT CURRENT ADDRESS
0C3F  A7 01               STAA  1,X         STORE ALSO AT NEXT BYTE
0C41  A7 80               STAA  128,X       STORE ON NEXT SCAN LINE
0C43  A7 81               STAA  129,X       STORE AT NEXT SCAN LINE + 1
0C45  20 F2               BRA   DOT11
                 *
                 ***********************************************************
                 * ADD BACKGROUND TO THE SSTV PICTURE , IF SELECTED THE ROUTINE
                 * ADDS THE BACKGROUND TO 9 SCAN LINES IN THE PICTURE AND
                 * THE CHARACTER DOTS ARE THEN OVERLAYED ON TOP OF THE
                 * BACKGROUND
                 ***********************************************************
                 *
0C47  7D 0C34 A  BACK     TST   DOTM        IS THE BACKGROUND MASK ZERO ?
0C4A  27 0A               BEQ   BACK3       IF SO ADD NO BACKGROUND
0C4C  FE 0873 A           LDX   ENTER+1     GET STARTING ADDRESS OF CHAR LINE
0C4F  C6 09               LDAB  #H'9        NUMBER OF SACN LINES FOR BACKG.
0C51  8D 04      BACK2    BSR   BACK1       ADD TO PICTURE
0C53  5A                  DECB              DEC COUNTER
0C54  26 FB               BNE   BACK2       IF NOT ZERO BRANCH
0C56  39         BACK3    RTS               RETURN
                 *
0C57  C6 80      BACK1    LDAA  #H'80       128 CONSTANT
0C59  37                  PSHB              SAVE B
0C5A  36         BACK11   PSHA              SAVE A
0C5B  B6 0C33 A           LDAA  DOTG        GET DOT GRAY LEVEL
0C5E  43                  COMA              1'COMP OF GRAY LEVEL
0C5F  A7 00               STAA  X           STORE IN PICTURE
0C61  08                  INX               NEXT ADDRESS IN PICTURE
0C62  32                  PULA              RESTORE A
0C63  4A                  DECA              DEC A
0C64  26 F4               BNE   BACK11      IF NOT 128 BYTES DO IT AGAIN
0C66  33                  PULB              RESTORE B
0C67  39                  RTS
                 *
                 ***********************************************************
                 * OPTIONAL ROUTINE TO RECEIVE AND TRANSMIT SSTV PICTURES
                 * WITH 64 GRAY LEVELS AND 128 PIXELS/LINE AND 128 LINES
                 * ROUTINES CALL SUBROUTINES USED IN THE SSTV5 (ENHANCEMENT
                 * PROGRAM)
                 * ROUTINES FORMAT 1 BYTE/PIXEL AND REQUIRES 16K FOR 1 SSTV PICT
                 ***********************************************************
                 *
         01C0 A  DEL3     EQU   H'01C0      GENERAL PURPOSE DELAY ROUTINE
         0128 A  GETA     EQU   H'0128      GET A PIXEL AND PLACE IN A ACCUM
         0186 A  INIT     EQU   H'0186      INITALIZE PIA FOR PROPER STATES
         01F3 A  HORIZ    EQU   H'01F3      WAIT FOR HORIZ SYNC PULSE
         0215 A  VERT     EQU   H'0215      WAIT FOR VERT SYNC PULSE
         0158 A  TEMP1    EQU   H'0158      TEMP BYTE STORAGE IN SSTV5
         0185 A  CNT3     EQU   H'0185      TEMP INDEX REGISTER STORAGE IN SSTV5
         03E1 A  SVERT    EQU   H'03E1      XMIT A VERT SYNC PULSE
         03C6 A  SHORIZ   EQU   H'03C6      XMIT A HORIZ VERT SYNC PULSE
                 *
5000                      ORG   H'5000      START ADDRESS ABOVE 20 K MEMORY
                 *
                 ***********************************************************
                 * RECV OR XMIT SSTV PICTURE WITH 64 GRAY LEVELS MAIN LINE
                 * ROUTINE
                 ***********************************************************
                 *
5000  BD 0186 A  START    JSR   INIT        INITALIZE PIA
5003  CE 5032 A           LDX   #MENU7      DISPLAY MESSAGES
5006  BD E07E A           JSR   OUT         OUTPUT DISPLAY
5009  BD E1AC A           JSR   INEEE       GET RESPONCE
500C  81 52               CMPA  #H'52       IS RESPONCE A LETTER R ?
500E  27 0F               BEQ   START1      IF SO BRANCH
5010  81 58               CMPA  #H'58       IS RESPONCE A LETTER X ?
5012  27 0E               BEQ   START2      IF SO BRANCH
5014  81 50               CMPA  #H'50       IS RESPONCE A LETTER P ?
5016  27 14               BEQ   START3      IF SO BRANCH
5018  81 4D               CMPA  #H'4D       IS RESPONCE A LETTER M ?
501A  27 13               BEQ   START4      IF SO BRANCH
501C  7E 07E0 A           JMP   MOD         IF NON OF THE ABOVE JUMP TO MOD
501F  7E 50A7 A  START1   JMP   RECV        RECEIVE AN SSTV PICTURE
5022  8D 46      START2   BSR   XMIT        TRANSMITT A SSTV PICTURE
5024  8D 44               BSR   XMIT
5026  8D 42               BSR   XMIT
5028  8D 40               BSR   XMIT
502A  20 D4               BRA   START
502C  7E 0228 A  START3   JMP   H'0228      PRINT A PICTURE
502F  7E 0F01 A  START4   JMP   H'0F01      JUMP TO MONITOR
                 *
                 * MENU FOR 64 GRAY LEVEL ROUTINES
                 *
5032     1016 A  MENU7    FDB   H'1016      HU/CR
5034     3634             FCC   /64 GRAY LEVEL VIDEO/
5036     2047
5038     5241
503A     5920
503C     4C45
503E     5645
5040     4C20
5042     5649
5044     4445
5046     4F
5047     0A0D A           FDB   H'0A0D
5049     523D             FCC   /R=RECV,X=XMIT,P=PRINT/
504B     5245
504D     4356
504F     2C58
5051     3D58
5053     4D49
5055     542C
5057     503D
5059     5052
505B     494E
505D     54
505E     0A0D A           FDB   H'0A0D
5060     4D3D             FCC   /M=MONIT/
5062     4D4F
5064     4E49
5066     54
5067     0A0D A           FDB   H'0A0D
5069     04               FCB   H'04
                 *
                 ***********************************************************
                 * XMIT A SSTV PICTURE 4 TIMES ROUTINE
                 * ALL SUBROUTNES CALLED ARE LOCATED IN SSTV5 (ENHANCEMENT PROGRAM)
                 ***********************************************************
                 *
506A  CE 1000 A  XMIT     LDX   #PICTS      LOAD START ADDR OF PICTURE
506D  7F 0185 A           CLR   CNT3        CLEAR PIXEL COUNTER
5070  7F 0158 A           CLR   TEMP1       CLEAR LINE COUNTER
5073  A6 00      XMIT1    LDAA  X           GET PIXEL
5075  8A 01               ORAA  #H'01       TURN OFF SYNC BIT
5077  B7 8010 A           STAA  PIA         TRANSMIT PIXEL
507A  08                  INX               SET UP FOR NEXT PIXEL
507B  8D 22               BSR   DELX        TRANSMIT PIXEL DELAY TIME
507D  7C 0185 A           INC   CNT3        INCRIMENT PIXEL COUNTER
5080  B6 0185 A           LDAA  CNT3        LOAD PIXEL COUNTER
5083  B1 50A5 A           CMPA  LINEH       IS IT THE 128 TH PIXEL ?
5086  26 EB               BNE   XMIT1       IF NOT BRANCH
5088  7C 0158 A           INC   TEMP1
508B  B6 0158 A           LDAA  TEMP1
508E  B1 50A6 A           CMPA  LINEV       IS IT THE LAST LINE ?
5091  26 04               BNE   XMIT2       IF NOT BRANCH
5093  BD 03E1 A           JSR   SVERT       XMIT A VERT SYNC PULSE
5096  39                  RTS
5097  BD 03C6 A  XMIT2    JSR   SHORIZ      XMIT A HORIZ SYNC PULSE
509A  7F 0185 A           CLR   CNT3        CLEAR PIXEL COUNTER
509D  20 D4               BRA   XMIT1       TRANSMIT PIXELS
                 *
                 * XMIT DELAY ROUTINE
                 *
509F  C6 41      DELX     LDAB  #H'41       DELAY CONSTANT
50A1  5A         DEL2     DECB              DECREMENT COUNTER
50A2  26 FD               BNE   DEL2        BRANCH IF NOT EQUAL
50A4  39                  RTS
                 *
                 ***********************************************************
                 * RECEIVE A SSTV PICTURE FORMATED FOR 64 GRAY LEVELS
                 ***********************************************************
                 *
50A5     80      LINEH    FCB   128         128 PIXELS PER LINE
50A6     7F      LINEV    FCB   127         128 LINES/PICTURE
                 *
50A7  7F 0185 A  RECV     CLR   CNT3        CLEAR PIXEL COUNTER
50AA  7F 0158 A           CLR   TEMP1       CLEAR LINE COUNTER
50AD  BD 0215 A           JSR   VERT        WAIT FOR VERT SYNC PULSE
50B0  CE 1000 A           LDX   #PICTS      PICTURE START ADDRESS
50B3  86 08               LDAA  #8          VERT SYNC PULSE DELAY
50B5  BD 01C0 A           JSR   DEL3        SSTV5 DELAY ROUTINE
50B8  BD 0128 A  RECV2    JSR   GETA        GETA PIXEL
50BB  84 3F               ANDA  #H'3F       MASK OUT VERT/HORIZ SYNC PULSES
50BD  48                  ASLA              FORMAT BYTE
50BE  48                  ASLA
50BF  A7 00               STAA  X           STORE IN PICTURE MEMORY
50C1  08                  INX               NEXT PIXEL
50C2  8D 24               BSR   DELR        RECEIVE DELAY ROUTINE
50C4  7C 0185 A           INC   CNT3        INCREMENT PIXEL COUNTER
50C7  B6 0185 A           LDAA  CNT3
50CA  B1 50A5 A           CMPA  LINEH       IS IT THE 128 TH PIXEL ?
50CD  26 E9               BNE   RECV2       IF NOT BRANCH
50CF  BD 01F3 A           JSR   HORIZ       WAIT FOR HORIZ SYNC PULSE
50D2  7C 0158 A           INC   TEMP1       INCREMENT LINE COUNTER
50D5  B6 0158 A           LDAA  TEMP1
50D8  B1 50A6 A           CMPA  LINEV       INCREMENT LINE COUNTER
50DB  26 03               BNE   RECV3       IS IT THE LAST LINE ?
50DD  7E 5000 A           JMP   START       RETURN TO START
                 *
50E0  BD 01F3 A  RECV3    JSR   HORIZ       WAIT FOR HORIZ SYNC PULSE
50E3  7F 0185 A           CLR   CNT3        CLEAR PIXEL COUNTER
50E6  20 D0               BRA   RECV2       GET NEXT PIXEL
                 *
                 * RECEIVE DELAY ROUTINE
                 *
50E8  86 23      DELR     LDAA  #H'23       RECEIVE DELAY CONSTANT
50EA  4A         DELR1    DECA              DECREMENT CONSTANT
50EB  26 FD               BNE   DELR1       BRANCH IF NOT ZERO
50ED  39                  RTS               RETURN
                 *
                 * MODIFICATIONS TO MOD ROUTINE IF MEMORY ALLOWES THE
                 * USE OF THIS ROUTINE > 20K
                 *
081C                      ORG   H'081C      JUMP FOR PRINT ROUTINE
081C     5000 A           FDB   START       JUMP TO START
                          END

SYMBOL TABLE:

AD64    0904 A   AD64A   09E5 A   AD64B   09E1 A   AD64C   09CA A
ADD     0C22 A   ADR     0028 A   AGN     C91C A   BACK    0C47 A
BACK1   0C57 A   BACK11  0C5A A   BACK2   0C51 A   BACK3   0C56 A
BUFF    002F A   BYTE    0C37 A   BYTE1   003A A   CHAR    002C A
CHAR1   0A78 A   CHAR10  C86C A   CHAR2   0AE0 A   CHAR3   CAE6 A
CHAR5   0AA2 A   CHAR6   0AB6 A   CHAR7   0A91 A   CHAR8   CAE0 A
CHAR9   0AEF A   CHART   0A6D A   CHBUF   C020 A   CNT3    0185 A
DEL     09EA A   DEL1    09EE A   DEL2    50A1 A   DEL3    01C0 A
DELAY   09E8 A   DELR    50E8 A   DELR1   50EA A   DELX    509F A
DOT1    0C3A A   DOT11   0C39 A   DOTG    0C33 A   DOTM    0C34 A
DOTX    0C35 A   ENR1    0B82 A   ENR2    0B99 A   ENR3    CBA3 A
ENTER   0872 A   FILL    0ACB A   FILL1   0B03 A   FSLA    0B44 A
FSLA1   0BAE A   FSLA2   03C2 A   FSLA3   CBB8 A   FSLA4   CBC5 A
FSLA5   0BCA A   GETA    0128 A   HORIZ   01F3 A   INEEE   E1AC A
INIT    0186 A   LOPL    C9C5 A   LETAC   C0C0 A   LINCT   0963 A
LINEH   50A5 A   LINEV   50A6 A   LOAD    0CC5 A   MASK    CC36 A
MENU    09F2 A   MENU1   0AF4 A   MENU2   0B10 A   MENU3   0B23 A
MENU4   0835 A   MENU5   C842 A   MENU6   C851 A   MENU7   5032 A
MOD     07E0 A   NUMAO   0E00 A   OUT     E07E A   PIA     8010 A
PICTE   2FFF A   PICTS   1C00 A   PIX1    082C A   PIX2    081F A
PIX22   0897 A   PIX3    C81E A   PIX4    C821 A   PIX5    C824 A
PIX6    0827 A   PIX7    082A A   PIXCT   0962 A   PLACE   C8E7 A
PLACE1  0BFC A   PRINT   0B1B A   RECV    50A7 A   RECV2   50B8 A
RECV3   50E0 A   RJT     093A A   RJT1    C945 A   SAVE    CC38 A
SHORIZ  03C6 A   START   5000 A   START1  501F A   START2  5022 A
START3  502C A   START4  502F A   SVERT   03E1 A   TEMP    0902 A
TEMP1   0158 A   TRANS   0966 A   TRANS1  096E A   TRANS2  C5E6 A
TRANS3  C956 A   TRANS4  C9AE A   TRANS5  09BF A   TRANS9  0378 A
TRANSF  09CE A   UDL28   C5CA A   LD256   C932 A   VERT    C215 A
XMIT    506A A   XMIT1   5073 A   XMIT2   5097 A   XSAV    C964 A
XSAV1   0C29 A

CHECKSUM = F4F8

LENGTH OF CSECT =     0 (0000)
LENGTH OF ISECT =     0 (0000)
```

package. As discussed earlier, the memory requirements range from 12K to 24K, depending on the program features required.

Two MIKBUG-type calls are made from the software package:

INEEE (E1AC)—Input a character from the keyboard into the A accumulator.

OUT (E07E)—Output an ASCII string from memory to the display until a 04 hex is reached.

If another CPU card speed is used which differs from the basic SWTPC 6800 clock (1.7971 MHz), a number of program delay functions must be changed. Table 1 is a list of these constants. Other delay constants may have to be changed, however. These values are contained in my most recent articles.[1]

The operation of the program is quite simple. In order to select all of the enhancement modifications (see Photo 7), the print function should be used in the enhancement program. If the 64 gray level program is installed, it can be selected by the print option in the MOD menu. As in the basic enhancement program, the start address is 0F01. This should be loaded in address A048,49 and the letter G typed, to execute the program.

Acknowledgments

The development of this program took a fair

Name	Address (Hex)	Value
60 Hz receive delay 256 pix	08A8	06
50 Hz receive delay 256 pix	08B5	01
90 degrees xmit delay	09EA	39
64 gray level xmit delay	50A0	41
64 gray level receive delay	50E9	23

Table 1.

References

1. "SSTV Meets SWTPC," November and December, 1978, *73 Magazine*, C.W. Abrams K6AEP.
2. Robot 400 scan converter, Robot Research, Inc., 7591 Convoy Court, San Diego CA 92111.
3. "MXV 100 Monitor," *Slow Scan Television Handbook*, Don C. Miller W9NTP and Ralph Taggart WB8DQT, a *73 Magazine* publication.
4. "SSTV Meets the SWTPC 6800," June, 1977, *73 Magazine*, C.W. Abrams K6AEP.
5. "Title Pictures With A Micro," October, 1977, *73 Magazine*, C.W. Abrams K6AEP.
6. G.N. Chapman VK2AIT, 70 Cliff Road, Epping, N.S.W. 2141 Australia.

Nov. 1979

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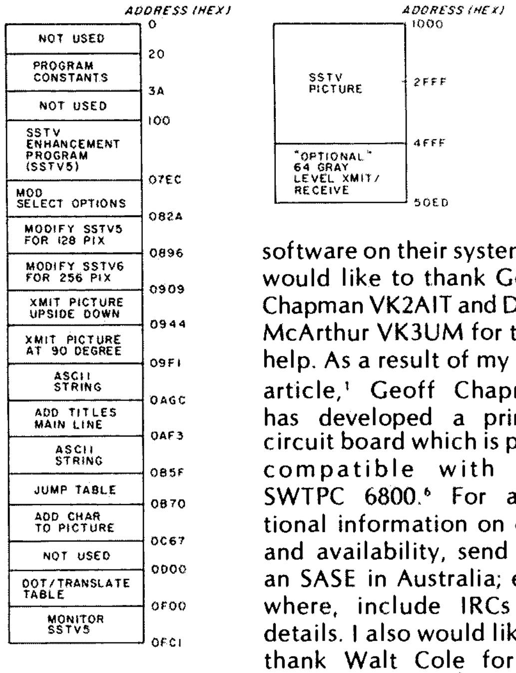
Fig. 5. Program memory map.



amount of work. Two amateurs assisted me in this project by reviewing my article and evaluating the software on their systems. I would like to thank Geoff Chapman VK2AIT and Doug McArthur VK3UM for their help. As a result of my first article,[1] Geoff Chapman has developed a printed circuit board which is plug-compatible with the SWTPC 6800.[6] For additional information on cost and availability, send him an SASE in Australia; elsewhere, include IRCs for details. I also would like to thank Walt Cole for his assistance on the photography. If you decide to write me a letter with additional questions, please enclose an SASE. ■

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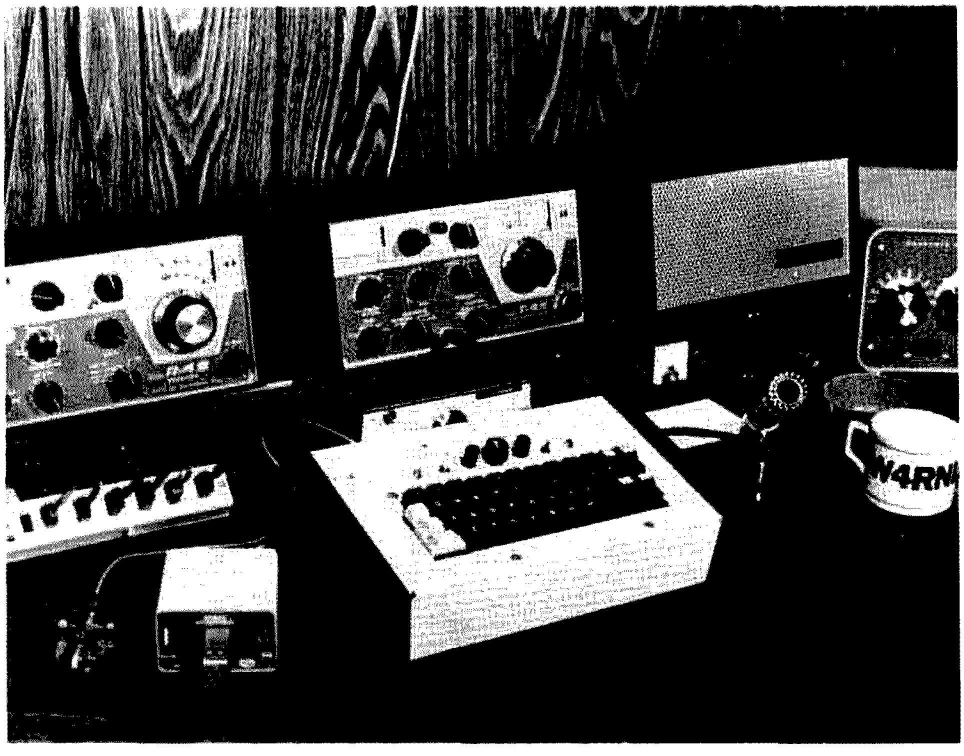
Son of Keycoder

—an even simpler CW typewriter

There are many good designs for CW typewriters. They have been designed around various levels of IC technology from RTLs to PROMs. One of the best is W9UBS's TTL version, which makes use of the W9TO encoding system. This machine, dubbed Keycoder I, was described in the July, 1976, issue of *73 Magazine* by WA9VGS. It represents a conversion of W4UX's RTL-based Touchcoder II, which was written up in the July, 1969, issue of *QST*. K6BS restocked the machine with CMOS chips (see *73 Magazine* for October, 1976), and perhaps his version should be called Keycoder II. It seems that one problem facing anyone developing a CW typewriter is coming up with an original name for it.

If anything, my version of the TTL CW typewriter should be called Son of Keycoder I. In fact, the mill is less a new design than a wedding of two designs: the electronics of W9UBA/WA9VGS (with encoding *a la* W9TO), and the old-fashioned diode matrix. It provides a lesson in the adaptability of designs, and may provide some useful ideas for those faced with modifying designs to suit local junk box conditions.



This is a view of the code typewriter amidst other CW-making equipment in the W4RNL shack. The photo also shows clearly how the use of wood end pieces will obtain the slope needed for the keyboard. To enjoy CW, everything on the operating table (including the coffee cup and ashtray) is needed except the mike. The 25-year-old J-38 and the Codax keyer are used often in an attempt to send CW as perfectly as does the typewriter.

What Makes the Machine Work

Fig. 1 shows the schematic diagram of the typewriter used here. With the major exception of the method of setting the flip-flops, the circuit closely resembles the one specified by WA9VGS. Included is the transistor output suggested in the original article as an alternative to relay output. The suggested means of construction, using the Radio Shack Universal Display Board (P/N 277-108), proved so easy that this same board has been used for other projects. The busses on this board can be chopped into short subsections, thus increasing the number of available lines far beyond eight.

Let us briefly review circuit operation, just to get a feel for the machine. When any key (letter, number, or prosign) is depressed, two things happen. First, the SCR fires 5 volts through the diode matrix, through one or more of the inverters, and sets some of the flip-flops. For example, for the letter A, f-f 2 and f-f 3 are set. The presence of a

set on any flip-flop—by virtue of the sequence of gates—changes pin 6 of the 7400 to a low, which closes down the SCR until the letter is complete. When all the flip-flops are clear, pin 6 of the 7400 goes high, readying the SCR for another letter. In the meantime, the anode of the SCR has charged up for the next letter.

Second, when pin 6 of the 7400 goes low, the NE555 clock turns on and produces a series of dots. These go to f-f 8 and to pin 5 of the 7402. F-f 8 is the dash generator whose output goes to pin 6 of the 7402. This section of the 7402 sums its inputs and sends them to pin 11, a different gate of the same DIP, where they are again summed with the output of the gates running from f-f 2 through f-f 7. If both pins 11 and 12 of the 7402 show a low—the case where we have a dot or dash—the output drives the two-transistor circuit to key the transmitter. The output circuit is set up for blocked-grid keying, i.e., negative voltage. Relay circuits are available for keying other voltages.

The sort of output that occurs is a function of which and how many flip-flops from f-f 1 through f-f 7 are set. If any one or more flip-flops from f-f 2 through f-f 7 are set, then a sequence of dots is generated as the set moves right, with the last one stemming from f-f 2. If f-f 1 and any other flip-flop (from f-f 2 through f-f 7) are set, then a dash is generated. This occurs because pin 10 of the 7402, having received a low on both its input pins 8 and 9, enables the dash generator. Once the dash is enabled by keying the dash generator, the set on f-f 1 drops out since it has no other flip-flop to its right to pick up the set. If only f-f 1 is set, as is the case at the end of every letter, then a silent E is sent; that is, the dot generator goes through one more complete cycle, but the output summing gate (pins 11, 12, 13 of the 7402) is disabled due to a lack of a set on any of the other flip-flops, f-f 2 through f-f 7. This ensures the proper spacing between letters. Thus, we have dots, dashes, and letter spacing, with the negative half of each cycle of the clock providing self-completion of each.

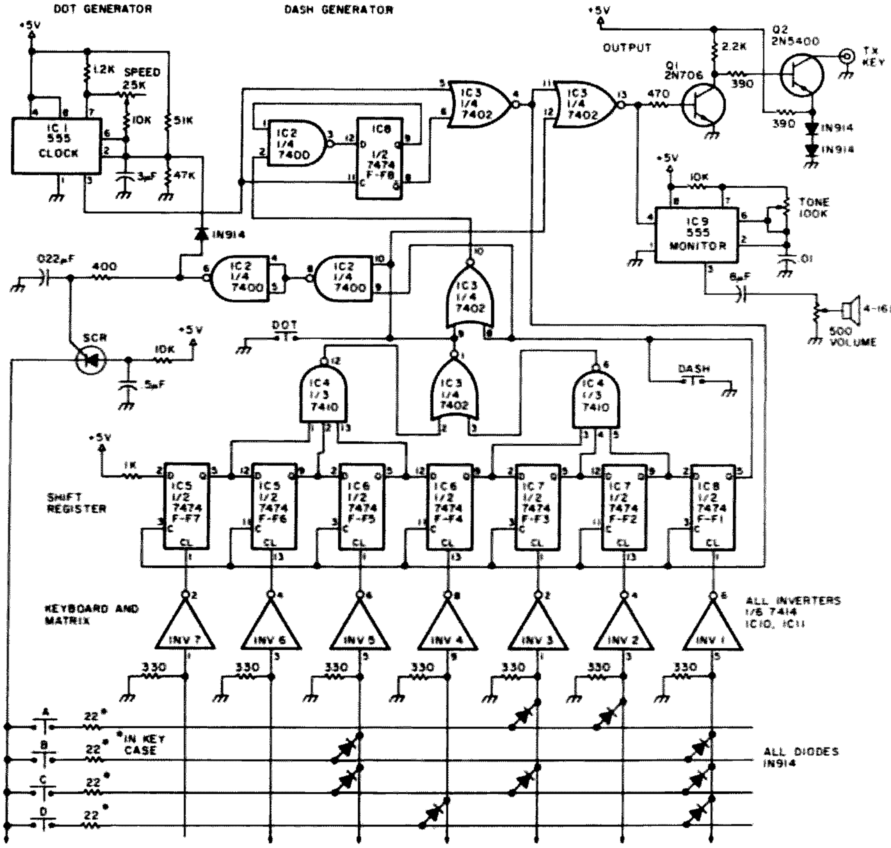


Fig. 1. Schematic diagram of the CW typewriter. Only part of the keyboard and matrix is shown. Not shown on the diagram is the pin 14 Vcc (+5 volts dc) and pin 7 ground connection to every IC. Every IC should have pin 14 bypassed with a .01 disc ceramic. Q1 can be almost any NPN transistor; Q2 should have a rating of—100 volts or better (see the article by WA9VCS for a list of suggestions). For this project, by all means, use IC sockets.

The output, pin 13, of the 7402 also drives another NE555 set up as an audio oscillator for the purposes of monitoring and practice. Getting used to a code typer does take some practice, since the rhythm of Morse code is quite unlike the rhythm of touch typing. In fact, having patience during letter formation, while still being ready for the letter after that surprisingly short E, is the hardest task. The results, however, bring rave notices on the air.

This circuit review has been kept brief, since full pulse-by-pulse details of circuit operation are contained in the Touchcoder and Keycoder articles mentioned above. Both discussions are complete and clear, and I heartily recommend them.

My unit differs from Keycoder I in three specifics: (1) setting the flip-flops (a major change); (2) the SCR circuit (a minor change, but a major problem in the minds of some builders), and (3), the method of cabinet construction (a personal and economic matter). Discussion will be confined to these areas.

From Keyboard to Diode Matrix to Flip-Flop

The authors (or sires) of Keycoder specified a cost of about $60 to $70 for their unit. Much of this cost was for the keyboard and case. If you have a keyboard and can make a case, the cost can be halved. Just this thought prompted me to use an old keyboard given to me long ago.

My keyboard is made up of individual switches about an inch and a half long, each of which contains a series resistor of 22 Ohms. As is, this switching system will not drive the

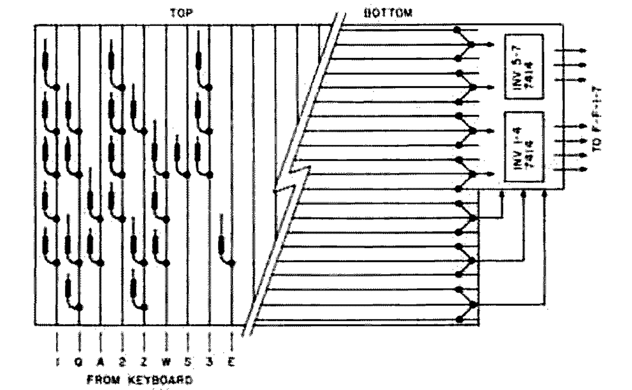


Fig. 2. Sketch of the Matrix Board. On the left is the topside showing the copper strips for the leads from the keyboard. Note that with most keyboards, the leads will not appear in alphabetical order. The unterminated diode leads pass through perforations in the board to be soldered to the transverse strips on that side. The right half of the sketch shows an X-ray view of the underside. Multiple lines serve each inverter, allowing greater flexibility in diode placement. Inverter pins for input and output are shown in the schematic. Any number of alternatives—from etched circuit board to copper wires—may replace the copper-bonded adhesive plastic used here.

toroid system used by Keycoder. Since the SCR pulse to ground through the toroids runs high current, the voltage drop across the resistor leaves too little for reliable setting of the flip-flops. The choice was clear: Either cut open 44 individual keys, short the resistor, and reclose with glue, or find an alternative method of triggering the flip-flops.

The surest method of getting a signal through the switches is to run a high through them, triggering some device that needs a high. The low current requirements for this state provide an insignificant voltage drop through the switch resistors. However, the flip-flops (7474s), typical of TTL technology, get set on a low. Therefore, on the diode matrix board there are shown seven Schmitt trigger inverters, packaged in two 7414s. This leaves several inverters unused, since they come six to a DIP. The Schmitt triggers may not be strictly necessary. Regular inverters (7404) might do just as well, but the 7414s have a snap action that cleans up minor glitches that might be caused by line variations or soft keying in the 22-Ohm switches. They have worked beautifully.

When no key is pressed, the input to the 7414s shows an open circuit rather than a low. Therefore, 330-Ohm resistors were run from the inputs to ground to hold the inputs low until a letter is keyed. The value of the resistor is non-critical, but something in the 300-Ohm ballpark should be used. Since the path of the high is through the switch resistor and the input resistor to ground, the voltage drop across the switch resistor is held to well-under ten percent of the 5-volts Vcc. Even with the voltage drop across the matrix, the minimum voltage needed to set the inverter high is more than met. Thus, the inverter output shows definite lows and highs to keep the flip-flops set inversely at high and low as needed.

Between the switch and the inverters is a diode matrix with some 130 1N914 equivalents soldered to it. After wiring the board, I am convinced that it takes only about the same amount of time to assemble a diode board as it does to string more than 40 number 30 wires through and/or around 7 toroids. The work goes fast if you do three things. First, have your board set up for easy work. Second, check each diode with an ohmmeter before soldering. Third, check the diodes for each letter immediately after soldering.

The second and third chores are quickly accomplished, but are essential. Toss out any diodes that do not show a very large difference between forward and reverse bias. Leakage can create erratic keying. These precautions provided perfect first-time operation of the code typewriter, so I am unsure what the consequences of a leaky diode might be. However, in a commercially made keyer, one such diode provided dots that sometimes became dashes, much to the chagrin of those trying to copy me. Finding the problem cost me several hours of hunting.

Setting up the diode matrix board is not difficult. Those who like to etch circuit boards can set up 44 thin lines on one side and seven broad lines on the other. The inverter ends of the diodes can pass through holes between pairs of thin lines, and emerge in the middle of a broad line on the reverse side. Other methods are equally possible. I had access to clear plastic with copper lines permanently bonded to it. The reverse side was sticky, and adhered perfectly to perfboard (.100 × .100 hole spacing). A four by seven inch board allowed all 44 letter lines to fit the length, while transverse lines were run across the back. To keep diodes well separated, I used three lines per inverter, wired in parallel. For keys like zero, which need six diodes, the spacing made assembly and any future servicing a matter of ease. Diodes are mounted on the 44-line side with their inverter leads puncturing the plastic to pass through a perf to the other side. The 44 leads to the keyboard make a dandy hinge (if not flexed too often), and the matrix board folds back under the keyboard. Even with a sheet of insulation between boards, the matrix adds less than a half-inch depth to the keyboard.

Fig. 2 shows a diagram of the principles of the matrix board. Here a drawing is definitely clearer than a photo. Although much maligned in recent years, with the advent of PROMs and the like, diode-matrices still have much to recommend them. Should something go wrong, a replacement diode costs a few cents; a replacement PROM costs much more and creates a much longer downtime, unless one can afford to have a spare programmed memory. Also, the diode matrix allows me to change my mind and revise the keying setup in just a few minutes; PROMs are permanent. In comparison to toroids, there is not much to choose from, except that diode matrices are generally voltage-fed devices, whereas toroid transformers demand a fairly high current. Of course my typewriter matrix requires only low current; it may be of use to remember diodes for other similar applications, where current is not available or needed in large doses.

One ham friend has characterized my diode-driven TTL keyer as a marriage between the slightly advanced Cro-Magnon and the very regressive Neanderthal. I prefer to think of

it as crossbreeding for the best characteristics of both. Neanderthal man, after all, had some socially redeeming characteristics.

Programming the matrix is no problem. The toroid threading chart provided by WA9VGS is also a diode chart for this keyer. Wherever there is an X on the chart, run a diode between the letter line and the proper inverter line. For convenience, Fig. 3 reproduces the character generation table.

Something About SCRs

If you were to compare the SCR circuit of Keycoder I with the circuit used here, you would find only one small difference. Instead of a capacitor of 1.5 uF from the SCR anode to ground, the value given here is only .5 uF. Actually, the value is uncritical, and anything from .25 to 1 uF will work.

The SCR circuit has one function: to provide a quick shot of voltage through the key and diodes to the proper inverters, and then to shut down. When there is a letter being processed by the keyer, pin 6 of the 7400 holds the SCR gate low, inhibiting current flow through the diode. However, a low on the gate will not cut off current flow unless the voltage on the anode also drops below minimum. The resistor in the 5-volt line, and the capacitor to ground (10k and .5 uF respectively), allow the voltage on the anode to drop as a key switch is closed, thus cutting off the SCR when its gate goes low. As the capacitor recharges, the low gate prevents the SCR from conducting until the keyboard clears, at which time pin 6 on the 7400 and the gate go high; then the SCR has an open gate and full voltage, ready for another key to be struck. If the same key has been held closed, the SCR will conduct through it for a repeated letter.

Character	INV/f-f7	INV/f-f6	INV/f-f5	INV/f-f4	INV/f-f3	INV/f-f2	INV/f-f1
A					X	X	
B			X				X
C			X		X		X
D				X			X
E						X	
F			X		X		
G				X		X	X
H			X				
I					X		
J			X	X	X	X	
K				X	X		
L			X			X	
M					X	X	X
N					X		X
O				X	X	X	X
P			X		X	X	
Q			X	X		X	X
R				X		X	
S				X			
T						X	X
U				X	X		
V			X	X			
W				X	X	X	
X			X				X
Y			X	X	X		X
Z			X			X	X
1		X	X	X	X	X	
2		X	X	X	X		
3		X	X	X			
4		X	X				
5		X					
6		X					X
7		X				X	X
8		X			X	X	X
9		X		X	X	X	X
0		X	X	X	X	X	X
.	X	X		X		X	
,	X	X	X			X	X
?	X			X	X		
/		X		X			X
—		X	X				X
$\overline{AR}$		X		X		X	
$\overline{SK}$	X	X		X			
$\overline{AS}$		X				X	
Silent E							X

Fig. 3. Diode matrixing table. An "X" indicates that a diode is wired from the character line to the inverter-flip-flop line (INV/FF). Thus the proper flip-flops are set to generate the indicated character.

The reason for this explanation is that many hams view SCRs as strange devices. Where they will substitute tubes and transistors freely, they fear to try substitutions for unfamiliar devices. In the given circuit, almost any hobbyist-grade SCR will work. From a package of five from Radio Shack, each having a different current rating, not one failed to work properly—once I had sorted out the cathode and anode leads, and quit installing them backwards! For the diode matrix system used here, a 15-volt rating was plenty, and the current demands are small. For the toroid application, as in the original Keycoder, somewhat higher ratings may be useful—say, 30 volts at half an Ampere. Since the diode matrix does not draw much current, a large capacitor across the anode of the SCR is unneeded; its value should be only large enough to hold the anode voltage down until the gate is cut off with a low, i.e., until the 7400 gate (pin 6) has registered that something is in the flip-flops. Some nanoseconds are all that is needed for this to happen. No new pulse can then interfere with the processing of the letter in progress.

SCRs have many other potential applications for voltage control in digital circuits. If the basic operating order of SCRs is remembered, they should become as useful and familiar to hams as transistors and FETs.

The only other circuit

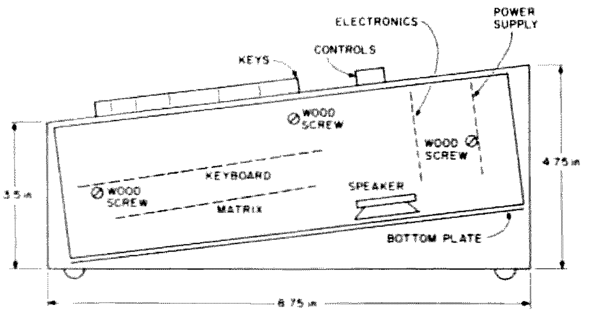
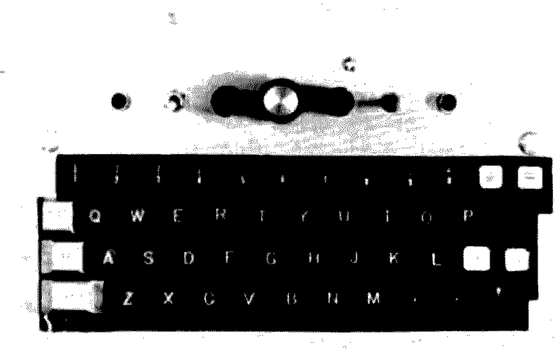


Fig. 4. X-ray view of end panel showing the alignment of the chassis to achieve the proper slope for the keyboard. The speaker mounts on the bottom plate. The dashed lines show the approximate placement of the power supply, main electronics, key switch, and matrix boards. Three half-inch wood screws hold the chassis to the wood end pieces cut from one-by-six. Rubber feet protect the operating desk.

notes are the following two. First, a DASH line is added to the DOT line of the original. It works by grounding pin 8 of the 7402 along with pin 9, i.e., by pressing both the DOT and DASH keys together. (Using a diode across the DOT and DASH lines did not work, since the low remains above the diode-voltage drop, and this causes erratic dashes when letter keys are pressed.) The only practical use of this is to test the dot and dash generators, and to demonstrate to prospective hams the distinction between dots and dashes. Holding the DOT key closed, then keying and unkeying the DASH line, produces a string of alternating dashes and dots.

Second, a SPACE key has been provided. It keys the silent E, i.e., only the last flip-flop (f-f 1). For on-the-air use, this key has no function, but it is useful for keying serial input memories or Morse-to-ASCII converters which are tied to the typewriter clock. The space ensures proper word separation; paragraphing might be accomplished by some related means, such as a sequence of three successive spaces. In this unit, the space bar was removed and the space function moved to the key in the lower left hand corner of the keyboard, which simplified construction.



This is a close-up top view of the code typewriter. The controls above the keyboard are, from left to right, the ac pilot light, power switch, volume control, speed control, tone control, tune-up switch, and tune-up pilot light. Keys with white squares were labeled by using adhesive address labels with a transparent tape cover; all were typed and then cut to fit the keys. The DOT and DASH keys have had their internal resistors removed.

Construction Notes

Since part of the project included cutting costs, the case is home brew. As the photograph shows, the case is made from a 12-by-8-by-3-inch aluminum chassis base. The depth was made necessary by the length of the key-switch bodies. The power supply is edge-mounted, in the upper right corner as you look at the photo. The main electronics board also is edge-mounted just above the row of switches and knobs. The SCR and output circuits are mounted on separate pieces of perfboard, since some breadboard experiments are occasionally tried with them. Leads between boards are long so that any board can be removed for checking without unwiring the circuit. No rf interference was noted when I used the unit with either the Drake transmitter or the Heath linear.

The switches on my keyboard are tilted to present the operator with a tiered effect. This resembles the old-fashioned manual typewriter keyboard. The chassis had to slope, therefore. After cutting the keyboard hole with a saber saw, I built two wood end-pieces to hold the chassis at the correct angle. They also serve to elevate the rear underside of the chassis, which is covered with a bottom plate of scrap perforated aluminum. The monitor speaker is held to this plate by four clips, and the angle of the case projects the sound into the crowd of future hams eagerly taking code practice. A little stain and varnish finished the end-pieces to a soft shine, while several light, spray coats of light blue finished the cabinet. Fig. 4 provides a cutaway drawing to show how the end-pieces fit to the chassis to provide tilt in a simple but effective way.

The only item purchased for the cabinetry was the chassis base. Still, visitors to the shack seem to find the case striking, despite my poverty of skills in metal work. I think the reason is the use of a little wood. There is something about the use of natural materials in home brew projects which humanizes them a bit. They are not just plastic and metal products of technology and mass production (although some modern equipment deserves high grades for industrial design); they are the end result of personal craftsmanship. There is no need to copy commercially-built items to the last detail; indeed, one probably should avoid trying to do this. The manufacturer has manufacturing reasons for his choice of materials and appearance; likewise, the personal craftsman should have at least a few personal reasons for the materials and appearance of his projects. Money-saving is not a bad reason, for a starter.

While these notes may not add much to the span of modern technology, I hope they have accomplished a few things. First, they are a reminder that designs are adaptable, with a little effort, to what you have available. Second, they resurrect the diode matrix from threatened oblivion. Third, they may encourage hams to try SCRs a little more often. Fourth, they are a reminder that home brew products are not just second best to manufactured ones, but in some ways often are superior.

Finally, perhaps these notes may encourage a few others to try their hand at building what may become the "Grandson of Keycoder I!" ■

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Sloppiness Will Get You Nowhere

—organize your coax

If you are like me, all the suggestions given by friends on how to route coax into the QTH don't meet your standards—or those of your wife. Holes in window panes, walls, and window frames just don't look right and are hard to patch if one moves. The solution I found is relatively simple and very easy to disguise if the equipment must be removed later.

I terminated my coax under the eave of the house, using an SO-239 connector for each coax cable. The SO-239 connectors were mounted on a metal plate, and hood-type shields were used on the rear of the connector to prevent rf leakage between coax leads. I also went to the expense of connecting a lightning arrester in each line at the plate—and, of course, the plate was well grounded.

A hole large enough to provide clearance for the rear of the connectors and smaller than the exterior dimensions of the plate was cut in the plywood under the eave of the house, and the plate was mounted in place so that it covered the hole completely. Several wood screws were used to secure the plate to the plywood.

Now, you ask, what is so easy to patch about a 2-inch x several-inch hole? Easy—just purchase an inexpensive attic vent plate at your nearby hardware store to properly cover the hole when it is time to move. It might be a good idea to visit the hardware store ahead of time and measure common sizes of vents that are available in your area so that you do not make the hole the wrong size or shape to cover.

Now that you have accomplished the feat of gaining access to the interior of the attic for your coax, how do you feed it down through a wall without making a mess? Another easy solution: Visit your friendly hardware man or electrical parts warehouse and purchase an electrical wall box such as those in which wall outlets and light switches are mounted. If the salesman is competent, he can sell you the box for the type of wall you have in your house. Also, buy a blank cover for the box, if you want, and you will be ready to cover the box if and when you move.

Locate carefully the place where you want to mount the box. It should be mounted in the wall at the same height above the floor as all other wall boxes. In the attic, measure carefully from known reference points and drill a hole vertically down into the wall directly above the location for the box *before*

cutting the hole for the box in the wall. Drop a weight on the end of a string into the hole and play it out until the string goes slack. Mark the string at that point, remove it from the hole, and measure from the mark to the bottom of the weight. If the measurement is the same as the measurement from the floor to the top of the wall, plus or minus one or two inches, then you are in business. If the measurement is shorter by two or three feet, it is obvious that there is an obstruction of some sort in the wall at the location you have chosen, and you must move left or right several inches and try again, drilling another vertical hole from the attic into the inside of the wall.

When you have found a location that will allow the coax to be fed from the attic down the inside of the wall, cut the opening in the wall at the proper height for the electrical box. Feed the coax through the cutout at the back or top of the electrical box as far as necessary and tighten the clamp to secure the coax. The box now can be mounted in the wall. If only one or two coax cables are used, a blank plate can be fitted with the appropriate number of SO-239 connectors and mounted to the box to make a neat and XYL-approved installation.

My installation consists of a bundle of 8 cables, and I used a double-width wall box without a cover. A desk and radio rack are in front of the box where it is installed, so I did not bother with using a cover. When we move, I will cover the empty box with a double-width blank cover, and the hole in the wall will be neatly concealed. ■

✓ Reader Service—see page 243

The Satellite TV Primer

—thousands watch satellite TV every day . . . here's how they do it and what they see

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Amateurs worldwide can be justifiably proud of amateur achievements with our noncommercial design, construction, and operation of space repeater/relay stations. The amateur fraternity's OSCAR-series satellites, and, more recently, the Russian RS-series satellites, have shown the commercial space communications world that gold-plated multi-million dollar space programs are not essential to the establishment of routine, predictable, space communication programs.

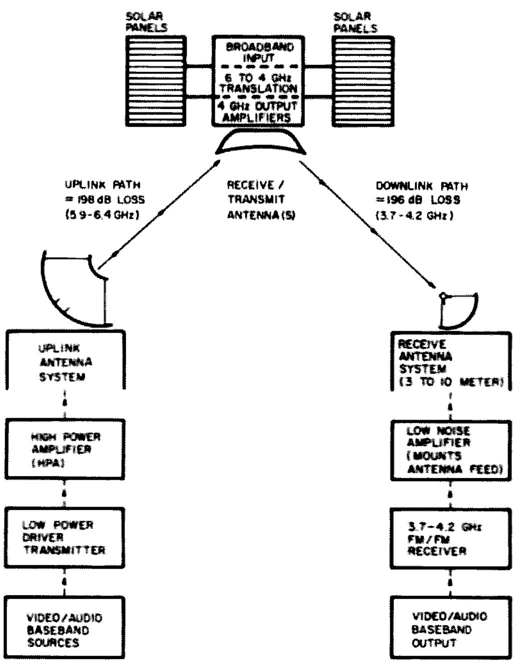

Fig. 1. How the geostationary satellite path works. Uplink transmitters send signals to appropriate bird in 5.9- to 6.4-GHz range. Within the satellite, the uplink signals are processed and downconverted to the 3.7-4.2-GHz range. The satellite is broadband processing until the final (single channel/transponder) output stage where individual transponders have their own 5-Watt peak power TWT amplifiers.

The amateur's appetite for challenge and his ingrained ability to achieve satisfactory results with equipment fashioned on the kitchen table—for budgets measured in the tens or hundreds of dollars rather than in the millions—has been a trademark of amateur activities since the earliest days of transcontinental communications. In a nutshell, amateurs have proven again and again through the history of communications development on Earth that the will to succeed is often a more powerful tool than unlimited budgets and large teams of technicians and engineers.

And history has a way of repeating itself. Geosynchronous satellites are a case in point.

To date, mankind has utilized four different types of satellites to achieve communications via "space stations." In the amateur world, the most familiar satellite is the low-orbit constantly-moving (with respect to a point on earth) active relay station symbolized by OSCAR. OSCAR follows in the footsteps of TELSTAR I (a commercial satellite launched in July, 1962, by Bell Labs) and RELAY I (a NASA-launched low-orbit satellite put into space in December of the same year). Low-orbit satellites are placed into a launch sequence which takes the satellite around and around the earth at relatively low altitudes (typically, within a couple of hundred miles of the Earth's surface) at a forward speed which allows them to circle the Earth

completely in several hours. Because the Earth is spinning on its own axis at the same time the satellite is circling the Earth, a low-orbit satellite crosses over different regions of Earth with each "pass"—a fact well known to OSCAR buffs.

Perhaps the next most-commonly utilized satellite is the Earth's moon, a "satellite" first used for communications in 1946 by a US Army communications team, with equipment originally conceived in the closing years of World War II. Amateur use of this particular satellite was pioneered in 1953 when moon echoes were first successfully received on the 144-MHz amateur band.

In our 1979 world of sophisticated rocket-launched active satellites, one may have some difficulty including the moon in our discussion of satellite communications, but it fits the mold nonetheless. In fact, the use of a passive relay device (the moon or similarly passive object) continued to spark interest in the scientific community up through 1963. In 1957, the moon was first utilized for passive relay of two-way voice communications. In August of 1960, a NASA-launched balloon satellite some 30 meters in diameter achieved a 1,600-km elevation orbit, producing the first satellite relay of both telephone and television communications (ECHO I). Even as late as May, 1963, MIT (in cooperation with NASA) launched another type of passive relay satellite: The West Ford Project put into space approximately 400,000,000 "dipoles" (thin strands of reflective material). ECHO I provided NASA, Bell Labs, and the California Jet Propulsion Labs with the opportunity to test 1- and 2.5-GHz FM transmissions (telephone and television) by directing high-power transmitters and large parabolic antennas at the mid-range (height) of the elevated passive reflector. A measure of success was achieved, while the multi-million-dipole West Ford Project was far less successful.

Yet a third form of satellite had been launched in 1957 by the Russians. SPUTNIK I was a low-orbiting satellite with its own self-contained capsule message on board. As the satellite circled the globe it transmitted the Morse message "Hi" over and over. The fact that it had been programmed to transmit in International Morse code and in English was not lost on anxious American defense and security personnel.

The mold created by SPUTNIK actually continued for several years. The United States rushed a satellite into low orbit in December, 1958 (SCORE, a US Air Force experimental satellite), with a tape-recorded Presidential message on board—just in time for the holiday season.

The first use of active electronics on board a satellite came in October, 1960, when the US Army launched COURIER 1B, a satellite that achieved a maximum altitude of 1,000 km, and was outfitted with high-speed magnetic tape equipment. COURIER was capable of being ground-loaded with voice and other communications as it passed over one remote location, storing the data, and then releasing it on command from a second earthbound terminal. This was hardly real-time communications, but it did fill both scientific and political needs of that era.

Another type of low-orbit "first" also happened back in 1960. In April of that year, NASA launched the first meteorological observation satellite (TIROS I) at a 700-km elevation. This weather satellite operated long enough to transmit back to Earth more than 22,000 meteorological pictures in about a two-month period. While this satellite was generally capable of what would today be called low-resolution pictures, it nonetheless did attract the interest of the general public when an inventive journalist called it "the world's first spy in the sky." And that message was hardly lost on defense and security planners worldwide.

During most of the late 50s and early 60s, communication via satellites was done in the lower VHF range or even the HF range. SPUTNIK I beat against WWV's 20-MHz assignment, SCORE sent a Presidential greeting via VHF, and TIROS transmitted cloud-cover and landmass black-and-white pictures via a frequency range just below our amateur two-meter band. All of this was destined to change when our fourth type of satellite was first launched in July, 1963. The magic word was "geostationary."

Our OSCAR and other low-orbit satellites provide a useful communications relay largely because they are predictable. Once the parameters of the launch are known (i.e., the intended altitude and inclination, or angle of trajectory), telemetering from the "bird" allows ground control stations associated with the launch to calculate with a high degree of precision

Uplink frequency range	5.9 to 6.4 GHz
Downlink frequency range	3.7 to 4.2 GHz
Modulation	FM video with FM subcarrier audio
Bandwidth per transponder	36 MHz*
Peak deviation	10.75 MHz*
Top of video baseband	4.2 MHz
Aural subcarrier frequency	6.8 MHz (6.2 MHz)**
Deviation of subcarrier	75 kHz
Top of audio baseband	15 kHz
Channelization	WESTAR, ANIK, vertical on SATCOM—40-MHz wide, each in even steps with transponder 1, 3700-3740; horizontal on SATCOM interleaved, with transponder 2 at 3720-3760.
Typical (free) space loss	196 dB
Typical EIRP	37 dBW WESTAR on boresight; 36 dBW SATCOM on boresight; 36 dBW ANIK on boresight. INTELSAT, 22 dBW global beam, 26 dBW hemispherical beam, and 29 dBW spot beam.
Polarization	WESTAR, ANIK—linear horizontal; SATCOM, COMSTAR—linear, horizontal, and vertical; INTELSAT-circular (either sense).

*Transponder 23 on SATCOM F2, utilized to relay television programming to Alaskan Bush Terminals, uses a split- (half-) transponder format; all INTELSAT transponders carrying video also utilize a split- (half transponder working) format.
**Aural subcarriers for INTELSAT and transponder 23 on SATCOM F2 may not be on the same transponder as the video.

Fig. 2. Geostationary Satellite System Parameters. With the exception of some Russian RADUGA-series geostationary satellites, this data pertains to all operating satellites in this service providing television relay.

the period of rotation about the Earth and the precise overfly route of the satellite. Given this data, it is no big trick to have the proper ground station equipment in operation and the satellite-accessing antenna pointed at that spot on the horizon where the low-orbiting satellite will first appear as it travels around the Earth. However, all low-orbiting satellites do move, and the ground stations that access data from or transmit data to such low-orbiting satellites must be capable of tracking the satellite as it passes from the access horizon through the sky and then out of view once again over the opposite horizon. It is a little bit like having a totally-predictable ionosphere at work at HF—something we have never achieved, incidentally.

Way back in 1945, an "amateur" with both an inventive mind and an amazing understanding of geophysics prescribed a solution to this low-orbit problem—long before low-orbit satellites were even dreamed of! His name was Arthur C. Clarke, and in *Wireless World* in 1945 Clarke postulated that if man could launch a "microwave repeater station" into a precise orbit position some 22,300 miles above the equator, the forward speed of the satellite would exactly match the rotational speed of the Earth on its own axis. Clarke demonstrated, on paper, that such a satellite would "appear to stand still" to an observer on Earth. Clarke saw this stationary orbit position as a key to achieving instant worldwide communications on command, since one satellite could "see" approximately 40% of the Earth's ground surface area; a trio of such satellites, properly spaced around the Earth, could be interconnected in such a way that a ground station could communicate with virtually any other ground station in the world.

Such a satellite was successfully placed into orbit in July of 1963. It was called SYNCOM 2, and it connected nations together across the Atlantic from an altitude of 35,900 km. It had a forward speed of 11,200 km per hour, matching the Earth's rotation. With a capacity of 50 telephone circuits or one television channel, SYNCOM was the first man-built machine capable of interconnecting two or more continents simultaneously for real-time television.

Geostationary satellites (or geosynchronous, as they also are known), are what this is all about. More precisely, the present generations of geostationary satellites, providing real-time television relay throughout the world today, are what this is all about.

International vs. Domestic

The present generation's geostationary birds generally fall into two operational categories, International and Domestic. Fig. 1 summarizes the operation of both types.

Satellites intended for international relay are known as INTELSAT birds, and they are operated by an international consortium formed initially in 1965, with the launch of EARLYBIRD. Although only three (properly-selected) satellites are required to provide Earth-circling communications, INTELSAT presently operates a total of 12 such satellites; they are identified on the map in Fig. 3. There are three primary regions, or "parking areas," for the INTELSAT satellites: the Pacific Ocean area (generally around 180 degrees west or over the equator north of the Fiji Islands), the Atlantic Ocean area (generally between 0 degrees west and 35 degrees west, over the equator between Africa and the eastern tip of South America), and the Indian Ocean area (generally near 300 degrees west 60 degrees east, over the equator north of the Seychelles Islands). At least two separate satellites are positioned in each region, one as a primary or operational bird and the other as a reserve or secondary bird. In the Atlantic region and the Indian Ocean region, there are more than two INTELSAT birds parked, largely because of the high volume of commercial traffic in these regions of the world.

The present generation of satellites is of the IV (or 4) class—which simply means there were other generations ahead of them. These satellites are capable of handling 20 or so simultaneous television channels or some combination of television plus telephone (voice) or data channels. They all operate in the 3.7- to 4.2-GHz downlink (i.e., satellite-to-ground) frequency range, a range that is shared in North America and many other portions of the world by terrestrial point-to-point (telephone) or common-carrier microwave. They are fed input signal in the 5.9- to 6.4-GHz range (the so-called uplink path) from earthbound transmitters operating typically with 1 to 3 kW of transmitting power and very large parabolic antennas (40-100 feet in diameter) with gains in the 55-65-dB range. All of which make the 100-Watt erp requirement for access

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to OSCAR seem tame.

In our second family we have "domestic satellites," those intended for and licensed for operation within the borders of a single nation. Under international agreements reached in 1970 and 1971, the equatorial satellite "belt" has been broken into an "assignment table" where certain locations above the equator are reserved for INTELSAT-class birds while other locations are set aside for operation of domestic or non-INTELSAT satellites. These locations are specified in terms of the prime meridian (0 degrees, or Greenwich), and the equatorial region (from 70 degrees west—roughly due south of Boston—to 135 degrees west—roughly due south of Sitka, Alaska) are set aside for satellite parking of birds intended to serve North America. Within that arc there are presently 10 US and Canadian satellites in operation. The arc has been chosen to ensure that a satellite parked at either end of the arc can still see all or the majority of the North American landmass. Remember, just as with OSCAR, the reliable coverage of such satellites is limited to those portions of the Earth where line-of-sight contact

MARINE SATELLITES

28 29 30	31	32 33	34	35 36
15 183 287	140	261	15	230 225
MARISAT 1 2 3	ATS 6	EKRAN 1 2	SIRIC	ETS CS 2
'76 '76 '76	'74	'76 '76	'77	'77 '77
COMSAT GENERAL	NASA	USSR DOM (SIBERIA)	ITALY	JAPAN
P P S	E		E	E E

INTELSAT SATELLITES

Key No.	Longitude (°W)	Name	Year Launched	Service Status
1	34.5	I-IV-F3	1971	Secondary
2	181	I-IV-F4	1972	Reserve
3	300	I-IV-F5	1972	Reserve
4	186	I-IV-F8	1974	Primary
5	298.6	I-IV-F1	1975	Primary
6	4	I-IV-F2	1971	Reserve
7	1	I-IV-F7	1973	Secondary
8	24.5	I-IVA-F1	1975	Primary
9	29.5	I-IVA-F2	1976	Reserve
10	19.5	I-IVA-F4	1977	Reserve
	297	I-IVA-F3	1978	Primary
	300	I-IVA-F6	1978	Reserve

DOMESTIC SATELLITES

Key No.	11 12 13	14 15	16 17	18 19	20	21 22	23 24 25	26 27
Long. (°W)	114 109 104	99 123.5	135 119	128 95	116	277 283	280 325 275	311 11.5
Name	ANIK-A 3 2 1	WESTAR 1 2	SATCOM 1 2	COMSTAR 1 2	CTS	PALAPA 1 2	STATSIONAR 1 2 3	SYMPHONIE 1 2
Year Launched	'75 '73 '72	'74 '74	'75 '76	'76 '76	'76	'77 '76	'75 '76 '76	'74 '75
Org. or Country	TELESAT CANADA	WESTERN UNION	RCA	ATT/ GTE	CANADA —USA	INDO-NESIA	USSR	FRANCE/ W. GERM.
Service Status	P S R	S P	S P	P S	E	S P	DOMESTIC & FOREIGN	E E

Note: P indicates primary operating satellite, S—secondary, R—rescue, and E—experimental.

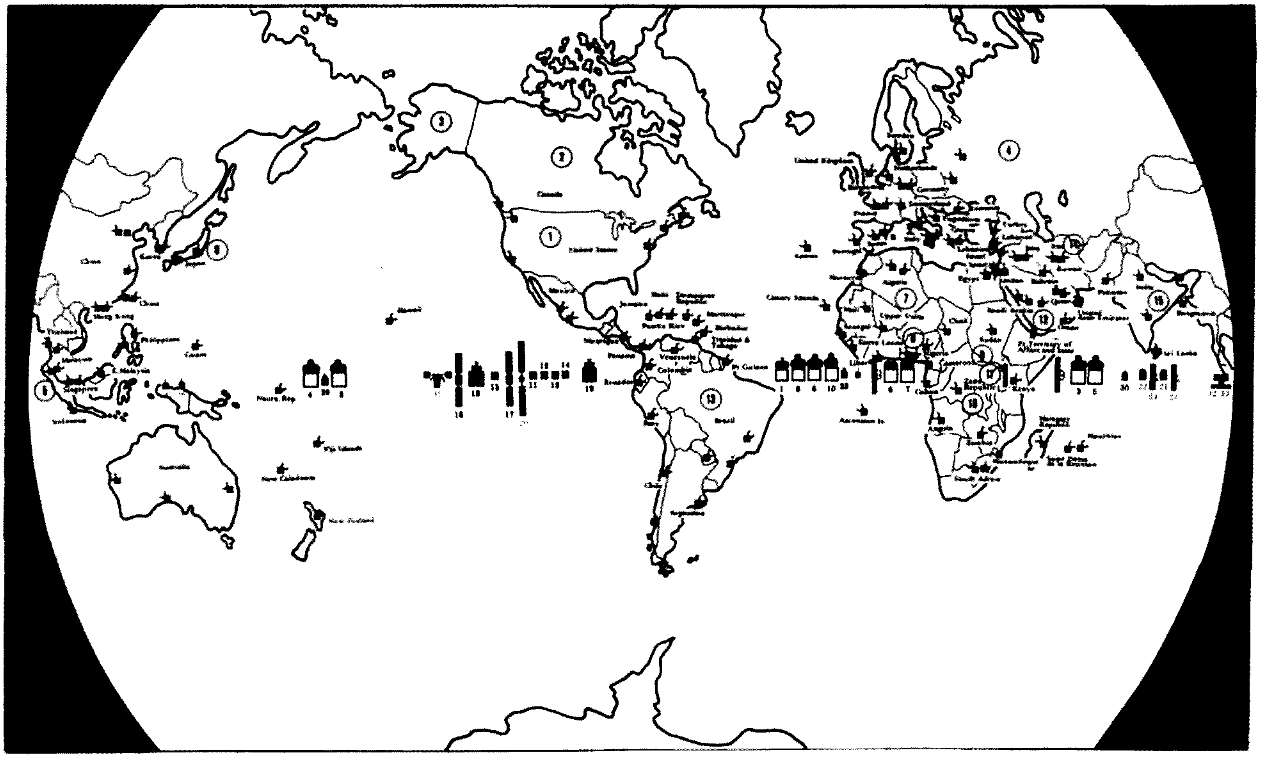

Fig. 3. Geostationary satellites and their locations. Equatorial parking locations of INTELSAT and domestic satellites providing television (plus voice and data) communications circuits are shown. Maritime satellites (which do not provide video services) are also shown because of high interest in their operation.

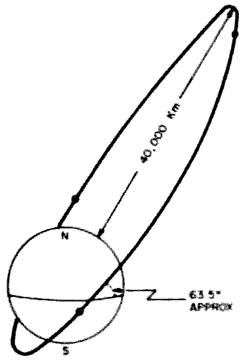

Fig. 4. Russian MOLNIYA satellites have been launched in an unusual inclined orbit resulting in elliptical orbits with a 12-hour period. By placing several satellites in the same ring, or train, virtually full-time service is maintained because of the length of the apogee period (8 hours) during which satellites appear (almost) to stand still to the ground receiving terminal. The system also provides coverage over the polar region, something not possible with equatorial-region geostationary satellites.

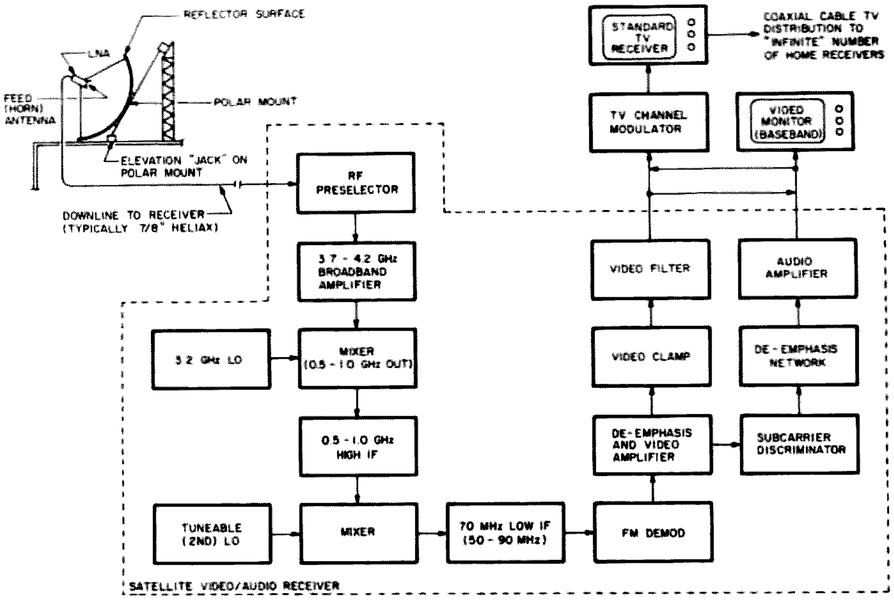

Fig. 6. Typical "small Earth receive-terminal" system (private or low-grade commercial) shows how the various component parts interrelate. The EIRP level present in a location determines the requirements for minimum size (i.e., gain) parabolic antenna, noise figure of LNA, and acceptable receiver i-f bandwidth.

can be achieved between the 22,300-mile-high satellite and the Earth receive terminal installed to access its signals.

Domestic satellites are fairly new in the satellite world. While more than 100 nations of the world now belong to INTELSAT and participate in its worldwide communications system, none of the member nations directly owns the satellites; they are owned and operated by an international investment consortium made up of both private investors and government agencies established in countries such as Nigeria to buy into the operation. Having bought in, the member nations are entitled to utilize the services of INTELSAT to interconnect their national telephone and data networks to the worldwide communications network, and to send out and receive television programming via INTELSAT. All of this is done on a very businesslike basis, with each user paying a use fee for the actual amount of satellite time the country makes use of. The domestic satellites operate on a slightly different principle.

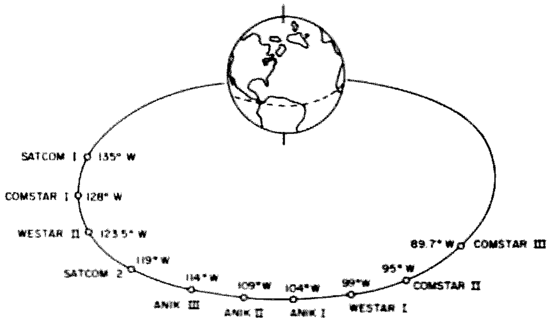

Fig. 5. United States and Canadian 3.7- to 4.2-GHz downlink-range geostationary satellites follow fairly closely to internationally-recommended 4-5-degree inter-satellite spacings established in 1970-71 by the United Nations. Satellites shown are only those operating in North-American service in this frequency range. Other satellites operating in other frequency ranges and serving North America are not shown. With the proposed launch of RCA SATCOM F3 this fall (scheduled to be spotted at 132 degrees), tests will be conducted to determine if closer (3-degree) spacing is feasible.

In Canada, Russia, and Indonesia, the respective governments have funded the design, purchase, and launch of their own communication satellites. Canada has four presently in operation, including one launched this past December. Canada, however, presently has only three "orbit spots" assigned to it, and one of the four will be retired shortly. The Canadian domestic satellites are utilized to provide telephone, data, and television communications to and from the less densely settled portions of Canada. This means that they are largely intended to serve the northern areas of the US, Canadian border provinces, plus the Northwest Territories and the Yukon. It is worth noting that with an equatorial orbit position, the horizon cuts off at the 80th degree north parallel; beyond that point, the bird cannot be "seen," so, in Canada's case, the ANIK-series satellites do not serve every nook and cranny of the country.

Indonesia has a pair of satellites purchased from the prime supplier of satellites in the free world, Hughes Aircraft Corporation. Indonesia was authorized to launch and operate their twin birds named PALAPA I and II, as a means of providing first-time communications (telephone, radio, data, and television) to the thousands of islands which make up the nation. However, the Indonesians have been

Photo A. "Novosti" or Russian news broadcast as received on an early model G8AKQ receive system with an 8-foot parabolic antenna. At the time this photo was taken, Birkill estimated his system receiver noise figure at about 3.8 dB (400 degrees Kelvin). He is within the 29-dBW contour from STATSIONAR. The satellite broadcasts on 3.89 GHz, well within the worldwide 3.7- to 4.2-GHz downlink range.

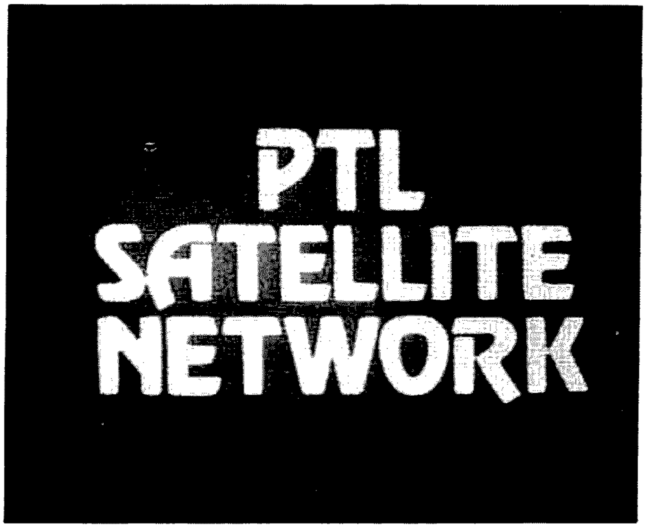

Photo B. PTL (transponder 2) is one of three full-time religious channels on the RCA SATCOM F1 satellite.

experimenting with leasing satellite channel space to other nearby nations, and television for the Philippines, Brunei, and other neighboring countries is relayed via PALAPA birds on a regular basis.

Russia's domestic satellites don't quite fit the mold of the balance of the world. The Russians first launched a domestic satellite system in 1965. The first Russian satellite was launched prior to the time the Russians had the capability to launch a heavy payload (2,200 pounds) into a geostationary orbit. So MOLNIYA I ("Lightning") was launched into an inclined, highly-elliptical orbit (see Fig. 4). This is a 12-hour orbit period with an apogee such that for approximately 8 hours per day the MOLNIYA bird appears to stand almost still with reference to Earth. By placing three satellites in the ring the Russians thus achieved many of the benefits of geostationary orbit without the precise orbiting equipment or launch power required for such a launch. More than 40 such satellites have been launched by the Russians, and one of the advantages of this approach is that there is coverage over the north polar regions, something not possible with equatorial geostationary satellites. In 1975 the Russians launched their first geostationary satellite (STATSIONAR) in the now-classic INTELSAT format. In the STATSIONAR series are two separate types of satellites: RADUGA, which is intended for both domestic and international telephone, data, and television relay, and EKRAN, which is a direct-to-the-home UHF-region broadcasting satellite. EKRAN operates at a much lower downlink frequency than other television-oriented satellites; a center frequency of 714 MHz (inside the US UHF television band, or, roughly, UHF channel 54). The onboard transmitter and antenna system create a very powerful ground level signal, such that simple yagi antennas provide first-class television to Siberia and other portions of far eastern Russia. Because of the location of this satellite (99 degrees east), it has a line-of-sight situation to portions of western Alaska and the Pacific, including Guam. Although the antenna is supposed to be "boresighted" on the UA9/UAØ region, amateur experimenters as far east and south as Rhodesia report reception from this powerful UHF-region television satellite.

The US Domestic System

By now, you may be getting the general idea that reception of geostationary satellites by amateur-constructed terminals offers a certain fascination. This may be the understatement of the year!

For example, how would you like to have access (via satellite) to *all* of the following in your own home?

1) Four of the nation's top independent television stations, such as Chicago's WGN, San Francisco/Oakland's KTVU, Atlanta's WTCG, and NYC's WOR?

2) Five separate pay cable services, including HBO (Home Box Office), SHOWTIME, FANFARE, HTN (Home Theater Network), and Warner's STAR CHANNEL?

3) Three separate full-time family/religion channels including PTL, CBN, and Trinity Broadcasting's KTBN?

4) A 13-hour per day Children's Television Network called Nickelodeon, created by the corporate family at Warner Brothers?

5) Over 1,000 hours per year of live sporting events from Madison Square Garden in New York, plus Notre Dame basketball, Penn State college football, and more?

6) A twenty-four-hour-per-day (!) all-sports channel?

7) A twenty-four-hour per day still-frame video news channel with accompanying audio from United Press International?

Too much television you say? Well, that's but the service list (early in 1979, and it grows monthly) on but a *single domestic satellite* serving North America. There are a total of ten such satellites with more than 40 such channels now in operation if you sum the video programmed services on the satellites serving the US and Canada.

The United States has followed a unique policy

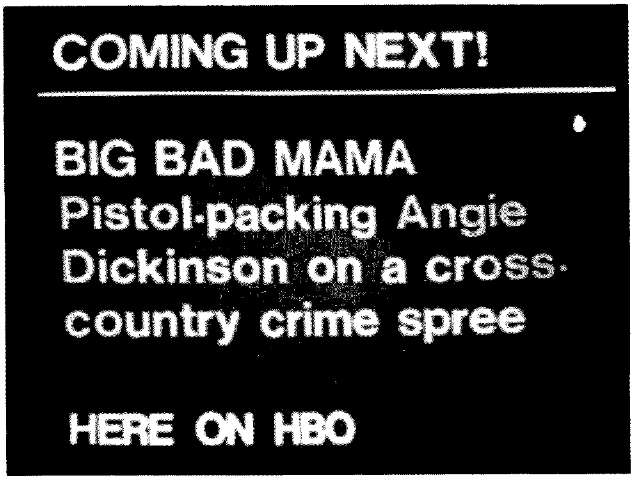

Photo C. HBO (Home Box Office) is perhaps the best known of the pay-cable services on satellite, although it is only one of five presently in service. Movies run 8-13 hours per day, are unedited, and run without interruptions (i.e., no commercials!).

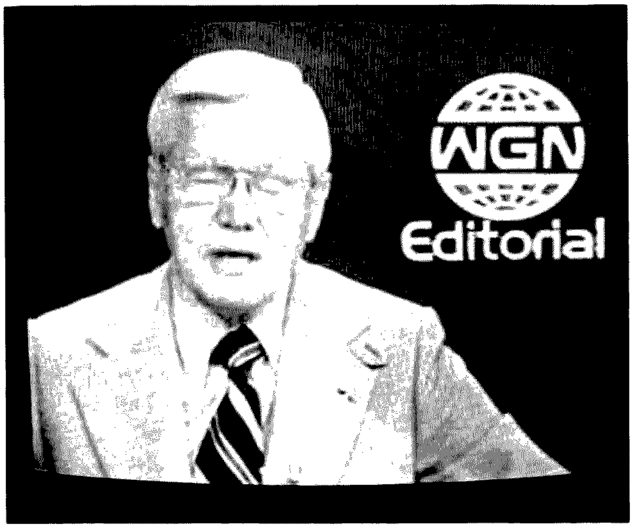

Photo D. Major market (i.e., big city), non-network stations, carried via satellite to cable firms across the country, provide a wide choice of movies, sporting events, and syndicated programs not seen on local televisions. Chicago's WGN, "the nation's highest-rated independent station" (or so they say), is presently on transponders on both SATCOM F1 and WESTAR II.

Photo E. SIN, or (the) Spanish International Network, is a consortium of US television stations in markets such as Miami, San Antonio, Los Angeles, etc., which have banded together to bring live Mexico City (Spanish language) programming into the US via WESTAR II. Bullfights, soccer matches, and a wide variety of Spanish soap operas, variety shows, and other entertainment fill the SIN channel approximately 12 hours per day.

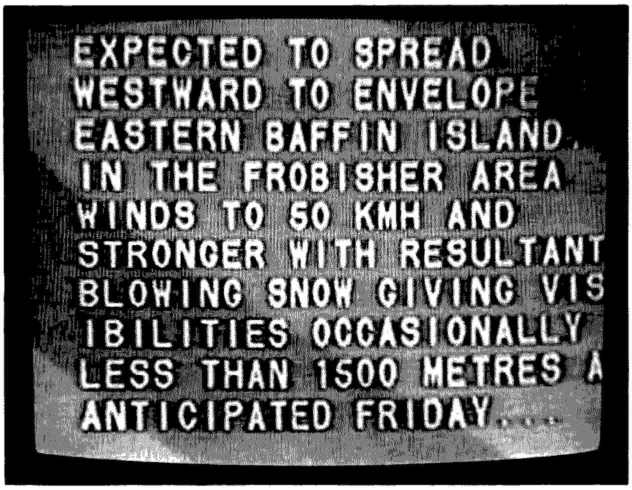

Photo F. Canada's three ANIK III television channels provide excellent diversion from US programming, since more than 50% of Canadian broadcasting now must be Canadian-produced. Weather reports for far northern Canada, Canadian coverage of US politics, and their own excellently produced documentary programs give one a broader slant on life than does US television.

of allowing private corporations to invest from 20 to 25 million dollars per satellite (for the bird itself), plus allowing these private corporations to rent launching services from NASA, in the hope that the firms launching such satellites can recoup their investments by renting out satellite relay services to qualified takers. A bird in orbit today represents between 40 and 50 million dollars invested. Compare that to OSCAR!

Following this opportunity, RCA has launched two such domestic satellites (a third is scheduled to be placed into orbit late in 1979), Western Union has launched three, and ATT/GT&E have launched three. Their orbital locations are shown in Fig. 5. Western Union satellites employ linear (horizontal) polarization, and they squeeze 12 separate video channels (known as transponders) of capacity into the 3,700- to 4,200-MHz downlink assignment. RCA and the telephone company birds (known as COMSTAR) employ dual polarization; they run one set of transponders in vertical uplink and vertical downlink and a separate set of transponders in horizontal uplink

Table 1. US/Canadian Domestic Satellite Channel Usage. Transponder assignments are not governed or made by the FCC (or DOC); they are subject to the engineering requirements of the various satellite operators.

SATCOM F2 (US domestic, 119 degrees west)

Transponder	Type of Video
4	Contract video, sports, and news
8	NBC pre-network feeds
10	Contract video, sports, and news
16	Contract video, sports, and news
18	Contract video, sports, and news
20	Contract video, sports, and news
22	Contract video, sports, and news
23	Alaskan Bush Terminal Video, half-transponder format

WESTAR I (US domestic, 99 degrees west)

Transponder	Type of Video
1	Contract video, sports, and news (networks)
2	Contract video, sports, and news (networks)
6	Contract video, sports, and news (networks)
8	PBS video (primarily eastern time zone)
9	PBS video (primarily central/mountain zones)
11	PBS video (primarily pacific time zone)
12	Contract and PBS video

WESTAR II (US domestic, 123.5 degrees west)

Transponder	Type of Video
1	WOR-TV, New York City (independent)
4	WGN-TV, Chicago (independent)
7	Spanish International Network (SIN) video, Mexico City
12	KTTV, Los Angeles (independent)

SATCOM F1 (US domestic, 135 degrees west)

Transponder	Type of Video
1	KTVU, San Francisco (independent)
2	PTL—Praise The Lord (religion)
3	WGN, Chicago (independent)
5	Star channel (east-coast and early west-coast feed)
6	WTCG, Atlanta (independent)
7	ESP (New England regional sports)
8	CBN—Christian Broadcasting Network (religion)
9	Madison Square Garden Events (sports)
10	Showtime (west-coast feed)
11	Warner Nickelodeon Children's Network
12	Showtime (east-coast feed)
13	KTBN—Trinity Broadcasting (Corona religious channel)
16	Fanfare (and shared feed for Holiday Inns of America)
17	WOR, New York (independent)
18	Reuters New Service
20	Modern Motion Picture Services, Penn State Sports
21	SPN (movies, sports)
22	HBO (west-coast feed)
23	HBO Family Channel ("Take Two")
24	HBO (east-coast feed)

ANIK III (Canadian domestic, 109 degrees west)

Transponder	Type of Video
4	CBC pre-network feeds, occasional use
8	CBC French-language television, 18 hours per day
10	CBC English-language television, 18 hours per day
12	CBC English television, northern TV service, 18 hours per day

and horizontal downlink. And they get away with this dual-polarization format inside the *same* 500-MHz bandwidth. By today's technology, this is just about the ultimate in frequency conservation since, in fact, two separate sets of signals manage to occupy the same spectrum at the same time, and they do so without interfering with one another!

Canada's domestic system (which was operational prior to the first US domestic satellites) fits the same operational format as the Western Union (WESTAR) birds. There are three of the Canadian ANIK birds with assigned orbital spots, although four have been launched. A recent (December, 1978) launch of ANIK-B is ultimately intended to be a replacement for one of the earlier ANIK-A-series birds. Although the Canadian system is run differently than the US system (the birds and their control stations are owned jointly by a government agency and by a consortium of Canadian telephone companies, operating under the trade name of TELESAT), it has the same technical operational characteristics as the US systems and will be described jointly with the US birds.

There are possibly three questions that might pop into your mind at this point. 1) Is it legal to set up a receiving terminal to access any or all of these satellites? 2) How much does it cost? 3) Where do I get the equipment or information necessary to build the equipment?

One question at a time. Is it legal? Yes, if you follow the proper guidelines established by the FCC or, in Canada, by the DOC. Basically, a geostationary satellite is nothing more than a common-carrier microwave relay station positioned in space. It is a broadband repeater not unlike the Bell or other microwave relay stations you see bundled atop nearby hilltops or tall buildings in your area. It is not a broadcasting station, like your local television station (although each is assigned call letters by the FCC), and the transmissions it relays are either privately owned or privately controlled. This means simply that under Section 605 of the Communications Act, you are not free to erect a station and receive the transmissions from a satellite *unless* you have obtained the permission of the owners of the programming material to access that material. The distinction here is that a satellite is a common-carrier relay station and its transmissions are not intended for the general public. They may ultimately be seen by the general public, but only after your local broadcasting station(s) or cable TV company have contracted with the owner of the program material to broadcast that material. This says, quite correctly, that the programming material on the birds is, by and large, privately owned while it is going through the satellite, and until you "buy a ticket of admission" you are not supposed to be enjoying it in your home.

There are thousands of backyard terminals now in operation or under con-

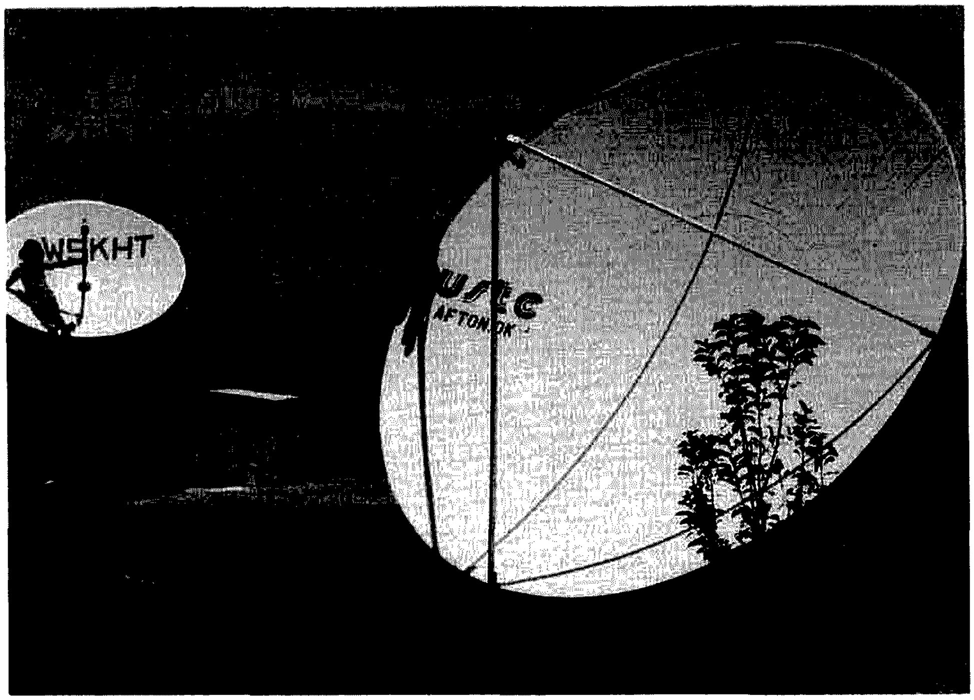

Photo G. Six-foot (left) and twenty-foot satellite antennas. The six-foot one is positioned on WESTAR I while the 20-foot one is on SATCOM F1. White reflective surface is essential to keep the sun's rays from "cooking" feed (and electronics there).

struction. Very few of these seem concerned about the legal requirement to obtain the permission of program owners before accessing the programs. Obtaining permission, at least from some of the program suppliers, is very simple, however. For example, the company that brings Atlanta WTCG and San Francisco KTVU up to the bird (Southern Satellite Systems) will grant a one-year use-right for an annual fee of $60 (per station). The religious channels (PTL, CBN, and KTBN) make such written grants without a fee. (I prepare a weekly program entitled *Satellite Magazine* which is distributed to the cable television industry on one of the satellites, and we routinely grant permission to access our program for no fee.) Table 1 summarizes current transponder usage.

Once you have written permission from a *single* program supplier, you then are able to complete FCC form 503, which is an application for an experimental radio receiving station license under Part 25. This one year, renewable license keeps you square with the FCC. The FCC is currently studying the possibility that satellite receiving terminals may not really need to be licensed after all, and perhaps before long, much of this paperwork will be a thing of the past.

How Much?

This is a tricky question because a great deal of the answer depends upon your own abilities, or the combined abilities of several people who agree to work together on the project. There are three essential elements to a TVRO (Television Receive-Only) terminal: the antenna, the antenna-mounted signal preamplifier (called an LNA, for low-noise amplifier), and the receiver itself. Fig. 6 shows the various parts of a typical satellite terminal. We'll look at each of these shortly.

When the first satellite programs for use by the cable television industry appeared in September, 1975, the terminals cost in excess of $100,000 each, installed. In those days, the FCC had a strange rule on the books which made it mandatory that a receive terminal utilize a receiving antenna with an aperture (diameter) of at least 9 meters. That translates to a parabolic dish antenna nearly 30 feet across—not something you would put in a normal backyard! Prior to the cable television industry's use of satellites for programming relay, the only intensive use of satellites was in the INTELSAT area. The big INTELSAT stations routinely cost several mega-bucks each, with receive antennas in the 50-100-foot class.

In December, 1976, acting on a petition that I drew up, the FCC removed the 9-meter restriction and began routinely to permit receive terminals as small as 4.3 meters (roughly 15 feet in diameter).

As a result of this change in FCC policy, the primary domestic industry utilizing satellites, the cable firms, has grown at an extremely rapid rate and is attracting all sorts of other industrial users of satellites. Back in December, 1976, there were but three channels or transponders in use for cable programming relay. By late spring, 1979, that number had grown to 20 on just one satellite, with another 4 to 6 on other satellites. The number of receive terminals installed by cable companies in operation in late 1976 was 75; now it is pushing 1,200 terminals and growing at a rate of nearly 100 per month.

A major motel chain (Holiday Inns of America) is currently installing the first of what will ultimately be perhaps 750 terminals. These motel terminals will be plugged into a special 14-18-hour per day satellite channel programmed with movies and sporting events available only at the affiliated Holiday Inns. Other major motel and hotel chains are expected to follow in short order. At least one national religious group (Full Gospel Businessmen International) initially will install around 350 terminals, which will be connected to local-service 100-Watt UHF translators operating in the UHF television band. Programming will be a mixture of the existing three religious programmed channels on SATCOM F1. And the surface is barely dented.

With volume production of satellite equipment now starting, the prices, not unexpectedly, are coming down. Cable firms are installing single-receiver 4.5-meter terminals for "as little as" $9,000 these days. And several hundred well-heeled individuals

have spent at least that much money to have their own backyard terminals.

Now, how cheaply can it be done? Taylor Howard W6HD of San Andreas, California, put his electrical engineering skills to work on the project at Stanford University where he is a professor. He ended up scrounging (in the best of amateur traditions) a 15-foot reflector surface and an azimuth-over-elevation mount from a surplus radar installation. Then he worked with some engineers at Hewlett-Packard, and, using the HP-6101-series bipolar transistors, he built a 2.8-to-3.0-dB LNA (low-noise amplifier) to mount at the feed of the antenna. Finally, for his receiver, he did some more scrounging and ended up with a surplus telephone company microwave communications receiver. Tay figures he may have $1,500 invested in the project, and his only real complaint is that his neighbors (when shown the pictures from HBO and other satellite programming sources) usually comment, "Yes, that's nice, but it's not any better than my Sacramento reception." People just don't have much appreciation for the technology!

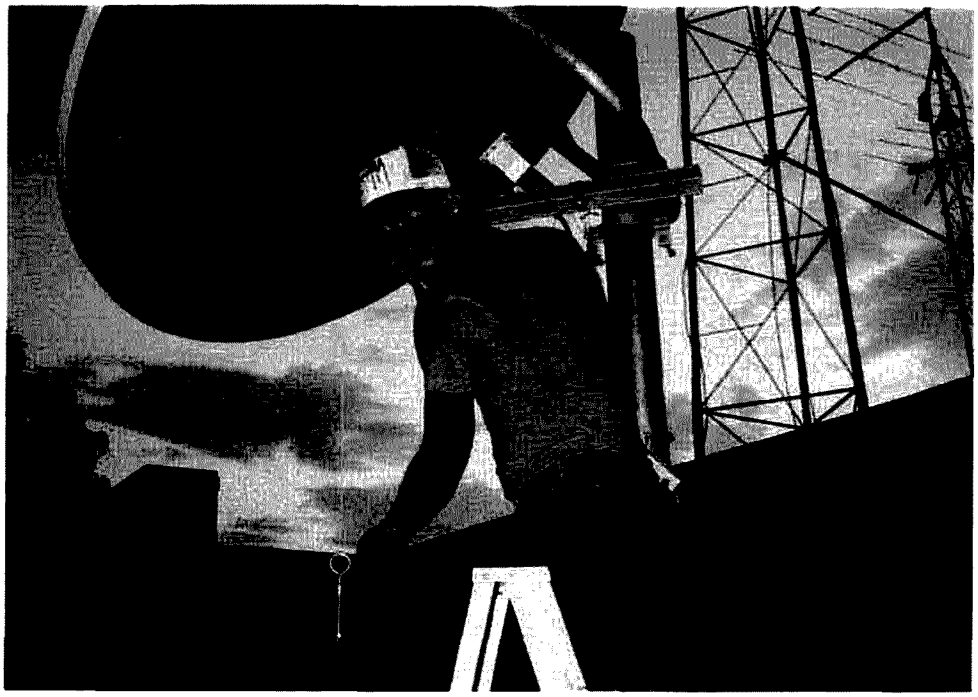

Photo H. The author checks the elevation angle on the six-foot satellite receive-terminal using a 29-cent protractor. The back of the dish presents a right angle to the feed, allowing use of a simple protractor with string and weight to check the elevation angle.

The quiet and steady development of backyard terminals by amateurs came into the full light of day this past October. In the October 21st edition of *TV Guide*, I had a short three-page article published which revealed just what a person could do in his own backyard. Thousands of telephone inquiries and letters later, a relatively clear pattern has evolved. There are apparently three types of enthusiasts out there.

1) Members of the *"I don't care what it costs"* group have socks filled with bucks and are willing to part with 12,000 or more of them to have a terminal installed by professionals. One energetic salesman for a major satellite terminal supplier took a stack of the October 21st *TV Guides* with him to Palm Springs and spent a weekend plying the country clubs. When he returned to his office the following Monday morning, he had ten checks in his pocket for $40,000 each, having sold that number of his firm's super-deluxe terminals simply on the strength of the *TV Guide* article!

2) Most people fall into the *"I don't have any money but I'd sure like one of those terminals"* crowd. Unfortunately, most of them also do not have any background which would equip them to sit down and assemble or construct the terminal on their own. Perhaps by 1983, or so, they will be able to walk into their neighborhood Radio Shack and buy such a terminal for around today's price of a TRS-80 computer. For now, they will simply have to sit and drool.

3) And, finally, there is the group that you probably fall into: the *"I don't have much money but I have a ham radio license and a background which should equip me to do most of this on my own"* set.

Of the three major elements in a satellite receive terminal, the antenna presents the best opportunity for individual effort. Some people will be fortunate enough to locate surplus or used dish (parabolic) antennas. A few of these may even come equipped with feeds for the 4-GHz range. But parabolic dishes are not that common, and the first wave of satellite TV enthusiasts has succeeded in driving up the prices and increasing their scarcity tenfold. Here are some parameters to watch out for.

1) The minimum dish diameter for most areas of the United States is ten feet. If you will look at Fig. 7, you will see an outline map of the United States and Canada with a set of "signal contours." For this particular satellite (RCA F1), if you are located within a 35-dBW or better contour, you can expect reasonably good reception with a ten-foot dish. In the 33- and 34-dBW contours, you will need a 12- to 15-footer. We'll come back to this.

2) The dish should have a design f/d (focal length to diameter ratio) in the .4 to .5 range. Most surplus parabolic surfaces will not have a feed attached and you will have to design your own (typically a simple horn antenna). Your feed should illuminate the total surface area and be 10-dB down at the edges of the dish surface. To simplify the design of the feed, the focal length should be in the range suggested.

3) The surface area need not be solid. The 4-GHz range is in the cross-over region where grid-wire or

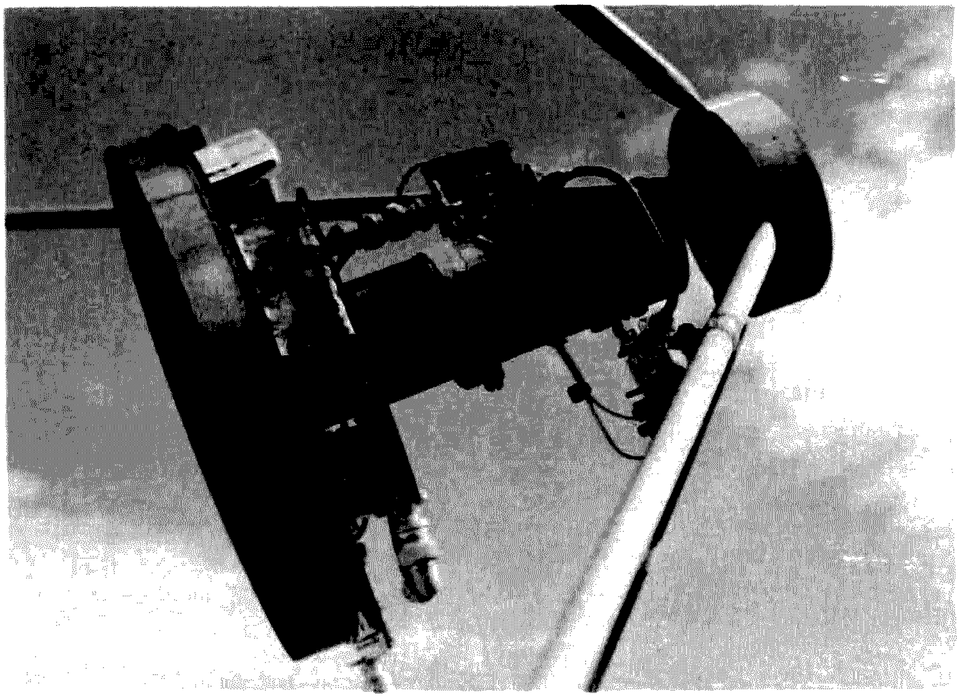

Photo I. G8AKQ's feed has two stages of low-noise amplification at the feed, with mixer, LO, and gain stages at his 450-950-MHz i-f also at the feed. The feed is a hybrid-mode scalar feed (corrugated horn) home-designed and built, allowing him to receive circular polarization from INTELSAT and Russian STATSIONAR satellites as well as linear-feed format birds.

fine-mesh reflector surfaces will work, but at reduced efficiency. Ideally, you will hope to have 55-58% efficiency from the antenna surface and feed combination to make the system operate properly.

You probably won't find a mount for the antenna, but if you do, the ideal mount is a polar mount system. Because there are numerous satellites in the sky, it is very handy to be able to install the antenna on a north-south (corrected) line and leave the elevation adjustment (i.e., up an down movement of the dish) alone, moving from bird to bird by swinging the antenna left or right (azimuth). This is what a polar mount does. The alternative to this is either an az-el (azimuth-over-elevation) mount or a fixed mount. Photo H shows an experimental six-foot antenna on a 4.5" fold-over pipe mount. The antenna is a terrestrial-style parabolic with a side-of-tower mounting kit which I have modified to allow manual elevation adjustment (a long support bolt that threads in and out to change the pitch, or elevation angle, of the dish). Azimuth adjustment is by the "armstrong" rotator method: You loosen some nuts and swing the antenna on the fixed pipe mount. A heavy prop-pitch motor could be rigged up to rotate the whole pipe just as well.

Another approach is simply to build the framework yourself and surface it with thin aluminum or galvanized steel sheet. One source[1] provides both plans and antenna kits for a 16-foot reflector surface, polar mount, and feed.

The antenna is the easiest place to make up system gain so that you can afford the luxury of less-sophisticated electronics. There is a very real trade-off possible between the noise figure (or noise temperature, as it is specified in these circles) of the LNA and the antenna gain. The satellite-to-Earth path is a long one with space losses in the 196-dB region. However, the long-term path loss varies less than ½ of one dB, so a receive-system designer can spend most of his time worrying about things like achieving an additional 1 or 2 dB of antenna gain, or lowering the LNA noise temperature by another 0.5 dB, with the expectation that such efforts will produce noticeable differences in his system.

The parameters of the system are shown in Fig. 2. It is an FM/FM system with 36-MHz-wide channels. Because it is FM video (and not AM video, as regular TV is) the system designer has the ability to take advantage of things such as the FM improvement factor and the "threshold" of noise. Getting the receive signal *above the threshold* is the key to high-quality reception, and slipping even half a dB below the threshold makes a big difference in the quality of the picture you see. For this reason, satellite terminal designers spend an inordinate amount of time looking for half-dB improvements, knowing that when they "make threshold" they are suddenly (and often dramatically, in terms of picture quality) "home free." The trade-off between LNA noise figure and antenna gain is summarized in Fig. 8.

All of this is another way of saying that, given an option, it is far better to build the antenna to achieve an extra couple of dB of raw signal gain than to assume that you can make up the difference (say between a 10-foot and a 16-foot antenna) with better quality electronics. This brings us to the electronics.

In the commercial area, virtually all LNAs are designed around mysterious little state-of-the-art devices called GaAs FET transistors. GaAs is short for gallium arsenide, a doping agent utilized in the manufacture of these very low noise, moderately high-gain transistors. Prior to GaAs FETs, if you wanted low-noise front ends at 4 GHz, you had to invest in parametric amplifiers priced upward from $20,000 each. With the advent of GaAs FETs, the cost of low-noise amplifiers "came down" to around $5,000 each for 2.5-dB-type noise figures at 4 GHz. More recently, 4-GHz preamplifiers have stabilized in the 1.5-dB noise-figure region at around $1,200 each.

Because of the very high losses in even 7/8-inch Heliax-type cable at 4 GHz (in the 3-dB region per 100 feet) and the extremely small signal margins (above the magic FM

threshold), the LNA is mounted directly at the feed of the antenna. Some experimental terminal designers, notably H. Paul Shuch N6TX, recommend that the LNA and the first downconversion stage (to a high i-f in the 1.2-GHz region) be located at the antenna feed.[2] A similar approach has been in use for two years by Steve Birkill G8AKQ, the world's foremost amateur experimenter in the satellite field. Ultimately, it is likely that many home terminals will be constructed in this fashion, but that is not fodder for this discussion. If the LNAs in use by the commercial folks are out of your price league, there is an alternate approach which hundreds of home terminals utilize.

Hewlett-Packard has an Applications Note (#967) which describes a single-stage amplifier producing around 10.5 to 11 dB of gain in the 2.6- to 2.8-dB noise figure region. By using two of their HXTR-6101 bipolar transistors, the circuit in the Application Note, and the board layout there, it is possible to achieve sufficient low-noise signal gain to drive perhaps 50 feet of 7/8-inch Heliax cable. To ensure that the noise figure of the HXTR-6101 LNA dominates the relatively high noise figure of the receiver (typically in the 11-14-dB region) it may be necessary to get into the 30-dB gain range with the LNA. Commercial units typically offer 50 dB of gain for this reason—as well as to allow for circuit aging.

This brings us to the receiver. Cable users first began buying receivers when they sold in the $10,000 to $12,000 range. More recently, a myriad of commercial receivers has appeared on the market including both tunable (i.e., covering all of the transponders) and single-channel (crystal-oscillator-controlled) models. Even with the stiffer competition and the market base broadening, satellite TV receivers remain expensive; the lowest-priced tunable units are in the $3,000 region, while the single-channel units are around $2,700. This is too high for most people.

The ultimate in low-cost receivers was assembled by a South Carolina amateur, Robert Coleman K4AWB. Robert has scrounged surplus equipment and assembled a fully operational home terminal for under $500. He even designed his own GaAs-FET LNA!

Another approach is the latest receiver designed by California's Taylor Howard. Starting out from scratch, Tay has created a widely duplicated receiver that tunes all 24 transponders, includes a bipolar LNA system, receives all of the audio subcarriers, and, using brand new parts from commonly available parts sources, can be copied for under $1,000 per "radio." Plans for both the Howard Terminal and Coleman (TD-2) Conversion terminal are available.[3]

Some home-brew terminal builders have taken advantage of one possibility by scrounging around for a Bell microwave TD-2 (video) receiver. Recall that (Bell) terrestrial microwave systems occupy the same 3.7- to 4.2-GHz range as the satellite downlink signals. With some work, these receivers can be made to function in this service. Other than sitting down and designing your own 4-GHz-to-baseband receiver, there are two other possibilities. Microcomm (H. Paul Shuch N6TX) has a series of modules which, when combined, make up a 4-GHz to 70-MHz i-f system in two downconversion steps. This particular system, if you elect to use all Microcomm modules, includes a

*Most US and Canadian domestic satellites transmit the accompanying audio on a 6.8-MHz FM aural subcarrier. However, certain of the WESTAR (Western Union) users prefer to utilize a 6.2-MHz FM aural subcarrier. Thus, a receiving system for "all possible" signals must be equipped for either subcarrier audio.

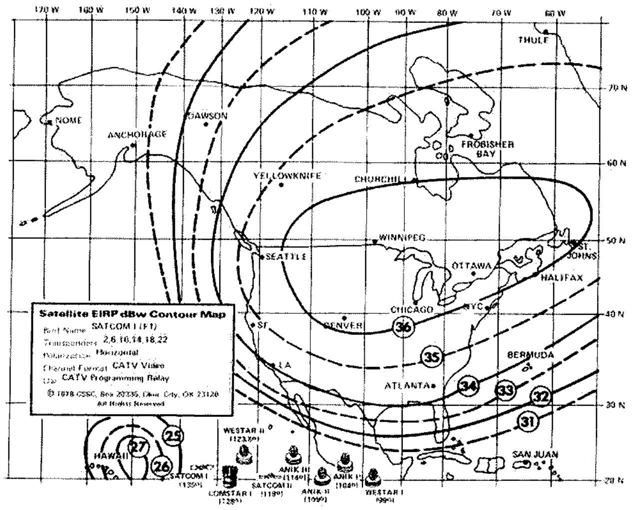

Fig. 7. This EIRP map illustrates the effect of carefully engineered "sculptured antenna radiation patterns" on the ground level signals from a satellite. WESTAR and ANIK-series satellites have a single pattern for all 12 channels, while SATCOM and COMSTAR satellites have four different patterns per satellite with six transponder channels grouped to a single transmit antenna (four such antennas per bird). Signal contours are in dBW (decibels above one Watt) nomenclature, with progressive circles in 1-dBW steps.

For An EIRP Area Of 36 dBW*

Antenna Diameter (60% efficiency)	Antenna gain	LNA noise figure	Video signal to noise ratio
6 foot (1.8 meters)	36 dB	1.0 dB	48 dB
8 foot (2.4 meters)	38 dB	1.7 dB	48 dB
10 foot (3.0 meters)	40 dB	2.6 dB	48 dB
12 foot (3.7 meters)	42 dB	3.8 dB	48 dB
15 foot (4.5 meters)	44 dB	5.1 dB	48 dB
20 foot (6.0 meters)	46 dB	6.6 dB	48 dB
30 foot (9.2 meters)	49 dB	9.2 dB	48 dB

***These numbers assume a 27-MHz i-f bandwidth, which creates an improvement over a full 36-MHz-wide bandwidth of approximately 1.3 dB without sacrificing baseband video picture quality.**

Fig. 8. Private receive terminal parameters. To determine (with 95% or better accuracy) the type of results you can expect with various match-ups in antenna size, LNA noise figure, and receiver i-f bandwidths, these numbers are useful. Note that you must first determine the EIRP in your area using EIRP maps available for this purpose.

Photo J. Six-foot antenna pictures from WESTAR I. This picture exhibits noise (known in the trade as "sparklies"); LNA in use when the picture was taken was a 1.5-dB noise level unit, about 0.5 dB too "high" for noise-free pictures.

24-dB-gain LNA built around the HXTR-6101 bipolar transistors, and when this is considered, the $1,700 price tag for the complete set of modules (wired and tested) may be cost-effective to some terminal builders. For individuals interested in the Microcomm approach, an applications note is available.[2]

The final approach at this time is to carefully study how the existing commercial receivers are designed and select the best of the various circuits to suit your own capabilities and pocketbook. A "Satellite Study Package" prepared to assist people in making a decision on the best way to go for your location is available.[4]

The Road Ahead

Having piqued your curiosity regarding satellite television terminals just a tad, some practical suggestions on what to do next might be in order.

There are only two things which usually create substantially lower equipment pricing. One is technological breakthrough and the other is very high volume production. Let's talk about both.

Back in 1971, a group at Stanford University studied the Earth terminal design vs. pricing conflict. They had a NASA contract which was part of a then-current proposal to launch a geostationary satellite to provide television reception to rural areas of Brazil. The group came to the conclusion (and developed the hardware to substantiate it) that with the 2.6-GHz satellite proposed, they could produce seven-foot parabolic antennas with feed, LNA, and receivers for well under a $200 material and labor cost per terminal, in 100,000-terminals-per-annum quantities. Brazil never bought the NASA proposed package, so the proposal more or less died.

More recently, the Japanese launched an experimental satellite called BSE. This one operates in the 12-GHz range, and to support the program (which is providing a channel of color television to all of Japan and Okinawa), the Japanese electronics industry has produced a small quantity (around 200) of experimental terminals. The Japanese have calculated the cost of the terminals in annualized quantities of 10,000, and they come to the conclusion that they could be built for a market cost of under $300 each.

So why do our terminals cost so much?

Two reasons, and they interrelate. In the Stanford study for NASA, a relatively low frequency for the downlink was assumed: 2.6 GHz. If you are rock-bound on 80 meters, 2,600 MHz may seem very exotic to you, but it is sufficiently low in the microwave spectrum so that exotic and expensive components such as GaAs FETs are not required for system design. The ability to use a $1.00 transistor in the front end versus having to use a $125 (GaAs FET) transistor is very important indeed!

In both the Stanford NASA study for Brazil and the existing Japanese BSE experimental bird program, the designers purposefully built a considerable amount of transmitter power into the bird itself—a subject we've not discussed up to this point. With the exception of the new ANIK-B satellite, the signals that wing their way through around 196 dB of space loss start out at the 5-Watt peak-power level. This output level (+7 dBW) plus the gain of the downlink transmitting antennas (28-29 dB in the center of the pattern) result in the EIRP pattern shown in Fig. 7: +36 dBW in the center or boresight of the antenna pattern. The Japanese BSE manages to start out with 200 Watts of transmitter power, and when that is coupled with its transmit antenna gain, the boresight (center) of the EIRP pattern is +55.5 dBW. That makes it around 20-dB hotter on the ground than our domestic satellites (and as much as 33.5-dB hotter than G8AKQ's INTELSAT signals which he receives in Sheffield, England!). On the surface, that translates to far simpler receivers, even when you add in the additional "free-space loss" that occurs at 12 GHz as compared to the 4-GHz downlink of the present domestic birds.

On top of that, you must remember that for a given size of parabolic reflector surface, each time the frequency is doubled the gain goes up 6 dB. On the receive end of the circuit, if you have 20 dB more signal at the antenna (because of the more powerful satellite signal) *and* antenna gain is 9 dB higher for a reflector surface of a comparable size than the same reflector would be at 4 GHz, some things can give. In the BSE experiment, two things "gave." First, they threw out the LNA and went directly into special diode mixers with noise figures in the 7-dB region. Then the BSE engineers reduced the size of the receive antenna (reflector surface) so that they had just enough antenna to provide a margin for system aging and some additional weather-effect losses that start to be troublesome in this frequency range. The net result is that 6-foot (1.83 meter) antennas, no LNA, and relatively simple single-channel receivers are practical with the BSE program. With these kinds of changes from our present domestic satellite system parameters, it is little wonder that the Japanese can bring the production costs down to the $300 range. Perhaps it is a wonder that it is so high!

As noted, space loss (from the bird to you) increases with frequency. While antenna gain goes up, LNA technology becomes more difficult with an increase in frequency and that translates to more expense. Fortunately, per-

haps, there is *no* need for LNAs at that frequency range. The receiver design stays about the same in either case, being more dependent upon frequency agility than input frequency.

Direct broadcasting satellites are something of a political problem. Regardless of who owns and operates them (i.e., government or private industry), there are many opposing forces pulling and tugging at the prospect of their operating in the United States. This leaves us coming to some logical conclusions about the next five years or more in the world of North-American satellite communications.

What You Can See

Commercially-constructed satellite terminals for the present 4-GHz band (although also perhaps for services not yet dreamed of) will proliferate. Battle lines already are forming to tighten satellite-to-satellite spacings in the orbit belt; present regulations require 4- to 5-degree spacing between birds operating on the same downlink band. RCA will have a shot at a 3-degree spacing late this year, and if that works, there will be room for perhaps six additional satellites serving North America. Experience has proven that with 4-degree spacing, when your 15-foot or larger antenna is pointed at one satellite, the interference from adjacent satellites cannot be detected on the television screen. It is there, but it is down so far in amplitude as not to be noticeable.

The American appetite for multiple channels of service will keep our future satellites multi-channeled. Having proven that 24 channels can be crowded into the spectrum space originally allocated to 12 channels through the use of dual polarization, future satellites will follow this format. Spectrum use (or maximum use of the spectrum) is a very important ingredient in space communications.

However, as long as it takes approximately as much solar power and battery reserve to operate one 200-Watt single-channel satellite (i.e., BSE) as it takes to operate twenty-four 5-Watt satellite channels, and additional solar power comes only at the expense of larger solar panels which come at the expense of larger rocket or Space Shuttle payloads, it is unlikely that short-term future American domestic satellites will go up in transmitter power much beyond their present limits. The recently launched ANIK-B has twelve channels with 10-Watt peak power aboard per channel, which results in Earth terminal antenna sizes within the boresight decreasing by the same 3 dB (or LNA noise figures going up approximately 3 dB); but that is for 12, not 24, channels. For the Canadians, having 3 dB more signal on the ground is more important to their space communications program than having another 12 channels of transponders available. Unlike the Americans, the *Canadians* have space spectrum to spare.

All of which suggests that, at least through 1985, it is unlikely that very many of the domestic satellite communications channels will be coming downward with very much more ground level signal than we now have available. Clearly, if advances are to be made in reducing the cost of the Earth terminals, it will have to be as the result of creative ground-station engineering. Much higher satellite powers are not likely for us in the foreseeable future. And that says, for all of the kitchen-table-building amateurs out there, that here is the type of frontier which fascinated the amateurs of the 20s and early 30s. The challenge of the 80s is in space communications.

The nitty-gritty of the challenge has been outlined for you here. Now, get out your tin snips, your micrometer, and your microwave diodes and go to work. Hundreds—no, thousands—are already at work on this project. A handful will make significant contributions to microwave state-of-the-art. A few will become wealthy beyond their wildest dreams. And everyone will become a part of the most fascinating television programming ever radiated from a transmitting antenna in or out of this planet we call Earth. ■

Photo K. Private terminal receiver designed initially for Canadian "backwoods terminals" features continuous tuning dial, tuning meter (with afc on and off switch), and selectable aural subcarriers. Unit (PT-1024) is manufactured by Satco, in Lewisville, Texas.

References

1. A 16-foot parabolic antenna designed specifically for the private experimental terminal user is available in either kit form or as a do-it-yourself project from a comprehensive set of plans from Paraframe, 611 Farmview Road, Park Forest South IL 60466.

2. An 8-page application note (#3), describing satellite TV terminal receive-system design parameters utilizing pre-wired and tested modules, is available for $1.00 plus an SASE from Microcomm, 14908 Sandy Lane, San Jose CA 95124.

3. The *Howard Terminal Manual*, describing complete construction of a state-of-the-art TVRO receiving system with LNA, and a 24-channel tunable receiver, is available; it includes complete schematics, board layouts where required, and part sourcing. The *Coleman TD-2 Conversion Manual* describes conversion of surplus equipment to TVRO reception service, plus details of the layout and construction of state-of-the-art GaAs-FET low-noise amplifiers for 3.7 to 4.2 GHz. Each manual is $30 alone, or both together are $50, from Satellite Television Technology, PO Box G, Arcadia OK 73007; (405) 396-2574.

4. A foundation in the world of geostationary (TV relaying) satellites can be acquired through the "Satellite Study Package." Included is a 72-page booklet describing the full satellite TV system, programming sources, typical system layout, and many references. Also included is a 22 x 35 four-color, two-sided "Satellite Wallchart" which details the operation of more than 30 geostationary satellites. The price is $13 US ($16 Canada) from Satellite Television Technology, PO Box G, Arcadia OK 73007.

A Three-Digit Timer for TTL Illiterates

—c'mon, tube fans, give it a try

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RD #1
Hopewell PA 16650

Since the publication of my article on the 10-minute ID timer in the May, 1977, issue of *73*, I have had some requests for a three-digit timer, as well as some embarrassing feedback because I neglected to show the power connections for the 7448 and 7400 ICs. (7448 IC pin 16 goes to +5 volts, 7400 IC pin 7 goes to ground, and pin 14 goes to +5 volts.)

A three-digit timer requires only two more LED readouts, two more 7448 ICs, 16 more 220-Ohm resistors, and one 7400 IC. The counters are already there, but need to be connected in another fashion.

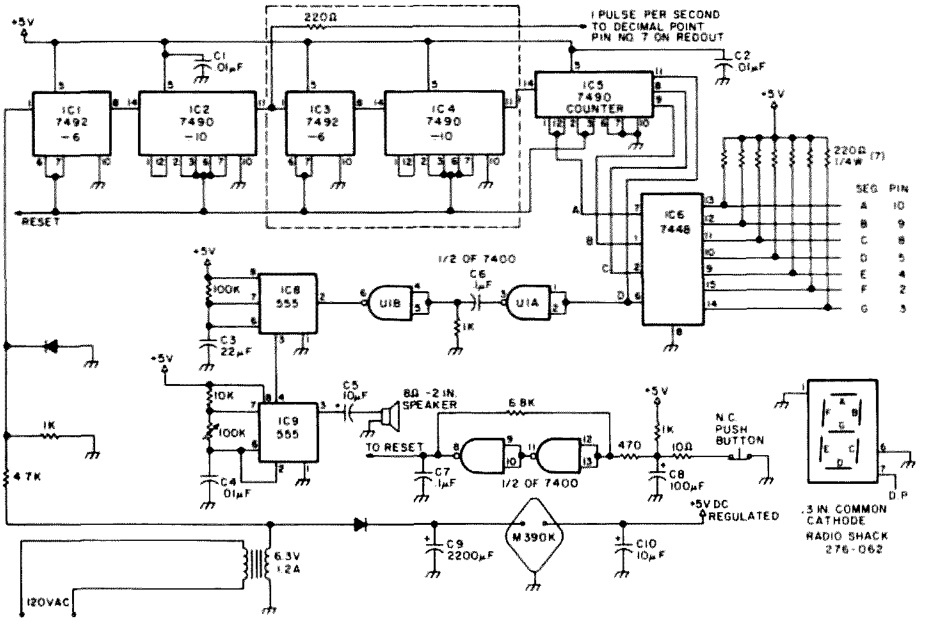


Fig. 1. The area which has to be changed lies within the dotted line.

Fig. 1 shows the area within the dotted line that has to be changed. The blinking decimal line is not used; IC3 and IC4 exchange places and are wired as shown in Fig. 2. The LED readouts have right-hand decimal points and, by inverting the middle digit, a colon is formed between the minutes and seconds digits. These decimal points are wired separately through individual 220-Ohm resistors to +5 volts. The segment hookup has to be reassigned for the middle digit. I will not describe this process, as you may possibly use another type of LED readout. This concludes the information needed to wire

the three-digit timer. I prototyped one, and another ham built a working model for his station console using larger readouts. I have not converted my timer, however. I am waiting for some ambitious cat to come up with a drilled PC board for the three-digit model.

I did not know how to reset that middle digit at the end of 60 seconds, so the following is an adventurous safari into the unknown. My first unfruitful attack was researching my old magazine issues for a cut-and-dried circuit to do the resetting job. This takes a lot of time because I found some neat projects and started to check the junk box. I could not find what I wanted, however; life isn't that long. Then the power of reasoning was tried. We know the counters are held low to count and made high to reset to zero. We needed a circuit that would reset the middle digit to zero at the end of six counts and we also wanted to manually reset the counters at any time.

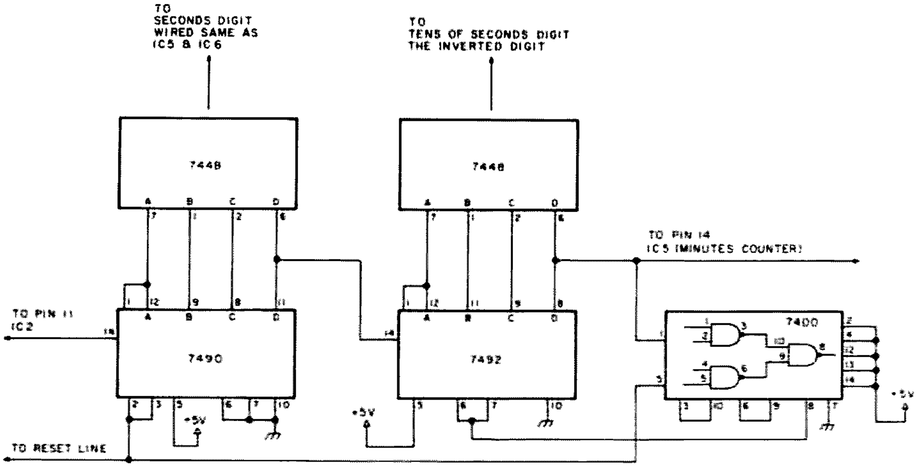


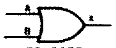
Fig. 2. Automatic reset of tens-of-seconds digit at end of 60-second count.

An examination of the truth tables in Fig. 3 shows that the 7492 was the ideal choice, as the "D" output goes high at the end of six counts and could be used for the high we needed to reset the counter. *The TTL Cookbook*, page 83, describing the 7492, stated, "The counter may be reset to zero by bringing either or both "0" set inputs positive." (These reset pins are #6 and #7.) Boy! This is going to be easier than I had hoped. All I needed to do was wire one reset pin to the "D" output and the other reset pin to the manual reset line. This first failure left me rather numb for some time. It took a long time to convince myself that there was a misprint in Don Lancaster's famous *TTL Cookbook*. My next source was the *TTL Data Book* by Texas Instruments. Fig. 3(d) shows the 7492 reset/count function table. It plainly shows that both reset pins must be made high to reset to zero.

The average TTL illiterate would have given up by now, but not this one. What was needed was a little black box with two inputs and one output so designed that a high on either or both inputs would give a high output to reset the timer; also, when both inputs are low, the output must be low to hold the reset low in order to count. This sounded a bit familiar and is described on page 128 of *The TTL Cookbook* as the OR gate. The truth table of the OR gate is shown in Fig. 3(a) and is exactly what I had been looking for. I am getting picky now, but I found another mistake on the same page. A NOR gate symbol is shown instead of the OR gate. The OR gate is not stocked here, so I used ¼ of the 7400 as shown on that same page, to custom-make the OR gate.

The purpose of this article is to illustrate to the novice and diehard tube addict who has never wired a transistor that they can have a ball playing with ICs. Almost all of my projects are one-shot deals, so I use the direct wiring method on .1" vectorboard for the projects I intend to keep. This is confusing when you turn the board over to do the wiring. Some people have been known to wire the wrong IC backwards. Wiring from a schematic is always a hassle, as the designer puts the pins anywhere for ease of drawing. It is much easier if you place a piece of carbon paper with the carbon side up under a plain piece of paper. Draw in all the components on the side just as they will be placed in your vectorboard. There is a tendency to crowd things, but this should be avoided.

I use sockets for all the ICs, as it makes for easier troubleshooting. It is nice to be able to try other ICs if a project fails, just to prove to yourself that you made a wiring error. Draw in all the wiring and make an over-sized period at every solder connection. When the working diagram is completed, turn it over and you are all set to go (if you had the carbon paper turned the proper way). Stick the components in the board, bending pins here and there to hold them in place. Heat up the old soldering iron and you are on your way to becoming a TTL addict. ■



OR GATE

A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

1/4 OF 7432
OR
3/4 OF 7400

(A)

7490

COUNT	OUTPUT D	C	B	A
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H

(B)

7492

COUNT	OUTPUT D	C	B	A
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	H	L	L	L
7	H	L	L	H
8	H	L	H	L
9	H	L	L	H
10	H	H	L	L
11	H	H	L	H

(C)

7492
RESET/COUNT FUNCTION TABLE

RESET INPUTS		OUTPUT			
R0(1)	R0(2)	D	C	B	A
H	H	L	L	L	L
L	X	COUNT			
X	L	COUNT			

X = IRRELEVANT

(D)

Fig. 3. Truth tables.

Mark Forbes WB9PHM
1009 Beech
Normal IL 61761

Sound for the CMOS Logic Probe

—keeps your eyes on your work

As mentioned in my previous article, "Ultra-Simple CMOS Logic Probe,"* sound can be added either in addition to the LED lamps or instead of any visual signal. This article describes a circuit which adds the sound option, and provides a design which meets the same criterion as the design for the logic probe: inexpensive implementation. A way devised to use a single 555 timer in its astable mode to produce three different tones. These tones are then amplified with a single op amp and fed to a speaker.

*Mark Forbes, "Ultra-Simple CMOS Logic Probe," *73 Magazine*, June, 1979, p. 50.

Operation

The operation of the audio circuit is really quite simple, although perhaps unique. As shown in the schematic, the use of the 4049 buffers must be included in the logic probe. These provide the necessary drive for the 555. The 555 is shown in the familiar astable configuration with one modification: Instead of pulling pin 7 to Vcc through a single resistor, three resistors are used in series and are driven high by the 4049s. The 1N914 diodes provide isolation. Since the time constant is directly related to the pull-up resistor, increasing the resistance lowers the frequency of the audio tone.

When no signal is present on the probe tip, the oscillator does not operate. When a low is present, the 6.8k resistor is effectively tied to Vcc, and a low frequency tone is heard. If a high is detected, an additional 3.3k is added and the diodes act in an OR gate fashion so that the path is from the HI inverter, through both resistors, to pin 7. A pulse signal acts similarly. It should be noted that a high overrides a low, and a pulse will override either. Therefore, if a pulse is detected, the corresponding tone will be heard even if a high or a low is already present.

From the 555, the signal is amplified by an LM386 audio amplifier. A high-low volume switch is provided to allow the volume to suit the conditions. The circuit will work at a reduced volume if the 555 is fed directly through a 27-Ohm resistor to a speaker. However, the LM386 is recommended.

Construction

My version of the audible logic probe was built on a Vero DIP prototyping board. This allowed easy placement of parts, and made the board narrower by eliminating circuit board foils. A circuit board could be made fairly easily if the builder so desired. The 555 and LM386 seem to be relatively immune to extraneous oscillations, so parts placement is not too critical.

Conclusion

After building and using the audible logic probe, I found a marked preference for this type over the visual type. First, the probe can be made quite thin and small since all the control circuitry can be housed remotely. Secondly, the audible tones allow the operator to keep his vision fixed on the circuit under test; he will not have to look at the lights. The addition of this device requires only a handful of parts; it is quite worthwhile. ■

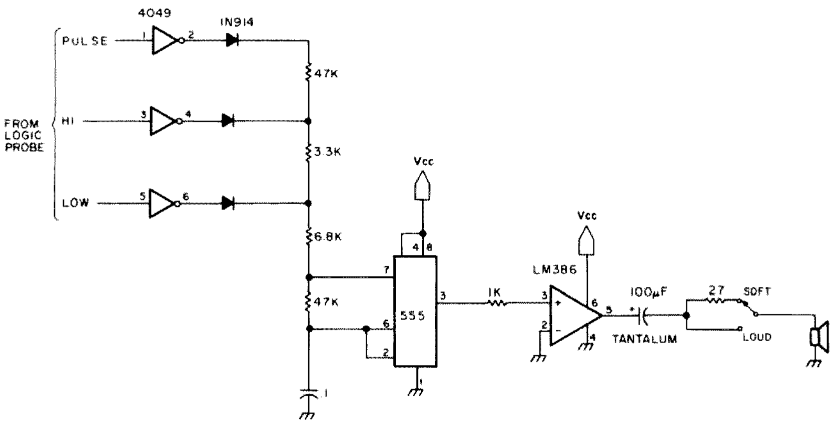


Fig. 1. Audible option for the logic probe.

Carl C. Drumeller W5JJ
5824 NW 58 St.
Warr Acres OK 73122

External Relay Control for Converted CBs

—switch anything with this setup

A simple accessory with many uses.

You can pick up new CB transceivers for very little cash. It's really not a difficult job to put these on the amateur 10 meter band. There's just one little catch: Very few CB transceivers have means of controlling external circuits. We radio amateurs, however, are accustomed to having means in our exciters for the control of external devices. This article describes a simple, easily constructed accessory that provides the missing control function.

Really, the circuit is just a third of a larger project, one that will use a CB SSB transceiver for operation on one of the Air Force MARS frequencies that lie far removed from any amateur frequency band and therefore require something other than the common amateur transceiver for operation. That project will be treated later.

For now, let's consider just what's needed to provide that control function. First, we'll need some means of sensing the rf generated by the transceiver when it's activated to the transmit mode. An isolating resistor backed up by a capacitor for further isolation, an rf choke for a return dc circuit, a signal-type diode, and a bypass capacitor take ample care of that job. Now the rf signal has been transliterated into a dc form, a form suited for actuating a transistor amplifier.

Although it might be feasible to use a single transistor to control a suitable relay, a pair of transistors connected as a two-stage dc amplifier can use readily-available components, ones you can pick up at Radio Shack or, better still, salvage off a surplus computer board. Such an amplifier can provide sufficient current to actuate a multi-pole, double-throw relay. Finding such a relay may not be an easy task. I was fortunate, as my junk box yielded several General Electric Company model CR2791 B100J3 relays. These are three-pole, double-throw relays that snap over firmly at a current flow well within the capability of run-of-the-mill transistors.

With the components identified, let's take a look at the circuit. You'll note that it's one well-adapted for laying out on a printed circuit board. For the prototype, I used a Radio Shack model 276-1392 perfboard and flea clips. This board also had the unexpected advantage of having suitable hole spacing for mounting the G.E. relay!

The values of the several components were arrived at by experimentation. In most cases, considerable latitude is permissible. For instance, R1 was varied from 500 Ohms to 5000 Ohms with no discernible effect upon circuit operation. The two .005-uF bypass capacitors may be replaced by any ones having low reactance at 27 MHz. Similarly, the rf choke was shifted from 45 microhenries to 2 millihenries with no undesirable effect.

A number of NPN transistors were tried. Most worked. A 2N335 was left

in the circuit solely because it was the last of a satisfactory series tested. The PNP is a bit more critical. It has to develop sufficient collector current to snap over a relay and hold it over for a considerable period. Therefore, it needs to be husky as well as being easily turned on. A number fell within this category. The 2N1381 does an excellent job, as do the Radio Shack HEP S5013 and HEP S0012. The one left in position was unmarked and was salvaged off a computer board.

Needless to say, the signal-type diode is highly uncritical. Just about any one will work and work well.

The 1000-microfarad capacitor across the relay coil may be omitted if you don't intend to use the unit with an SSB transceiver. Its function is to hold the relay actuated between spoken words. In the prototype, that particular value provided the desired delay. You may have to experiment to get the delay you want.

Now, let's talk about how the thing works! A signal is piped in through the R1C1 isolating (and power-reducing) combination to CR1, where it is rectified. The resultant dc circulates through the CR1-Ch1-C2-emitter/base junction mesh to trigger off TR1. Current then flows from the negative terminal of the power supply through TR1 through R2 to the positive power supply terminal. That resistor serves to limit the collector current of TR1 and should not be reduced appreciably in magnitude. The IR drop across R2 is applied through R3 (another current-limiting resistor) to the base of TR2, with C3 serving to bypass any residual radio-frequency component of the signal. That transistor (TR2) is inverted, having its emitter to the positive power supply lead. Its collector load consists solely of the dc resistance of the relay; therefore, a relay of at least 200-Ohms resistance should be used in order to limit the collector current to a tolerable figure. As mentioned earlier, capacitor C4 is used only to hold the relay contacts closed during the short pauses in SSB speech.

With the use of a multipole relay, a variety of control functions can be had. You may want to bypass an amplifier, turn off a power supply, or . . . you name it!

Build this unit. It's fun to build, and it has many uses. ■

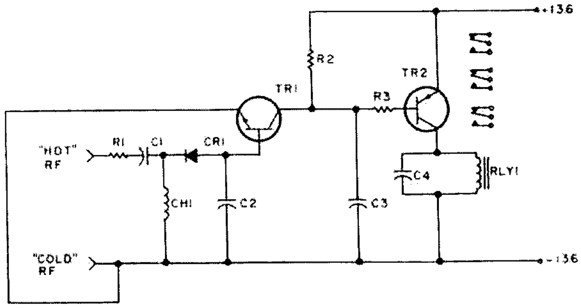


Fig. 1. Rf-actuated control unit. C1—47 pF. C2, C3—.005 uF. C4—1000 uF. R1—5000 Ohms. R2—2200 Ohms. R3—1000 Ohms. CH1—56 uH. CR1—signal diode. RLY1—General Electric CR2791 B100J3. TR1—2N335. TR2—2N1381. R1 is adequate for 4 Watts carried in a 52-Ohm cable; adjust for other powers or impedances. All resistors are ½-Watt. C1, C2, and C3 are mica. C4 is rated at 16 volts.

Reader Service—see page 243

Preserve Your Sanity with this Midland 509 Mod

—why put up with rotten noises?

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The Midland 13-509 is basically a nice radio. It does, however, have a few areas where there is room for improvement. One of the most obvious shortcomings of the 509 is the squelch circuit. It has been properly accused of a rather sharp attack, and a blast of noise when you let go of the mic button that becomes old after the second or third transmission.

There is a rather simple cure for these problems, and all it will cost you is a resistor, a diode, and about ten minutes of your time.

Fig. 1 shows the squelch circuit of the 509. The addition of a diode connected in series with a resistor from a keyed 12-V dc bus will keep the squelch switching transistor (TR-13) closed during the transmit period. This will eliminate the irritating blast of noise that was caused by the squelch circuit suddenly being energized at the release of the mic push-to-talk button.

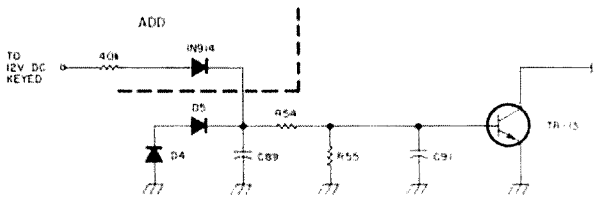

Fig. 1.

This modification also will broaden out the squelch action, which may or may not be desirable, depending on personal preference. If a harder squelch action is desired, cut C91 out of the base circuit of TR-13. This capacitor does nothing but delay the lockup of the transistor.

Placement of the parts is not very important, but take care that these new components do not short out anything in the adjacent circuitry. The +12 V dc may easily be obtained from pin 3 of the accessory jack at the rear of the radio. If a more sanitary approach is desired, I suggest point 27, near the speaker on the transmit board. I have used both points with equal results.

The slender lead of the 914 diode will probably slip right into the hole in the PC board, allowing installation from the top. If this method is not practical, attach the diode to the bottom of the board. Be sure that you have located the correct place for the connection, as all of that foil down there tends to look the same.

My experience has been that a small, slightly-obnoxious noise, frequently repeated, will become extremely irritating over even a short period of time. Think of this as you find yourself strangely enraged after what should have been a pleasant QSO in your mobile. Was it the weather, the traffic, or the "squelch tail" on your radio?

Modify your squelch and have a nicer day! ■

✓ Reader Service—see page 243

Touchtoning Your Memorizer

—Yaesu's made it easy

Tom Hart AD1B
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I recently purchased a Yaesu Memorizer for my two meter operations. This has been my first exposure to synthesized operations, and I've been very surprised at the amount of activity that I can hear while listening up and down the band. All in all, the Memorizer is an excellent buy and meets all of my expectations.

Fig. 1. Front view of Yaesu connector.

Since touchtone™ facilities come in very handy at times, I decided to look into using my Drake touchtone mike (model 1525EM) with the rig. The Yaesu manual does not give any data on the microphone requirements, so I checked the schematic. It appeared that the rig is factory-wired to provide 12 V dc at the mike connector. A check with a VOM showed that pin #4 does provide the voltage necessary for the pad and that no internal modifications would be required. I rewired the Drake microphone with a Yaesu connector as shown in Fig. 1.

The new arrangement works quite well and no adjustments were necessary to the tone levels. It worked on the first try. What's more, the new mike caused no loss to the audio qualities of my golden tones while in the windbag mode. So, if you want to use a touchtone pad with your Memorizer, this arrangement will work quite well. ■

✓ Reader Service—see page 243

Si Dunn K5JRN
c/o The Dallas Morning News
Dallas TX 75265

The Small But Mighty Arboreal Aerial

—tree-hanging triband vertical

Living in apartments these past five years, I've learned a lot about short antennas, bent antennas, and antennas with traps. I've had to. I simply haven't had the room to put up the kinds of antennas that I would really like to have. Fortunately, I've usually had a small patch of dirt and a sturdy tree outside the window. By stringing up, over the years, an assortment of temporary wire antennas running to the nearest tree limb, I have been able to make many good contacts on all bands from 160 meters to 2 meters. And I've done my DXing with low power to minimize TVI and CQs coming out of the speakers of neighbors' stereos.

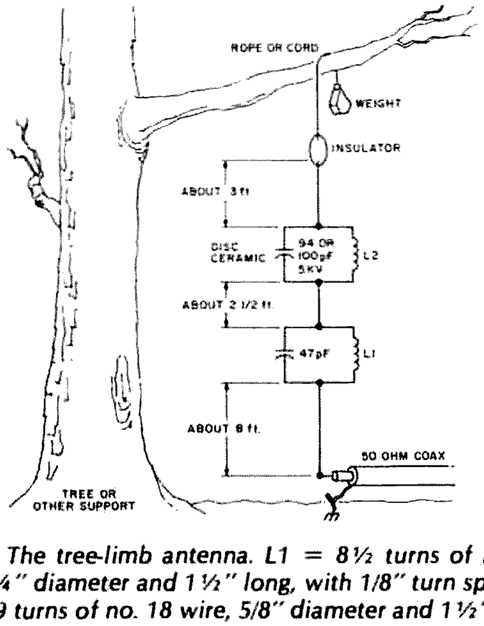

Fig. 1. The tree-limb antenna. L1 = 8½ turns of no. 18 wire, ¼" diameter and 1½" long, with 1/8" turn spacing. L2 = 9 turns of no. 18 wire, 5/8" diameter and 1½" long, with 1/8" turn spacing.

An efficient three-band vertical for power levels under 200 Watts can be made cheaply with wire, insulators, and homemade traps. The wire vertical that I've used for more than two years can be suspended from a tree limb or other support. It can be bent, sloped at angles up to 45 degrees or more, used indoors, rolled up and taken on camping trips, or tossed out an upstairs window to work as an "inverted vertical." Some sort of ground system is necessary, and a network of radial wires beneath the vertical could make it perform as well as a store-bought trap vertical.

You also can make two of these wire antennas for 20, 15, and 10, hook them to coaxial cable in the usual dipole fashion, and have a dandy three-band antenna for horizontal or vertical mounting.

A grid-dip oscillator is necessary to adjust the traps to the right frequency range. To protect the traps from rain and ice, I enclosed them inside plastic film canisters that come with Kodak 35mm film. Punch holes in the lid and the bottom just big enough to pass the ends of the wire. The holes and film canisters will be sealed later with glue or varnish, after the traps are installed.

Begin by cutting a piece of antenna wire to a length of 8 feet 6 inches. Connect one end of this wire to your coax and ground system. Suspend the other end vertically from an insulator and a support. Using your swr bridge as a guide and a few Watts of 28-MHz rf, trim the antenna from the top—a half inch at a time—for the lowest swr in your favorite section of the 10-meter band.

Take down the wire temporarily and build the first trap. I used a 47-pF, 5-kV disc ceramic capacitor hooked across 8½ turns of no. 18 wire, ¼ of an inch in diameter and 1½ inches long, with the turns spaced by 1/8 of an inch. Do not solder the leads together until you have trimmed the coil to resonance at 28

MHz using the grid-dip meter. Then install the trap in its case and solder one lead to the top of the wire previously trimmed for lowest swr on 10 meters. Solder a 3-foot piece of antenna wire to the top lead of the trap, suspend this combination from a support, and trim the top section for lowest swr on either 21 MHz or your favorite section of the 15-meter band. On my antenna, this top section turned out to be 2½ feet long.

If you want only a 15- and 10-meter trap vertical, you can stop right here and put the antenna up in the air. But if you add just one more trap resonant to 21 MHz and another 3 feet of antenna wire, you can operate 20 meters as well. My second trap consists of two 47-pF, 5-kV disc ceramics in parallel (94 pF total capacity—or use 100 pF) hooked across 9 turns of no. 18 wire, 5/8 of an inch in diameter, 1½ inches long, with the turns spaced by 1/8 of an inch.

Using the grid-dip meter, trim the coil and capacitor combination to resonate at 21 MHz. Then solder the trap to the top of the wire previously trimmed for lowest swr at 21 MHz. Solder 3 feet of antenna wire to the top of the trap and trim the wire for lowest swr on 14 MHz.

Hang the wire securely from a tree limb or other support and put it on the air. The whole antenna is about 14 feet long.

I don't make any great DX claims for this antenna, but it has helped me reach all continents with 180 Watts or less. And I haven't had to give up ham radio just because I live in an apartment.■

What Do You Do When Your Rotator Dies?

—you fix it . . . like this

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The Problem: After several decades of faithful service, the control unit of my Ham-M rotator ceased functioning. A postmortem examination revealed a dead 130-microfarad, 50-volt alternating-current motor-starting capacitor.

The Non-Solution: A quick survey of electronic supply stores showed that no such capacitors were available. A visit to electrical supply houses revealed numerous motor-starting capacitors, but none was physically small enough to fit into the space within the control unit housing.

The Solution: Two 150-microfarad, 50-volt electrolytic capacitors and two 100-volt, 3-Ampere silicon rectifiers were used in the circuit shown. The control unit was resuscitated.

Another interesting situation came to light during the repair job. The meter had been intermittent, sometimes operating normally, sometimes quite dead. The cause was the 1/16-Ampere fuse used in series with it. This is indeed unusual. A fuse normally is fully conductive or unmistakably open. This one probably had a mechanical discontinuity instead of having been blown. The original one was soldered in place, an action fraught with peril to the delicate interior conductor. A clip-type fuse holder was installed to minimize the probability of future trouble.

For those interested in the theory of the functioning of the circuit, the explanation is simple. During any half-cycle, one capacitor is shorted by its associated diode. It might be presumed that having two capacitors in series, the resultant capacitance would be halved. This, however, is not the case because the diode acts as a bypass for the capacitor during every half-cycle. ■

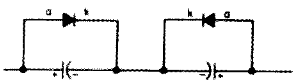

Fig. 1.

Beams vs. Linears: Which Should You Buy First?

—get the most bang for your buck

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Many hams who would enjoy the performance and convenience of a rotary beam antenna hesitate to consider this alternative because of the cost. Instead, they purchase a linear amplifier with hopes of making up for the lost antenna gain with power. This is not only a less desirable solution from the standpoint of "spectrum pollution," but it also results in less performance and more dollars spent, making it a poor choice indeed. Why? Read on.

First, consider the average amateur installation prior to purchasing either a beam or a linear. The transmitter input power is about 180 Watts, and the antenna is a trap vertical. The effective radiated power on twenty meters is given by: $P_{erp} = (P_t)(\eta_t)(\eta_a)(10^{.1G_a})$, where G_a = antenna directive gain (dB); P_t = transmitter dc input power (Watts); η_t = efficiency of transmitter final (%); and η_a = antenna radiation efficiency (%).

For a trap vertical, therefore, the directive gain is approximately 0 dB, and the radiation efficiency is anywhere from 10 to 50% depending on the radial system and traps. Assuming the best, say 50%, and assuming a transmitter efficiency of 70%, the resulting erp is 63 Watts.

Now, consider the addition of a medium power amplifier—say a Heathkit SB-200 or Yaesu FL-2100A, with 1200-Watt PEP input power. The resulting erp is now 420 Watts! Sounds pretty good, huh? Well, maybe so. But first let's see what a moderate beam can do.

Consider the Hy-Gain TH-3 Junior. This is an extremely lightweight (26 pounds) beam which is small enough (12-foot boom, and approximately 25-foot elements) to be turned by a TV rotor. The TH-3 Junior boasts a gain of 8 dB over a dipole, or 10.4 dB over isotropic. And the efficiency is essentially 100%. Let's see how this stacks up against the linear. The erp of a 180-Watt transmitter with a TH-3 Junior is a whopping 1382 Watts!

This is not to mention other advantages of a beam over a vertical. First, a beam will improve the strength of the signals you hear as well as your own signal. (Remember the old addage: "You can't work 'um if you can't hear 'um.") Also, the directivity of the beam may often be used to reduce QRM from stateside stations, etc., or even line noise. Finally, TVI is reduced whenever an antenna system is raised to a higher location.

Okay, you say. But what about cost? That's the best part. First, what is the best deal on a medium-power linear amplifier that you can hope for? The Heathkit® SB-201 is about the best buy for the money at $449. A three-band rotary beam, on the other hand, can be yours for the bargain price of only $243.70, including tax, rotor, and mounting hardware. Table 1 gives a cost breakdown for the antenna and associated hardware. Notice that, with the exception of the antenna (a Hy-Gain TH-3 Junior available from most ham dealers), all other components are available at your local Radio Shack store.

By mounting the antenna on the roof, one is able to get about 15 to 25 feet of height for free, thus making the overall height about 30 to 40 feet, depending on the house. While not optimum for long-haul DX on 20 meters, this antenna will perform

quite respectably on 15 and 10 meters, and will be considerably better than a vertical even on twenty. My wife (WA4WQH) has, at last count, totaled up 101 countries on just such an antenna, driven with a KWM-1!

Although the TH-3 Junior is my personal choice, there are several other antennas which might fit the bill. Mosley, for example, has the TA-33 Junior for only $130.00. Several companies offer lightweight quad kits, and even a CB antenna turned horizontal would be a good bet. If you just can't bear to mount the antenna on the roof of your house, a telescoping mast could be substituted for a slight increase in cost. Any way you do it, such an antenna system will be the best buy in a linear on the market. 73 and good DX.■

15-1220	Archer servo-rotor	$54.95
15-842	5 ft. mast, 1-1/4"	3.29
15-843	10 ft., 1-1/4" mast	5.99
15-517	Heavy-duty tripod	15.95
15-888	Universal mount mast anchor	1.19
15-1204	50 feet of rotor cable	3.99
278-971	50 feet of RG-58/U	9.95
15-825	Guy wire anchors (2 sets)	1.18
15-829	Turnbuckles (2 sets of 2)	1.58
15-031	100 feet of RoH galvanized steel guy wire (2 each)	1.89
	TH-3 Junior antenna	129.95
		$229.91
	Alabama sales tax 6%	+13.79
		$243.70

Table 1. Cost breakdown.

Dr. Barry S. Fromm K8SD
3107 Ridgecrest Rd.
Greenville TX 75401

The Chicken Delight Beam

—a tasty morsel for 10

Requires a Crossbow.

The Chicken Delight 10 meter beam is a quick, inexpensive, and effective monoband yagi. There's no need for truck or UPS shipments, just a trip to Radio Shack.

The main ingredient is a Radio Shack Archer® 3-element CB (known around these parts as chicken band) beam. This one is stock number 21-933, known as the Crossbow™ III. This lightweight beam can be easily modified for 10 meter operation. The element spacing and lengths must be changed as well as the gamma match network.

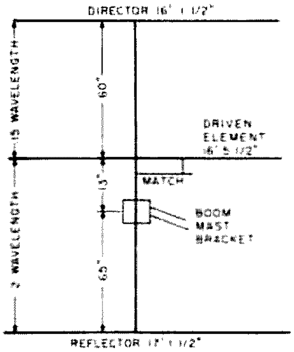

Fig. 1.

The Dimensions

The distance between the reflector and the center of the boom mast bracket remains at 65", but the boom bracket center to the driven element dimension is shortened to 13". The driven element to director distance is increased to 60". These dimensions create a yagi with a .2-wavelength reflector spacing and a .15-wavelength director spacing. The reflector element length is 17' 1½". The driven element length is 16' 5½" and the director length is 16' 1½". These dimensions place resonance in the phone portion of the band. Transposing the above dimensions directly to the assembly instructions makes for rapid construction of the antenna.

The gamma match will need to be readjusted a small amount from the 11 meter setting. This adjustment will need to be made on an individual basis. An easy way to adjust the match is to place the beam on end, with the reflector against the ground and the antenna pointing straight in the air. Matching performed in this manner is usually close enough for practical purposes. The construction of the match is good and it takes legal-limit rf easily.

I recommend using a small quantity of anti-corrosion compound where the elements slide together, a dab of RTV on each element end sheet metal screw head, and plenty of RTV on the gamma match coax connector.

Because of the beam's light weight, it is easy to erect and may be turned by a light-duty rotor.

The performance of the Chicken Delight is far superior to the 10 and 15 meter interlaced duobander I also have up, even though the duobander is 30' higher in the air.

There is no doubt the Chicken Delight is an inexpensive, effective beam. There now can be no excuse for not using a yagi on 10 meters.■

The TR-7500 Goes Inverted

—see you on the flip-flop

Put it in reverse.

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Poughkeepsie NY 12603

The Kenwood TR-7500 is a beautiful 2 meter FM rig. It is synthesized and has a 50-position channel switch, which, together with a +15 kHz switch, gives 100 channels. It also has selectable ±600 kHz transmitter offset and simplex for each channel. The rig comes set up with 44 × 2 = 88 preprogrammed channels to cover all repeater and most simplex frequencies listed in the ARRL 2 meter band plan. For what more could you ask?

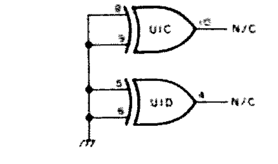

Fig. 1. The unused inputs (pins 5, 6, 8, and 9) of the IC are grounded. This is good practice for any CMOS project. U1 = 4070 CMOS "quad exclusive OR" IC. R1 = 47k Ohms, ¼-Watt resistor.

Well, you could ask for the rest of the simplex channels (147.57, 60, 63, 66, and 69). And that's no problem: The TR-7500 has a diode program board which allows you to program six frequencies of your choice. The above-listed simplex frequencies take five of the six channels. Now you have all repeater frequencies and all simplex frequencies, and one channel left on the program board. What do you do with that one channel?

How about programming it for your favorite repeater's input frequency so you can go reverse if the repeater is down and you want to QSO with your rock-bound buddy? Or perhaps you want to be able to listen on the input to determine if you are in direct range of another amateur? Good! Just program the remaining channel for the favorite repeater's input frequency. Suppose, however, there are two or more favorite repeaters? Which simplex frequencies do you give up? Another problem with programming the repeater input frequencies (at least in my case) is that the programmable channels are on the opposite side of the channel selector switch from the repeater output frequencies. In switching from output to input and back, I'd miss half the conversation.

After going through all of the above within the first couple of months of purchasing my 7500, I decided to look for a better way. The squelch knob has a pull-on push-off switch which is meant to control an optional subaudible tone encoder. I had no intention of installing that option on my rig, which meant that there was a free switch on the front panel. I decided it would be nice if I could go reverse by simply pulling out the squelch knob.

This modification will allow you to do just that. It is inexpensive (a resistor, an IC, and an IC socket) and very easy to install. No circuit board lands have to be cut. Just unsolder a couple of wires and add more. The modification has performed flawlessly for several months in my rig, and for about a month in a friend's rig.

The circuit works quite simply (see Fig. 1). The two exclusive OR gates are used as controllable inverters. The two lines inverted are labled RS and TS on the 7500's schematic. These lines control the selection of the correct offset crystal during transmit and receive. For normal operation (squelch knob pulled out), the simplex crystal is used for transmit and the receive crystal is selected by the transmit offset switch.

The circuit is constructed on the bottom of a 14-pin IC socket (see Fig. 2). All leads are brought out, the IC is plugged in, and the whole assembly is wrapped in electrical tape. (Be careful not to short anything when applying the tape.) The front panel, diode program board, and the transmit offset switch are removed. The red and yellow wires are unsoldered from the offset switch. The red wire is TS and the yellow wire is RS, coming from the phase locked loop circuit board. The red wire goes to TSIN in Figs. 1 and 2; the yellow wire goes to RSIN. TSOUT is soldered to the lug of the offset switch from which the red wire was removed. RSOUT is soldered to the lug from which the yellow wire was removed. The wire labeled "from SUB switch" is connected to the orange wire coming from the back of the squelch control. This wire comes

soldered to the small PC board on the back of the power selection switch (see the 7500 owner's manual). Plus nine volts can be taken from the brown wire, which is plugged into the driver circuit board at the point labeled C9. Don't unplug this wire, just solder to it. A convenient ground can be found next to the microphone jack. The completed circuit is fitted into the clear spot on the driver circuit board, where the subaudible tone assembly is meant to go. The rig can now be reassembled.

Operation is a joy; just dial your local repeater normally, including setting the normal transmitter offset, pull out the squelch knob, and you are operating reverse. Note that when the squelch knob is pulled out, the transmit frequency is displayed on the LED readouts; the receive frequency is set by the transmit offset switch. After using this mod a couple of times, you'll wonder why it wasn't included as original equipment in the rig. ■

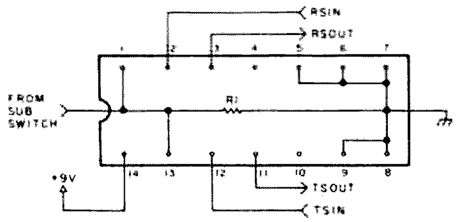

Fig. 2. Bottom view of the 14-pin IC socket.

Ready for the New Repeater Subband?

—your FT-221R can be

Simple mod does the trick.

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With the announcement by the FCC of the opening of 144.5 to 145.5 MHz of the 2 meter band for repeater operation, many of us were caught with rigs that would not operate in that portion of the 2 meter band. In my case, I have a Yaesu FT-221R.

Not wanting to spend a lot of money for a new rig, I decided to find another solution to the problem. After looking over the schematic diagram, I decided that a simple modification should do the trick. So, after about thirty minutes of work, I was on the new subband. I'm sure there are other ways of modifying the FT-221R to operate on the new subband, but this way seems to be the fastest and the simplest. It requires only the addition of one crystal, one jumper wire, and the relocation of two wires.

The crystal required is a 13.96666 MHz in an HC-25/U holder, shunt capacitance 34 pF, drive level 5 mW, resistance below 20 Ohms, tolerance 20 ppm, fundamental mode.

The modification steps are as follows:

1. Place the new crystal in crystal socket X09 on PB-1454 (local unit).
2. Place a jumper between terminals 3 and 6 on S2B (bandswitch).
3. Remove the wire on terminal 6 on S2C and place it on terminal 3.
4. Remove the wire from J18, pin 6 (PB-1459), that runs to S8 and place it on pin 4 of J18. Be sure to select the correct wire on pin 6 because there are two of the same color.

After the modification is completed, TC09 on PB-1454 may be adjusted to trim the crystal frequency for exactly 600 kHz offset. When this modification is incorporated in the FT-221R, it will be necessary to place the 600 kHz-Aux switch in Aux position when operating 144.5-145.5 and in the 600 kHz position when operating 146-148 MHz. ■

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Panama City FL 32407

Grady Clark W4RYY
213 Sandifer Road
Athens AL 35611

"Hey! That Sounds Like .01 uF!"

—intended for the blind, this audible multitester is great for everyone

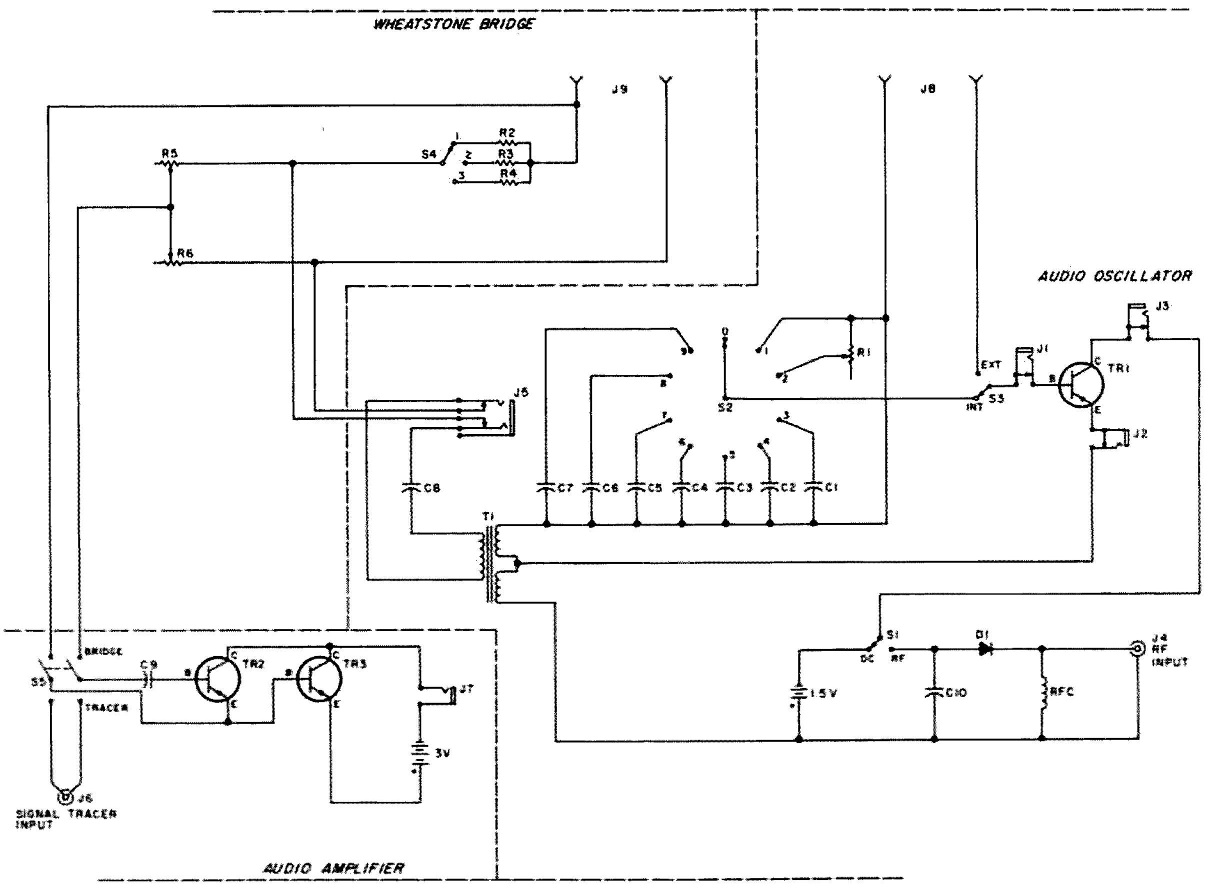

Fig. 1. Circuit diagram.

This article describes a simple but versatile test instrument designed especially for use by the sightless radio amateur or electronics experimenter. Although it may also prove useful to persons of normal vision, the instrument does not require the sense of sight for its use. All measurements of which the instrument is capable can be made using only the auditory and tactile senses. This is accomplished by 1) nulling or peaking an audio tone, 2) comparing and matching the pitch of audio tones, 3) counting the time-rate of audio pulses, or 4) reading by touch from dial plates especially suited to that purpose.

The two dials that must be read by touch are the controls for variable resistors. Dial reading is greatly facilitated by using variable resistors of the Helipot® or Spectrol® type. These are precision potentiometers requiring exactly ten turns of the control shaft to cover the full range of resistance with a high degree of linearity. When fitted with a pointer knob and a dial plate divided into ten equal divisions marked by raised dots, variable resistors of this type can easily be read by touch, in increments of one one-hundredth of the total resistance. For example, with the 10k-Ohm Spectrol, each revolution of the knob represents 1,000 Ohms and each dial division represents 100 Ohms; similarly, with the 200k-Ohm Helipot, each knob revolution represents 20,000 Ohms and each dial division, 2,000 Ohms.

Our dials were cut from thin sheet aluminum, and are about 2 inches in diameter. The raised dots marking the dial divisions were made with a center punch from the reverse side. Two dots were used at the 12-o'clock position to mark the fiducial point of zero and full resistance.

When used with appropriate test probes to be described later, this instrument has the following capabilities:

1. Checks continuity of circuits.
2. Provides an audio signal source of variable pitch for test purposes.
3. Measures capacitance from 0.0015 uF to 20 uF or higher.
4. Measures resistance from 10 to 200,000 Ohms.
5. Determines polarity of electrolytic capacitors.
6. Serves as an audio amplifier for weak signals.
7. Serves as a signal tracer for either audio or modulated rf/i-f signals.
8. Serves as an rf detector, transmitter tuning indicator, approximate frequency meter, or CW keying monitor for rf signals.

Circuitry and Applications

Fig. 1 shows the circuit diagram of the test instrument. As indicated in this figure by the dashed lines, the circuit is comprised of three basic elements: an audio oscillator, a Wheatstone bridge, and an audio amplifier.

The heart of the instrument is the audio oscillator, which can be powered by either an internal battery or an external source of rf energy. The oscillator uses a 2N107 PNP transistor in the familiar Hartley circuit. Inductive feedback is provided by T_1, which is a vertical blocking oscillator transformer from a TV set. In our case, this transformer is a Merit A-3001, with one primary and two secondary windings. The ratio of primary to secondary #1 is 1:48, and the ratio of the primary to secondary #2 is 1:1. These ratios are not critical, and any transformer of approximately similar characteristics should

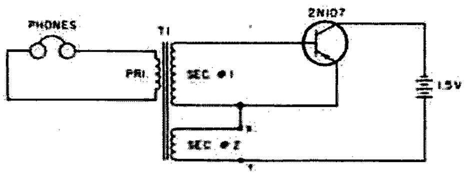

Fig. 2. Basic oscillator circuit.

serve. It is important, however, that the two secondary windings be connected so as to provide positive feedback for oscillation. The simplest way to determine the proper connections to the transformer is to temporarily hook up the basic oscillator circuit with clip leads as shown in Fig. 2. If oscillation is not obtained, as indicated by a low-pitched buzz in the phones, reverse the connections of secondary #2 at points X and Y.

A characteristic of this oscillator is that the frequency of oscillation can be varied over a wide range by inserting different values of resistance, capacitance, or inductance in series with the base lead of the transistor. Low values of series resistance produce low-pitched tones, and high values, high-pitched tones; whereas low values of series capacitance produce high-pitched tones, and high values produce low-pitched tones. The frequency of oscillation is highly sensitive to small variations of this kind, so that even quite small variations in series resistance or capacitance can be detected by a keen sense of pitch, which most sightless persons possess.

The important point, however, is that two resistors of equal resistance, or two capacitors of equal capacitance, when alternately inserted in the base lead, will produce tones of the same pitch. This characteristic provides a means for determining the value of an unknown resistance or capacitance by comparing the pitch of the tone it produces with the pitch produced by a standard resistor or capacitor of known value contained in the test instrument.

The standard resistor incorporated in the instrument for measuring resistance by the tone-comparison method is the 200,000-Ohm Helipot, R_1. It is inserted in series with the transistor base circuit when the selector switch, S_2, is placed in position 2.

Referring to Fig. 1, the procedure for measuring an unknown resistance by the tone-comparison method is as follows:

1. Connect the unknown resistance across the test leads plugged into the jacks at J_8.
2. Plug the headphones into J_5 (or J_3).
3. Set the SELECTOR switch, S_2, at position 2.
4. Apply battery power to the oscillator by throwing the power supply transfer switch, S_1, to the DC position.
5. Throw the tone comparison switch, S_3, to the up or EXTERNAL position and note the pitch of the tone heard. This is the tone produced by the unknown resistance.
6. Now throw S_3 to the down or INTERNAL position, thereby substituting the standard resistor, R_1, for the unknown resistance. Adjust R_1 until no difference in pitch is heard when S_3 is thrown from one position to the other.
7. R_1 now has the same resistance as the resistor under test. Read this value

from the dial of R_1. This is readily done by noting the number of dial divisions and knob rotations passed over as the control knob is turned back to the zero-resistance position. As previously noted, each dial division represents 2,000 Ohms and each knob rotation, 20,000 Ohms.

On our instrument, this method of resistance measurement was found to be more useful for resistances greater than about 1,000 Ohms. For smaller values of resistance, the pitch becomes so low that all tonal character is lost and an accurate matching of pulse rates is more difficult. However, resistances under 1,000 Ohms can be accurately measured by the Wheatstone bridge.

Seven capacitors, C_1 through C_7, are incorporated in the instrument as standards for estimating capacitance. They are inserted individually into the base circuit by setting the SELECTOR switch, S_2, in positions 3 through 9. These capacitors range in value from 0.0015 uF to 0.1 uF in increments such that the capacitance is doubled each time the selector switch is advanced one position. In our case, we were fortunate enough to find in the junk box a multi-section capacitor containing all of these seven capacitances in one shielded can. Individual capacitors will serve just as well, of course, though perhaps not as neatly.

The procedure for estimating capacitance is the same as that for measuring resistance, except that a tone match or a near tone match is obtained by rotating the SELECTOR switch from position 3 to position 9. As the standard capacitances are available only in discrete steps, it is unlikely that a perfect tone match with the unknown capacitance can be obtained. More commonly, the pitch produced by the unknown capacitance will be bracketed by two SELECTOR switch positions, one giving a higher pitch and the other a lower pitch than the capacitor under test. The unknown capacitance is then approximated as somewhere within the range of capacitance represented by these switch positions, giving consideration to the relative differences in pitch of the three tones.

Although the highest standard capacitance provided is 0.1 uF, much higher values can be measured by using a different technique. As the unknown capacitance across the test leads is increased, the audio tone becomes lower in pitch; for capacitances greater than 0.5 uF, the pitch becomes so low that individual pulses can be counted. On our instrument, pulse rates were counted for high-quality oil-filled capacitors of different values as shown in Table 1.

These pulse rates were counted by ear with the phones plugged into J_5. A stopwatch was used for timing purposes, but the one-minute intervals from WWV could also be used and probably would be more convenient for the blind. These same pulse rates would probably not be duplicated in replicas of the tester, but they are indicative of what is to be expected. Each instrument would need to be calibrated individually, which is a simple process if a variety of marked capacitors is at hand.

Capacitance (uF)	Pulses Per Minute
0.5	360
1	180
2	90
3	54
4	45
8	24
10	20
20	10

Table 1.

The capability of operating from an external rf source as well as from the internal battery greatly increases the utility of the audio oscillator. With the power transfer switch, S_1, in the RF position, the oscillator may be powered by rf injected at J_4. The components RFC, D_1, and C_{10}, comprise a half-wave rectifier and filter for converting the rf current to dc. More will be said about this feature of the instrument in connection with the rf pickup to be described later.

Note that the power transfer switch, S_1, also serves as the off/on switch for the battery and should be left in the rf position when the instrument is not in use.

One final comment on the oscillator may be worthwhile. The closed-circuit jacks, $J_{1\text{-}3}$, were installed in case it might be desired to insert other test components into the oscillator circuit. The audio tone can be heard with the phones plugged into either the base jack, J_1, or the collector jack, J_3, as well as the regular phone jack, J_5. A useful application of the emitter jack, J_2, was discovered quite by accident. An electrolytic capacitor inserted into the circuit at J_2 will have a dc voltage impressed across it. If the polarity of the capacitor is correctly observed, the capacitor will slowly charge, and the pitch of the tone heard with the phones plugged in at J_5 will gradually rise until it pinches off when the capacitor reaches full charge. If the polarity of the capacitor is incorrect, the tone may continue indefinitely or it may pinch out as before, but at a much slower rate. This characteristic can be used to determine the polarity of electrolytic capacitors or to detect leaky electrolytics.

Wheatstone Bridge

The Wheatstone bridge is energized by a tone from the audio oscillator. The audio tone is automatically transferred to the bridge input by the switching function of J_5 when the headphone plug is removed from that jack. The bridge circuit is composed of four resistors: any one of the three standard resistors, R_2, R_3, or R_4 selected by S_4; the variable balancing resistor, R_5; the Spectrol variable resistor, R_6, and the unknown resistance, R_x, connected across the test leads at J_9. The theory of the Wheatstone bridge is explained in any high school physics book. Suffice it to say here that the bridge is in balance when the ratio of a standard resistor (R_2, R_3, or R_4) to the balancing resistor, R_5, is equal to the ratio of the resistor under test, R_x, to the Spectrol nulling resistor, R_6. The instrument provides three bridge ratios: 1:10, 1:1, and 10:1. The upper limit of resistance that can be measured by the bridge is the maximum resistance of R_6, 10,000 Ohms, multiplied by the bridge ratio. Thus, if the bridge ratio is set up as 1:10, the bridge will measure up to 1,000 Ohms in calibrated dial divisions of 10 Ohms each. If the bridge ratio is set up as 1:1, resistance values up to 10,000 Ohms can be measured with dial divisions of 100 Ohms each. If the bridge ratio is set up as 10:1, resistance values up to 100,000 Ohms can be measured with dial divisions of 1,000 Ohms each.

It may be noted that the standard resistors, R_{2-4}, need not be precision resistors. In fact, they need not even have the nominal values indicated. The only criterion for selecting these resistors is that they must have some value that will allow the desired bridge ratio to be obtained by adjusting R_5. The values indicated were chosen merely because they make the proper setting of R_5 fall at about midscale.

Three precision resistors will be required, however, for initially setting up the bridge to measure unknown resistances. Ideally, these precision resistors would be 500, 5,000, and 50,000 Ohms, but, again, this is not necessary. The closest we could come from our junk box was 500, 1,000, and 79,000 Ohms, and these values will be used in the explanation to follow.

To set up the bridge for a 1:10 ratio, proceed as follows:

1. Connect the 500-Ohm precision resistor across the test leads plugged in at J_9.
2. Connect the output of the bridge to the input of the audio amplifier by throwing the transfer switch, S_5, to the BRIDGE position.
3. Throw S_3 to INTERNAL (down) position.
4. Plug the headphones into J_7. This automatically turns on the audio amplifier.
5. Set the bridge RATIO switch, S_4, to position 1.
6. Set the nulling Spectrol, R_6, to 5,000 Ohms by turning its pointer knob 5 revolutions counterclockwise from the zero resistance setting. If your precision resistor in step 1 is some value other than 500 Ohms (any value in the range 100-900 Ohms would be satisfactory), set R_6 to read ten times the value of your precision resistor.
7. Set the SELECTOR switch, S_2, to position 8. Other positions of this switch can be used if a higher- or lower-pitched tone is preferred. On our instrument, position 8 yields a pleasing tone of about 500 Hz.
8. Turn on the audio oscillator by throwing the power transfer switch, S_1, to the DC position. A tone will now be heard.
9. Null this tone by adjusting the balancing resistor, R_5, until the tone disappears or is weakest. Once the null position is found, *do not move this control again.*
10. The bridge is now in balance for a 1:10 ratio. Remove the test leads from the precision resistor and clip on the unknown resistance. Find a new null by adjusting the Spectrol potentiometer, R_6. The unknown resistance will be one-tenth of the resistance read from the Spectrol dial at the new null setting.

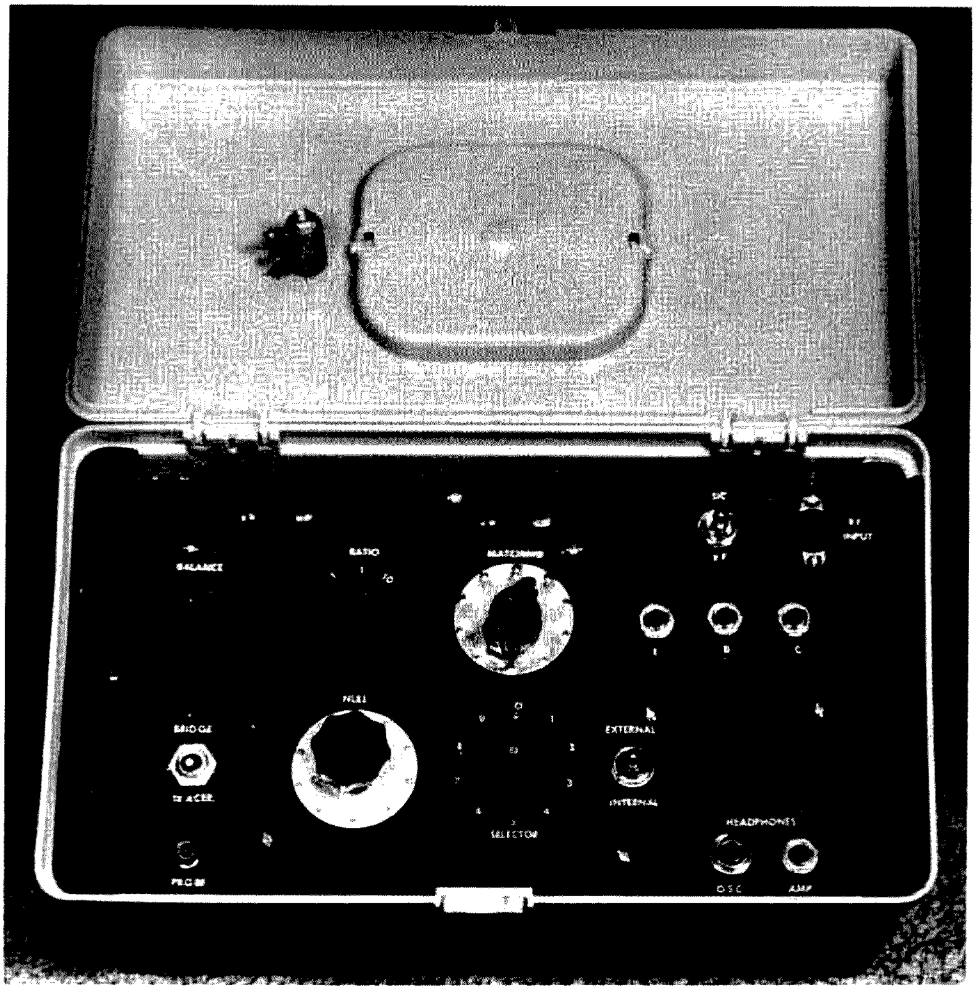

Photo A. Related controls are shown here, grouped to facilitate memorizing the panel layout. A precision resistor used for setting up the bridge is bolted to the lid for safekeeping.

To set up the bridge for a 1:1 ratio, the same procedure is followed except that the 1,000-Ohm precision resistor is clipped to the test leads, and R_6 is initially set to read 1,000 Ohms. If your precision resistor is of some other value in the range 1,000 to 9,000 Ohms, set R_6 to that same value. The bridge RATIO switch, S_4, is set to position 2. With the 1:1 ratio, the null-point reading of R_6 for an unknown resistance will directly indicate that resistance.

To set up the bridge for a 10:1 ratio, again proceed as before, but clip the 79k-Ohm precision resistor across the test leads and set R_6 to 7,900 Ohms. If your precision resistor is of some other value in the range 10k-90k Ohms, set R_6 to read one-tenth the value of your precision resistor. The bridge RATIO switch, S_4, is set to position 3. With the 10:1 ratio, the null point reading on R_6 for an unknown resistance must be multiplied by 10 to equal the unknown resistance.

Audio Amplifier

The circuit of the audio amplifier is about as barebones as it can be made, consisting only of the two

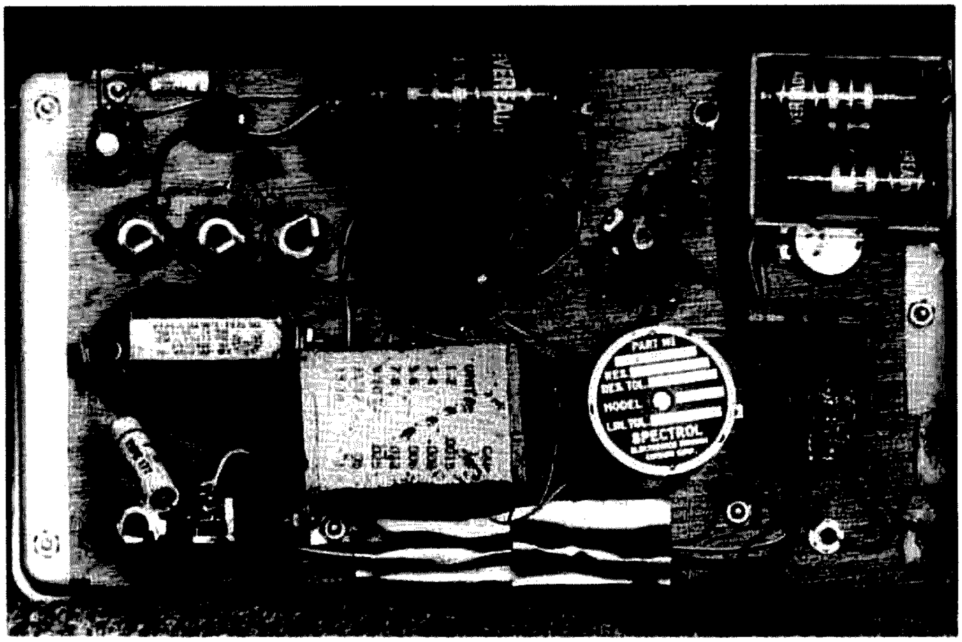

Photo B. All components are mounted on the panel, as shown here.

directly-coupled transistors, $TR_{2,3}$, and the coupling capacitor, C_9. The DPDT switch, S_5, serves to transfer the amplifier input either to the bridge output or to the jack, J_6, for the signal-tracing probes. The amplifier is powered by a separate 3-volt battery supply. There is no on/off switch, as this function is served by plugging or unplugging the phones at the open-circuit jack, J_7. Initially, we tried to operate the audio amplifier and the oscillator from a common 1.5-volt battery, but this did not work out because of audio leakage around the Wheatstone bridge that made it impossible to obtain a distinct null. The separate power supply for the amplifier cured this trouble, and raising the supply voltage to 3 volts gave the amplifier a little more clout.

Construction and Arrangement of Parts

Construction of the test instrument is easy and simple. No PC boards are needed, and the only material to be drilled is the 1/8-inch plywood panel. Our tester was built in a plastic cosmetic box purchased at the local drugstore for about $3. The box is approximately 12 inches long, 7 inches wide, 6 inches deep, and has a hinged lid with a latch and a recessed carrying handle. Originally, the box had a removable tray which, unfortunately, was divided into compartments with rounded bottoms so that it could not be used as a mounting panel. The supporting ends of the tray were sawed off, therefore, and attached to the ends of a plywood panel. All components are mounted on this panel, which can be lifted out for battery replacement or servicing.

Electrically, the placement of parts is not at all critical, but a little thought should be given to grouping associated controls in some coherent fashion that will be easier for a sightless user to memorize. The external appearance and panel arrangement of our version of the instrument are shown in Photo A. Photo B shows the "works" underneath the panel. Referring to Photo A, the controls related to the oscillator occupy the right half of the panel; those for the bridge and audio amplifier, the left half. At top center are the test-lead jacks, J_8. In line below these jacks, are the pointer knob with embossed dial plate for the Helipot, R_1, and the pointer knob for the SELECTOR switch, S_2. In the right corner are the power supply transfer switch, S_1, and the jack, J_4, for the rf pickup. The two phone jacks, J_5 and J_7, are in the lower right corner. The tone comparison switch, S_3, is to the right of the selector switch, and the three jacks, J_{1-3}, are in line to the right of the Helipot dial.

In the lower left corner is the jack, J_6, for the signal-tracing probes; above this is the transfer switch, S_5, for the audio amplifier input. To the right of this switch is the other embossed dial for the Spectrol bridge-nulling resistor, R_6. Above this dial is the bridge RATIO selector switch, S_4, and to the left of this switch is the control for the bridge-balancing resistor, R_5. Finally, at top left are the jacks at J_9 for the bridge test leads.

The reader may wonder why all of the controls are so elegantly labeled on an instrument intended for use by the blind. The truth of the matter is that the builder wanted to try out those rub-on letters, and could not resist the urge to add this utterly useless embellishment.

Accessories

Accessories for the test instrument include, in addition to the three precision resistors for setting up the Wheatstone bridge, a pair of test leads, an audio signal-tracing probe, an rf signal-tracing probe, and an rf pickup (Photo C).

The test leads are unshielded, with a clip at one end and a plug at the other, to match the panel jacks at both J_8 and J_9.

The audio signal-tracing probe uses shielded wire with a phone plug at one end to match jack J_6 and an ordinary test prod at the other. A short grounding lead with a clip is provided to complete the ground circuit at the prod end.

The circuit for the rf signal-tracing probe is shown in Fig. 3. The components are mounted on a narrow strip of perfboard and inserted into a cylindrical aluminum shield can about 1 inch in diameter and 5 inches long. The shield can we used was obtained at the drugstore as a small butane cylinder intended for refilling cigarette lighters. After releasing *all* of the butane outside in the open air (butane and air form an explosive mixture—*don't* do this in the shack), the valve end of the cylinder was sawed off and replaced with a wooden disk to hold and insulate the probe tip. The wire lead for the probe is shielded phono cable with a phono plug to match J_6. A short grounding lead with a clip is provided to complete the ground circuit at the probe end.

With a short antenna

connected to the probe tip, and the probe feeding the audio amplifier, local broadcast stations can be heard with good volume (although with considerable QRM if there are several stations). With a good antenna and a tuned circuit ahead of the probe, we might also claim that the test instrument will serve as an emergency BC receiver.

With the power transfer switch, S_1, in the RF position, and a short random-length wire plugged into J_4 for an antenna, the oscillator can be powered by any strong rf field in the high-frequency range. Sensitivity is much increased, however, by using a tuned pickup. This pickup consists of a simple parallel-tuned circuit, enclosed for convenience in handling in a cylindrical cardboard container about 2 inches in diameter and 6 inches long (see Photo C and Fig. 4). The container we used was originally full of ready-mixed biscuit dough. We cut off one of the metal ends, disposed of the dough, and removed the tinfoil inner lining, since no shielding is desired for the pickup. The components of the tuned circuit are then wired and inserted, using the metal end left in place as a mounting plate for the variable capacitor. A wooden disk restores the strength of the open end.

The frequency range covered by the pickup is left to individual preferences. We selected a small variable capacitor of perhaps 150-pF maximum and a coil from a defunct surplus item that looked as though it might tune the 80- and 40-meter amateur bands. Actually, the combination tunes the range 3.2 to 11.4 MHz, which suited our particular needs quite well. The range covered by the pickup could be extended if desired by arranging to tap the coil, or by using plug-in coils of different sizes.

With this pickup plugged into J_4, the oscillator will work with the pickup about 3 inches away from the coil of our grid-dip meter, which would seem to indicate fairly good sensitivity. It also works well as a transmitter peaking indicator or CW keying monitor, with the pickup on the operating table about 6 feet from the transmitting antenna tuner.

The resonance point of the tuned pickup is fairly sharp, so that the pickup also could be made to serve as a wavemeter by fitting the variable capacitor with a calibrated dial readable by touch. Although our efforts did not extend that far, this possibility is pointed out to those who might wish to increase the versatility of the instrument in that direction.

Credit for the concept and general design of the test instrument is due W4RYY, who had previously used the basic circuits individually but had never combined them as an integrated unit. Except for a few minor refinements, all I did was to build the instrument and prepare this description of it. ■

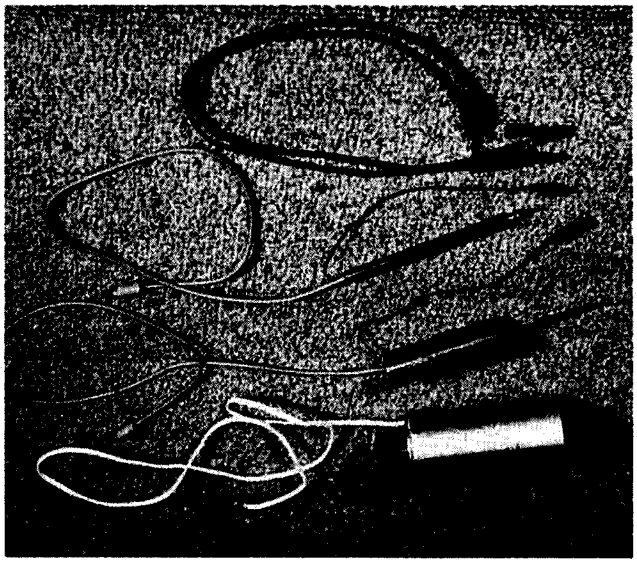

Photo C. The tester is completed with the test leads, signal-tracing probes, and rf pickup shown here.

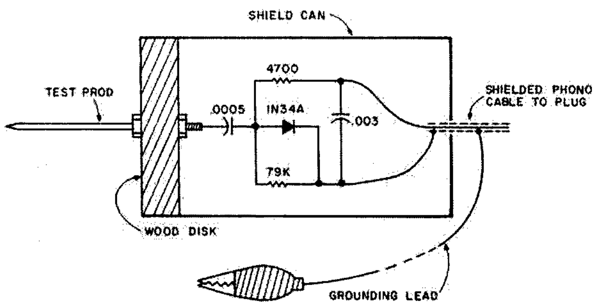

Fig. 3. Circuit and construction of the rf signal-tracing probe.

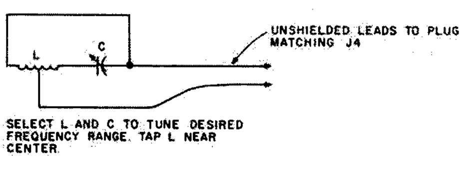

Fig. 4. Circuit for rf pickup.

Parts List for Fig. 1

C1—0.0015 uF
C2— .003 uF
C3— .006 uF
C4— .012 uF
C5— .025 uF
C6— .05 uF
C7— .1 uF
C8— .1 uF
C9— .22 uF
C10—.002 uF
D1—1N34A germanium diode
J1,2,3—Closed-circuit jacks
J4,6—Phono jacks
J5—Double closed-circuit jack
J7—Open-circuit jack
J8,9—Paired test-lead jacks
R1—200k-Ohm precision potentiometer (Helipot)
R2—500 Ohm, ½-Watt
R3—5,000 Ohm, ½-Watt
R4—50k Ohm, ½-Watt
R5—10k-Ohm potentiometer
R6—10k-Ohm precision potentiometer (Spectrol)
RFC—2.5-millihenry rf choke
S1,3—SPDT toggle switch
S2—10-position rotary switch
S4—3-position rotary switch
S5—DPDT toggle switch
T1—Oscillation transformer (see text)
TR1,2,3—Type 2N107 PNP transistors

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The W4HCY Antenna System

—give this new design a try

The W4HCY antenna system is designed to provide maximum possible current throughout *all* of a radiating antenna during any or all parts of an alternating cycle of antenna current for whatever frequency the antenna is tuned and operating.

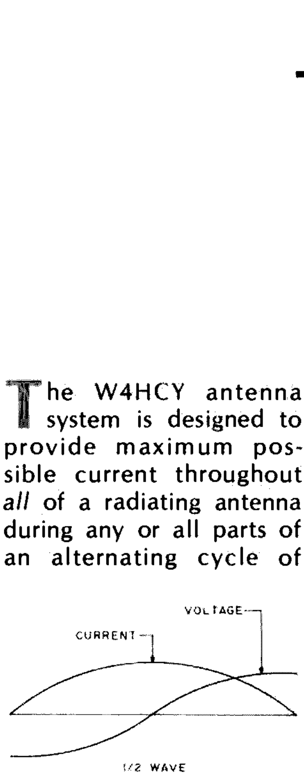

Fig. 1. From The ARRL Antenna Book *(page 25).*

By far, the greatest factor contributing to radiation from any antenna is its magnetic field, which is produced directly by the current flow through the antenna. In my opinion, failure to provide for maximum full-length antenna current in amateur antennas up to this time has been due to a failure either to recognize this fact, or to design provision for it.

Therefore, the requirement necessary to provide maximum full-length antenna current is to develop a design that will force maximum current flow throughout the full antenna length. The W4HCY design is engineered to do this job.

Throughout all of the articles on antennas that I have been able to find, none of them offers an effective solution to this problem. In fact, some give explanations on the operation of antennas that, to me, are misleading.

I am not saying that the writer is wrong in his own understanding, but the choice of words and explanation used do not, in my judgment, fit properly into the fundamental factors which determine operation of ac circuits.

Here is an example: *"When a charge reaches the end of the antenna and is reflected, the*

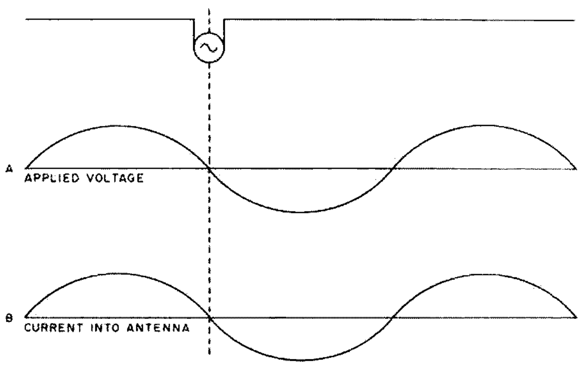

Fig. 2. From The ARRL Antenna Book *(page 28).*

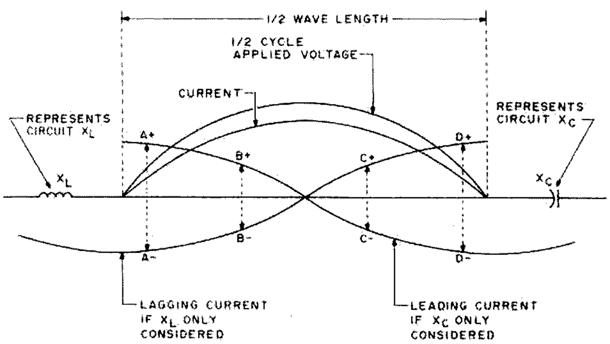

Fig. 3.

direction of current flow reverses, since the charge is now traveling in the opposite direction."[1]

The word "reflected" is misleading in that it implies that there is some kind of barrier at the end of the antenna that a charge strikes and bounces back from. This is similar to an earlier example in the same article wherein it is said that a ball traveling along a trough bounces back whenever it strikes the far end.

"Bouncing back" and "being reflected from" are poor descriptions of what really happens. The following is a more accurate description of what actually happens:

At the end of each half cycle, the voltage from end to end of a resonant antenna reverses polarity and the current is *driven* back in the opposite direction, not reflected.

The same article further states that the current and voltage are out of phase by 90°, and Fig. 1 shows the phase difference between voltage and current along a half-wave antenna. I fail to understand such an explanation for current and voltage relationship in a resonant antenna.

If current flowing in an antenna circuit were this far out of phase with the voltage, I doubt that it would be possible to keep the overload relay closed.

Further on in the same antenna article, the following *correct* statement is made in describing operation of antennas: *"Exactly at resonance, the current at the input terminals will be in phase with the applied voltage."*[2]

Yes! And who wants an antenna that is not tuned to resonance at the operating frequency? Fig. 2 illustrates the above quote wherein voltage and current are in phase. Yes, Fig. 2 shows the way it really is.

Now let's take a good look at what actually happens in an antenna circuit when we make use of accepted fundamentals which govern the operation of alternating-current circuits. These would be resistance (R), inductive reactance (X_L), capacitive reactance (X_C), alternating voltage (alternating polarity), and alternating current.

It will not be necessary to describe here in detail all these functions, but it is essential to state that current in a capacitor leads the voltage by 90°, and that current in an inductance lags the voltage by 90°. It is necessary for proper balance in a series resonant circuit that the X_L and X_C be adjusted to balance against each other sufficiently to bring the current in phase with the applied alternating voltage.

Fig 3 shows how it works in a half-wave antenna. At radio frequencies, a straight wire or conductor presents inductance (X_L) to rf current. The spacing between antenna conductors and between antenna conductors and ground presents capacitance (X_C) to rf current. When these reactances are combined (made equal) to resonate an antenna to a given frequency, the antenna current flows *in phase* with the antenna voltage. Reactances X_L and X_C cancel, and only resistance remains; voltage and current are in phase. Note that the A+ and A− currents cancel each other, leaving only pure resistance in the half-wave length of antenna wire. Other examples are shown at B+ and B−, C+ and C−, and D+ and D− for all the length of the antenna. The inductor and capacitor shown at the ends of the antenna represent the total X_L and X_C of the whole circuit. They are not intended in this case to represent a physical presence as shown in the drawing.

Now let's take a look at a typical antenna installation along with the circuitry inside a transmitter which is the source that supplies energy to the antenna. To illustrate the theory of operation, I have chosen to use the typical pi-network-type final transmitter circuit. However, the basic fundamentals of transferring radio energy to antennas are the same for other types of antenna coupling. Fig. 4 is a typical example. The transmission line is omitted for simplicity.

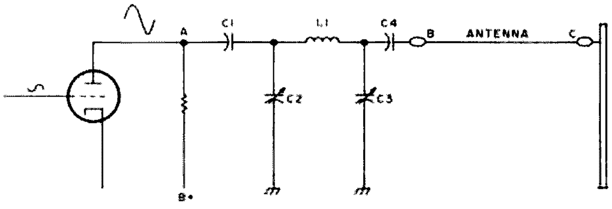

Fig. 4.

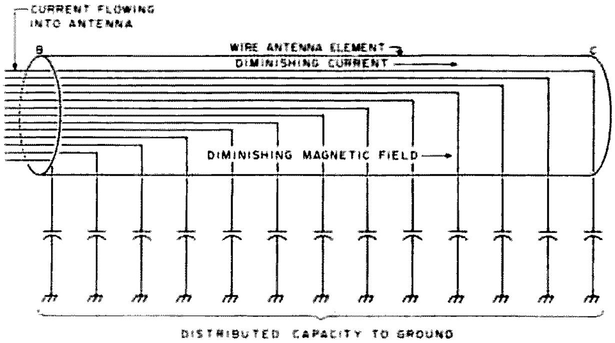

Fig. 5.

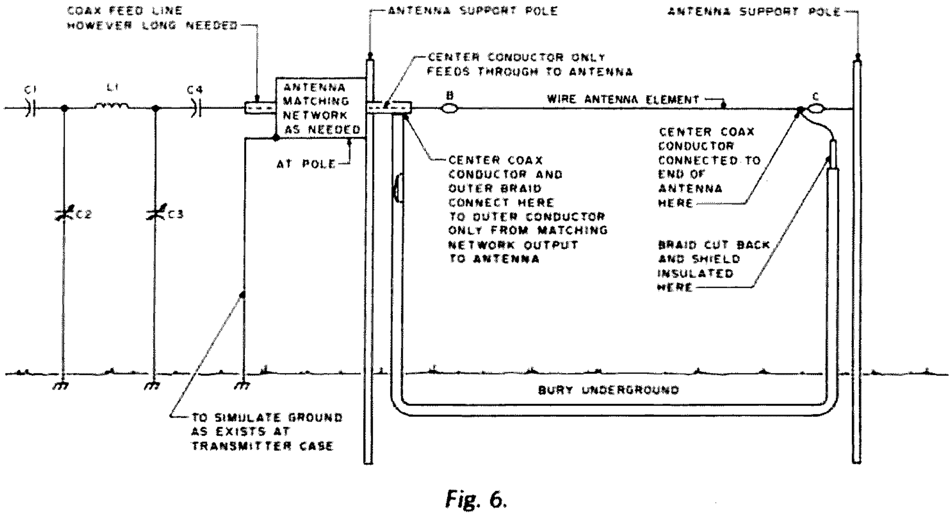

Fig. 6.

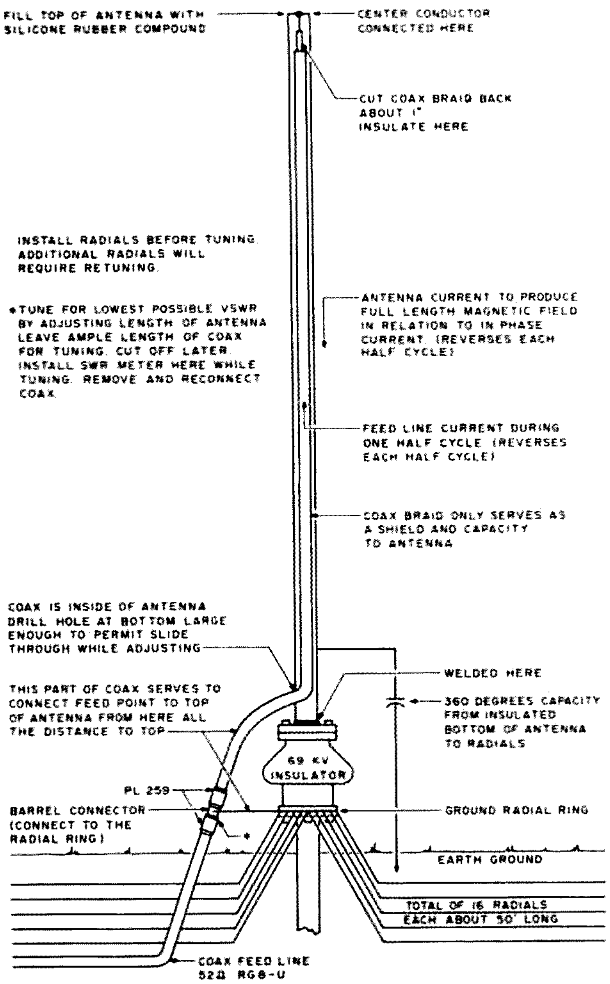

Fig. 7. The W4HCY 40-meter antenna now in operation is made of 1/8"-wall aluminum tubing in four sections: 2 inches o.d. at the bottom and telescoping to 1 inch o.d. at the top. It is free-standing and approximately 33 feet long.

How does it work? The desired frequency appears at tube grid where it is amplified, inverted and appears at coupling capacitor C1 at point A. In a correctly operating transmitter, the frequency at this point never changes. All the other parts of the circuit *must* be adjusted to provide an in-phase voltage with the tube plate voltage at point A.

Capacitor C1 couples this ac voltage to the tank circuit pi network (C2, L1, and C3). When tuned to resonate with the transmitter frequency at point A, the action of inductor L1 and capacitors C1 and C2 set up an oscillating current in these three components that is free-running at the transmitter frequency. It will, however decay because of circuit losses unless it is reinforced by the tube output. This action begins at the beginning of each free-running half cycle and continues throughout each half cycle.

Ok, we all agree up to this point. This is old stuff. I have included these operating functions only to complete the picture.

So now let's examine the antenna operation. I have chosen a longwire parallel to the ground. Does it radiate because of something mythical, or some type of tangible reflecting substance at the end of the antenna at point C? Absolutely not.

No current can ever flow anywhere except where there is a voltage (potential) difference between two points wherein it is desired that a current should flow. But, the antenna shown in our example, Fig. 4, will work. How?

Whenever the loading capacitor, C3, is adjusted to load the antenna, the resonant tank circuit does not go out of resonance as one might expect. Why? Because the capacity in C3 is transferred in part to the distributed capacity that exists between the antenna wire and ground. Resonance is maintained, however, because more intensive use of the antenna capacity to ground is now made and current is now flowing in the antenna.

Right here is where the real important thing about this article begins. Let's watch it carefully.

As the voltage increases on the end of the antenna wire nearest the coupling capacitor at point B, the current flowing first sees the portion of the distributed capacity that is nearest to this end of the antenna from point B to ground. Therefore, this capacity becomes charged most and there is a *diminishing* charging current available for the remainder of the distributed capacity out to the far end of the antenna at point C. Fig. 5 shows this current flow action.

The W4HCY antenna system (Fig. 6) provides a feed point and current return circuit which forces a strong, full-length antenna current through all of the antenna, thereby providing a stronger, longer magnetic field for maximum possible magnetic radiation.

Ground connection from the matching network is made to the far end of the antenna through the shielded coax. The shield must be left ungrounded at the outer end of antenna point C. Outer braid is only used to serve as a shield. It is not a part of the antenna. It does not carry antenna current. Only the antenna radiates.

I have a home-brew 1/4-wave vertical antenna for 40 meters that is made of heavy-wall aluminum tubing and is free-standing, supported by a 69-kV insulator. There are 16 underground radials, each about 50 feet long.

I have changed the feed line on this antenna as shown in Fig. 7. No other changes were necessary except lengthening the antenna by 8-1/2 inches to offset the increased X_C due to its higher efficiency to the same capacity radials and added X_C of the coax shield braid inside the vertical radiator.

The use of coax, by which the braid serves as a shield between the center conductor and radiating element, introduces extra X_C into the antenna tuning network. This added X_C must be considered in the design. Compensation can be made by making the antenna element longer, using a larger diameter antenna, spacing the coax to the exact center of the antenna, and using smaller diameter coax such as RG-58/U.

Although this antenna is only a 1/4-wave radiator, the results have been very rewarding. I have never operated it yet when I did not get back reports such as, "strongest signal on the band," etc. My monitor scope shows a 25 to 30 percent increase in talk power.

Another operating feature is that the antenna appears to operate at a much higher Q. This is evidenced by much sharper receive and transmit action. I find that I must tune very sharply to a received signal

to prevent distortion. At only 100 cycles each side of a received signal, distortion becomes annoying. Before changing to the antenna feed as described herein, the same off-frequency tuning would only change the voice quality of the received signal.

I have checked the transmitting improvements by asking other amateurs to tune slightly off my frequency, and the reports have been the same (very narrow and very strong) and without even asking about audio quality, I almost always hear reports of excellent audio.

The W4HCY antenna feed system is applicable to a large variety of antennas, except those that already use full-current feed, such as a terminated rhombic, quad, delta loop, etc.

I am presently in the process of applying it to my five-element monoband yagi for 20 meters. This will require a matching network which I do not have. However, I have put it on the air a couple of times using a James Millen Co. antenna tuner. The same improved operation is evident both on receive and transmit. The feed method for the driven element on this beam is shown in Fig. 8. The coax inside the antenna serves only as a shield to prevent cancellation of the antenna element current. Be sure to connect as shown. Always insulate the outside end of the braids.

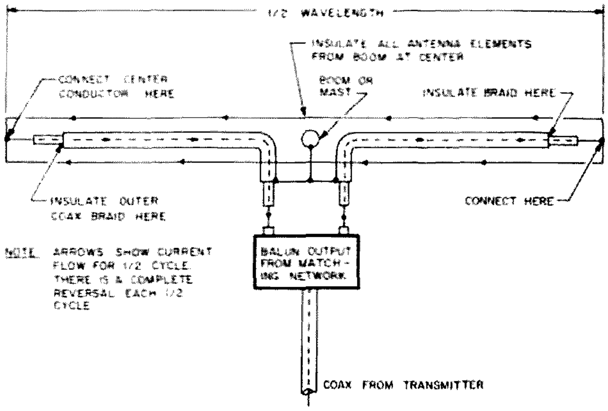

Fig. 8.

This system can be used on multiband antennas by using a separate shielded feedline inside the driven element and correctly connecting to each band outer end section of the antenna. Only one feedline up to the antenna will be necessary.

I am very confident that this antenna system will outperform most other conventional antennas. Radiation will be greatly improved and signals transmitted from the antenna will require less space on the band.

Please feel free to use the system for your own pleasure. I will be delighted to hear from you about your results—pro or con. But, I will not be able to answer a multitude of letters.

I reserve the right to require permission from me or my heirs for the use of this system by anyone who may desire to use or apply it in any way to antennas manufactured and sold for profit.■

References

1. *The ARRL Antenna Book*, The American Radio Relay League, Inc., 1976, page 25.
2. *Ibid.*, page 28.

✓ Reader Service—see page 243

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484 Esther Ave.
Moorpark CA 93021

A 3-Band Mast-Mountable Miniquad

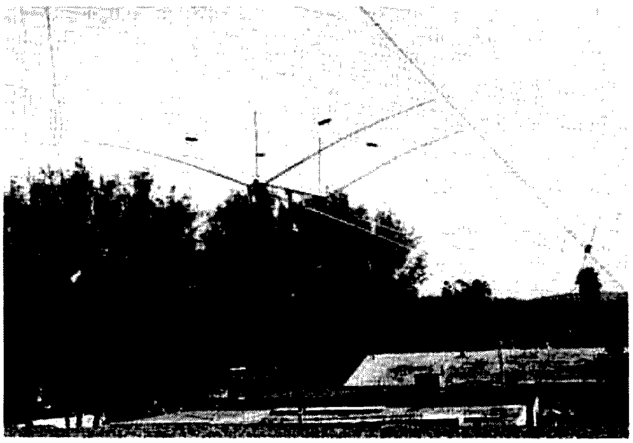
—a quad need not be monstrous

Small in size, high in performance.

Combining two compact quad designs into one results in a miniquad with lots of appeal. It's small in size and cost and high in performance. So, after numerous requests during QSOs for a detailed description of this somewhat unorthodox quad, I decided to write it up for *73 Magazine*.

What Is Different About It

A full-size 20-meter quad measures approximately 19′ x 19′. This miniquad for 10, 15, and 20 meters measures 6½′ x 14′. The unorthodox part of this design is that the 20-meter loops (using loading coils) are mounted between the 10- and 15-meter loops. It wasn't planned that way, but the physical dimensions required to resonate each band resulted in that configuration. Also, all three bands use vertical wire stubs both for tuning and to reduce the vertical dimensions.



This is the miniquad after two years of operation (lowered for refinishing spreaders). Optional materials for spreaders are fiberglass (expensive, but non-deteriorating) or PVC tubing, if properly braced. (See Reference 3.)

Why You'll Like It

You will find that, unlike the full-size quad, this one is a breeze for one man to handle and mount on a tower. What's more, because of its small wind load, it can be mounted on an ordinary TV rotor and a low-cost telescoping TV mast. Also, this antenna requires only about half the copper wire of a full-size quad. Overall, that represents quite a savings for the typical low-budget ham like me!

While the miniquad may have slightly less gain than a full-size quad, for most of us, the advantages far outweigh the slight loss. The miniquad performance is really impressive when compared with the inverted vee antenna, especially when the band appears to be dead on the inverted vee. I have made some excellent DX contacts since switching to the miniquad.

How It Evolved

Being dissatisfied with the performance of an inverted vee on 10, 15, and 20 meters, I made a search of ham magazines and antenna books for various types of beams and quads. I decided that the quad, which requires less height than a yagi-type beam, was best for this QTH, as the degree of acceptance by the XYL of another antenna on top of the house was calculated to be inversely proportional to the square of antenna height!

Two interesting quad designs were found. Neither was small enough to fit on

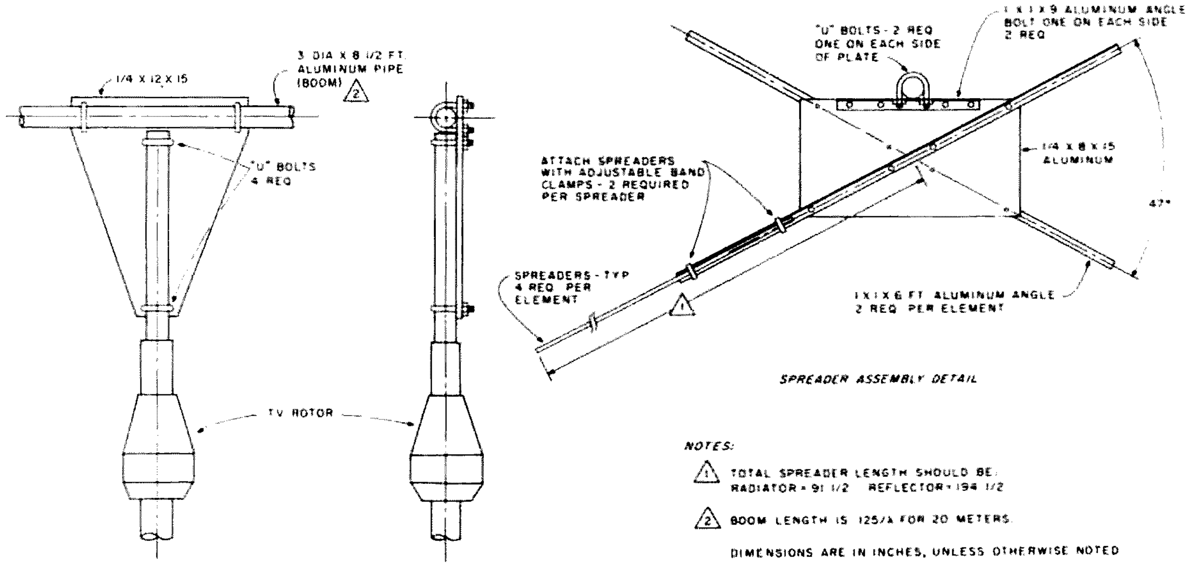


Fig. 1. Boom-to-mast assembly detail.

the bamboo spreaders donated by a friend, however, so I decided to combine two designs and make a more compact antenna. One was the Low Profile Quad[1] and the other, the Japanese Quad.[2]

The Low Profile Quad consisted of folding the vertical sides of a full-size quad to form long, narrow, vertical loops set in a few inches from the vertical sides of the quad. This reduced the dimensions of the 20-meter full-size quad from 19′ x 19′ to 12′ x 19′. The resonant frequency of the Low Profile Quad was adjusted by sliding shorting bars up or down on the narrow loops.

The Japanese Quad used loading coils, four per element, which reduced the full-size 20-meter quad to 12′ x 12′. By combining the Japanese Quad with the Low Profile Quad, a further reduction was obtained down to 6′ x 12′ for 20 meters.

First, I experimentally constructed a two-element (radiator and reflector), 20-meter-band-only miniquad. It used loading coils and folded loops with shorting bars. In an effort to simplify the design, the folded loops and shorting bars were replaced with vertical wire stubs spaced a few inches in from the sides of the antenna. The wire was attached at the bottom side of the quad loop and supported vertically with monofilament fish line to the top. Tuning was done by pruning the vertical wire. The longer the wire, the lower the resonant frequency.

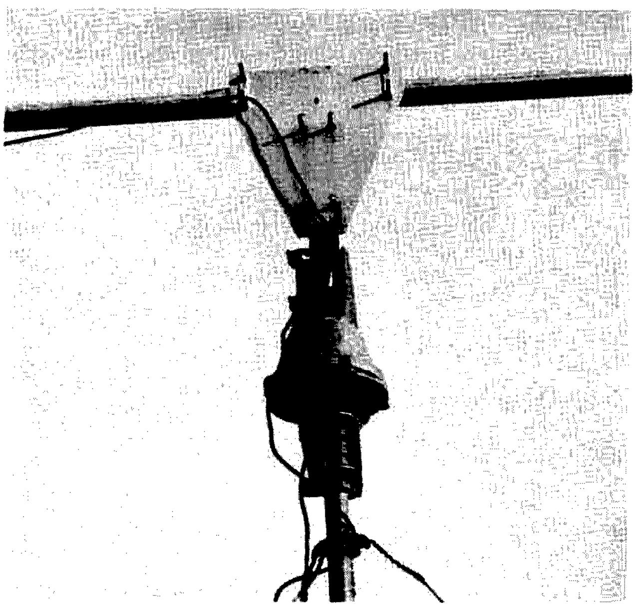
The 20-meter miniquad was placed on a TV rotor, and the mast was raised to about 35 feet. After some additional pruning, the antenna was tested in actual use with excellent results.

After testing the 20-meter design, the antenna was taken down and the 10- and 15-meter elements were added. The 10-meter loops were installed inside the 20-meter loops. Resonating the 15-meter loops without loading coils resulted in physical dimensions larger than the 20-meter loops. This accounts for the 15-meter loops around the outside of the antenna.

Construction

The miniquad was constructed on bamboo spreaders, supported as shown in Fig. 1. The 20-meter loading coils were made of 17½ turns of #14 AWG copper wire wound on 1½-inch-diameter x 5-inch-long PVC thin-wall plastic tubing. The coils were spaced as shown in Fig. 2. Fig. 1 shows details of the boom-to-rotor attachment. The coils and spreaders were given two coats of polyurethane-type varnish. The 8½′ boom was made from 2-inch-diameter aluminum irrigation pipe. The guy wires supporting the mast were attached directly to the TV rotor because the lower half of the quad extends only 3 feet below the boom (compared with 9 feet for the full-size quad). This made the installation much more rigid. At every 5 feet, the guy wires were cut and egg insulators attached.

Preliminary antenna tuning was done on the ground by placing the boom on top of an 8-foot stepladder. The coil of a dip meter was



A close-up photo showing the method of attaching the boom to the rotor.

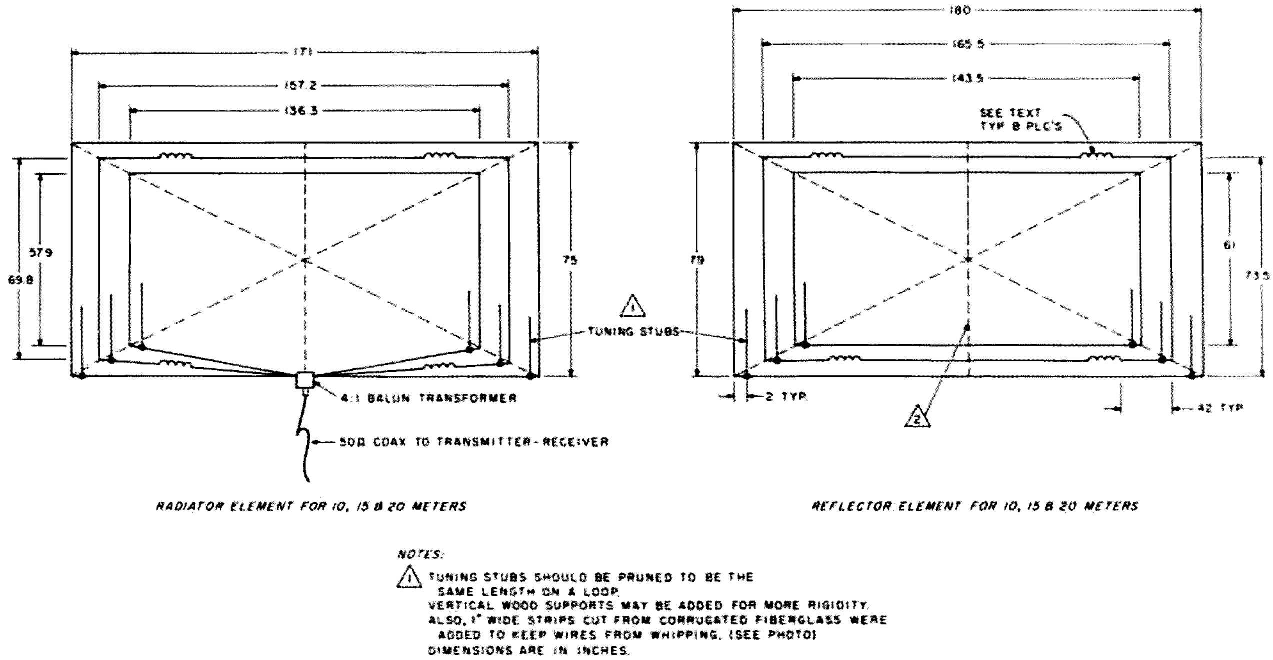
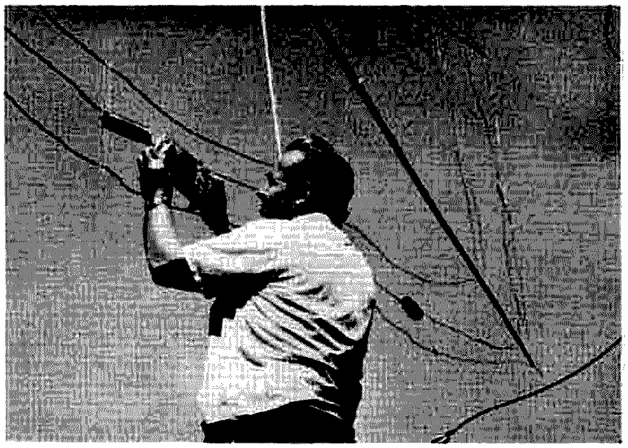


Fig. 2. Radiator element for 10-, 15-, and 20-meter bands. If a director element is desired, make dimensions 5% less than radiator and space the director .125 x wavelength (in meters) in front of the radiator element.

placed inside one of the 20-meter loading coils and the length of the tuning stubs adjusted for the proper resonant frequency. Since raising the antenna from ground level to the top of the TV mast raises the resonant frequency, resonance on the ground was adjusted about 100 kHz lower than that required in the air.

After installing the antenna on the mast, fine tuning of the radiator was accomplished by checking the swr in the ham shack. Additional pruning of the stubs was required to bring the lowest swr reading into the desired portion of the 20-meter band. The reflector was pruned using the dip meter reading 5 percent lower than the final radiator dip reading. For example, if the 20-meter radiator is tuned to 14.2 MHz, then the reflector should be tuned to 14.2 x .95 = 13.49 MHz. All fine tuning was done with the mast telescoped down.



Here the antenna tuning is being checked after two years of operation, using a home-brew dip meter-transistor checker.

With the 8-foot stepladder on the roof and the boom U-bolts loose, I was able to rotate the antenna vertically and reach the stubs for pruning.

Tuning the 20-meter band only was easy. After installing the other two bands, however, interaction between bands made it necessary to repeat the pruning process. This was the most critical part of the whole project, but you will find that a few extra trips between the roof and the shack to recheck tuning on each band will be well worth the extra effort. You'll have an antenna that will provide many hours of good DXing and solid contacts. Also, when your neighbors see you climb up your roof a number of times and see you clip only an inch or two of wire from your antenna, they will *know* you are crazy!

If, as I did, you have problems getting enough coupling with your dip meter to the 10- and 15-meter loops (no loading coils on these bands for coupling), try the following:

1) For the radiator, clip a ½"-diameter turn of wire across the coax terminals at the bottom of the loop. Couple the dip meter into the added turn.

2) For the reflector, put a ½"-diameter twist in the bottom center of the loop. Tune the reflector 5 percent lower in frequency, as noted above.

The Proof is in the Pudding

Having previously used an allband inverted vee antenna, I was amazed at the superior performance of the miniquad. After completion of the 20-meter portion of the miniquad, it was installed and a quickie evaluation was made when 20 meters appeared dead on the inverted vee. With the quad pointed south, some South American stations were picked up, including an ice-breaker running traffic to the States from the Wadell Sea. Then, rotating the quad northwest, a QSO was made with a station in Tokyo, Japan. I couldn't hear them on the inverted vee, and if you can't hear

them, you can't work them!

The next day, using the miniquad, I answered a "CQ". Running barefoot (150 Watts), a fine 20-minute QSO was made with OK1TA in Czechoslovakia. (Later I received a fine QSL card and letter.) At the conclusion of the QSO, there was a big pile-up, mostly east coast stations trying to work him! I was impressed, as this was my first European contact as a ham! After adding the 10- and 15-meter elements, results were equally satisfying. Many contacts have since been made around the world, on all three bands.

The antenna has been in service for two years now, and is still performing as well as it did originally. The two coats of varnish are starting to show some deterioration from exposure to the intense radiation of the southern California sun, however, and while I don't have the problem of ice as do my eastern counterparts, we do have Santa Ana (devil) winds. These winds can reach 70 miles per hour and higher. At times, they have really made the antenna dance a jig, but it has stood up well.

I think that for a cheap, compact, directional, gain antenna, this one is hard to beat, since much of it can be built with bits of material you may have lying around your QTH! ■

References

1. "The Low Profile Quad," J. P. Tyskewicz, *CQ Magazine*, February, 1974.
2. "Unusual Cubical-Quad Antennas," J. R. Fisk W1DTY, *Ham Radio Magazine*, May, 1970.
3. "Meet the Plastic Wonder—Quad Antenna," D. Starr, *73 Magazine*, March, 1978.

Bargains in Remote Antenna Switches

—watch for these surplus gems

Carl C. Drumeller W5JJ
5824 NW 58 St.
Warr Acres OK 73122

Remote antenna switching can be a highly desired feature in one's station. The high cost, up to $125.00 or over, deters many amateurs from giving it serious consideration. The answer? Keep an eye on military surplus outlets and on swapfests.

The choicest item to look for is the Thompson Products, Inc., type 10281 coaxial switch. It'll mount outdoors, antenna level or wherever you elect to put it; it operates on direct current at a low voltage. Although rated at 24 volts, it'll function at as low as 10 volts. Its control requires a 5-wire cable, as it involves positive selection of the desired switching function . . . no stopping at a wrong position. It provides for selection of three antennas from one incoming cable. The cable connectors are of the type N variety, which means they can be weatherproof, quite unlike the UHF type often used for outdoor applications. The control function connector involves a standard type of Amphenol, one readily available.

Why is this "choice"? Well, for one thing, there are 12 steps in its transfer action. These provide for such operations as grounding the unused antennas, opening all incoming circuits, grounding all incoming circuits, and then connecting through the selected antenna. One purpose of these operations is to ensure that all accumulated electrostatic charges are drained off an antenna before it is shifted into service. Thoughtful, huh? Note that when one antenna is in use, the other two are not gounded. Some may find this preferable, some may not. But with 12 steps in the operation, only one action is needed. You just close a switch placing the direct current voltage between the common and the wire controlling the antenna outlet you want. The interior stepping motor does the rest! No continuing current is required to hold the desired selection. The circuit is broken when the stepping motor reaches the selected segment. The switch you used can be left closed to provide an indication of the antenna in use.

There's another surplus relay worth looking for, too. Like the first mentioned, it's suited to outdoor mounting, has type N rf connectors and an Amphenol control connector, and operates on low voltage direct current. It, however, is only a single-pole double-throw coaxial switch. Although rated at 24 volts, my advice is to supply it with no less than 28 volts. I've had one stick between antennas when the controlling voltage was less . . . a highly undesirable condition, as the controlling circuit is broken and the relay must be disassembled in order to move it on to a position that permits the controlling circuit to function!

This second item is made by General Communications Co., and is the model 2N18ORC-5 rf coax switch. It appears to be a bit more readily available than the Thompson Products relay.

Either of these two devices can be an asset to an amateur station. Neither should cost the "arm and a leg" asked for commercial relays that are no better and probably not as good. If you see one, grab it. ■

A No-Nonsense Operating Table

—basically, it's a flat surface on legs

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Age 11
3005 W. 19th
Lawrence KS 66044

To build this table, you will need 8 or 9 two-by-fours. Check to see if some are crooked. If some are, do not use them; this is important to your table. Using the two-by-fours, cut four pieces 27 inches long; these will be the legs. For the sides, cut out two 72-inch pieces. For the leg supports, cut four pieces 24.5 inches long. For the footrest support, cut out a 72-inch piece.

Now you are ready to begin the main part of the table. Take two of the legs and two of the supports and bolt them together as shown in Fig. 1. Do the same to the other legs and leg supports. Now get a piece of particle board 72 inches by 28 inches, but don't put it on until the end. Have someone holding one of the leg pieces while you are bolting the footrest support to the middle of the bottom leg support. Then do the same to the other side. Now nail the sides on and screw the top on as shown in Figs. 2 and 3. If you want your table to be very flat on top, countersink some flathead screws. To cover up the screws, use wood putty.

Tools and materials needed include: drill, hammer, right angle, power saw, wrench, 14 bolts, 8 nails, 8 or 9 two-by-fours, 1 piece of particle board 72 inches by 28 inches. ■

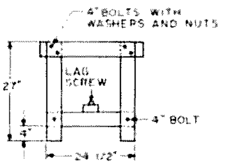


Fig. 1.

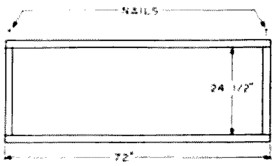


Fig. 2.

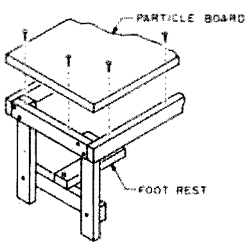
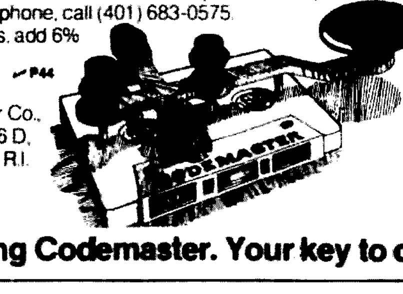
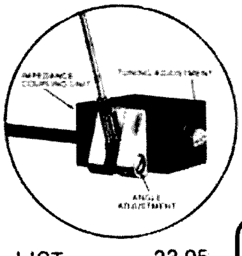


Fig. 3.





✔ Reader Service—see page 243

Social Events

Listings in this column are provided free of charge on a space-available basis. The following information should be included in every announcement: sponsor, event, date, time, place, city, state, admission charge (if any), features, talk-in frequencies, and the name of whom to contact for further information. Announcements must be received two months prior to the month in which the event takes place.

FORT MYERS FL
NOV 3-4

The Fort Myers Amateur Radio Club and the ARRL will host Ham-arama '79 on November 3-4, 1979, at the Ramada Inn, Fort Myers Florida. Featured will be dealer displays, educational forums, and an outdoor flea market. Registration is $3.00 per person. For information contact K4VGN at (813)-334-6190, or WD4ERA (813)-332-1825.

HICKSVILLE OH
NOV 4

The Defiance County Amateur Radio Club is sponsoring its 2nd annual hamfest on Sunday, November 4, 1979, from 8:00 am until 4:00 pm at the Defiance County Fair Grounds, Hicksville, Ohio. Tickets are $1.50 in advance and $2.00 at the door. Talk-in on 146.52 and the club repeater, 147.69/.09.

WEST MONROE LA
NOV 11

The Twin City Ham Club will sponsor North Louisiana's annual "Hamfest" on Sunday, November 11, 1979, from 8:00 am until 3:00 pm at the West Monroe Civic Center, North 7th Street and Ridge Avenue, West Monroe, Louisiana. Tickets may be purchased at the door or in advance for admission and for the prize drawings. Featured will be swap tables for buying, selling, or trading amateur and related equipment, displays of new radio and electronic equipment, information on becoming an amateur operator, and prizes. Everyone is invited. The building is heated and cooled for your comfort. Talk-in on .25/.85, .52/.52, and 3910.

FRAMINGHAM MA
NOV 11

The Framingham Amateur Radio Association will hold its annual fall flea market on Sunday, November 11, 1979, from 10:00 am to 3:00 pm at the Framingham Police Station Drill Shed, Framingham, Massachusetts. Admission is $1.00 for the general public and $5.00 per table for sellers. Sellers are advised to pre-register as tables are limited! Talk-in on .75/.15 and .52. For information, contact Ron Egalka K1YHM, FARA, PO Box 3005, Saxonville MA 01701, or phone (617)-877-4520.

CLEARWATER FL
NOV 17-18

The Florida State ARRL convention will take place on November 17-18 at the Sheraton Sand Key Hotel on Clearwater Beach, Clearwater, Florida. An Icom 701 HF station is the main door prize. The latest update on WARC proceedings is just one of the interesting forums we have scheduled. FCC exams will be given on Saturday at 9:00 am. Please send 610s to the Tampa office by November 9. There will be ladies' events both days, with a luncheon and style show on Sunday. Tickets are $5, which includes a Tappan microwave oven as first prize. The QCWA Gator Chapter will host the Saturday luncheon, with all hams and guests welcome, too; tickets are $6. Saturday evening banquet tickets are $9. Swap tables are $10 for both days—no one-day tables, all advance sold. There should be plenty of parking with courtesy buses running on demand for the duration of the hamfest. We have arranged for special room rates at $30 double, per day, with each extra person $4 and kids under 18 free. Hamfest donation is $3; each advance ticket includes two free prize tickets. Talk-in on .37/.97 and 223.34/224.94. Please make all reservations through and checks payable to: FGCARC (Florida Gulf Coast Amateur Radio Council, Inc.), PO Box 157, Clearwater FL 33517. For ham convention and hotel reservations, phone (813)-461-HAMS.

MASSILLON OH
NOV 18

The 22nd annual auction, Auctionfest '79, sponsored by the Massillon ARC, will be held on November 18, 1979, from 8:00 am until 5:00 pm at the Massillon Knights of Columbus Hall, Massillon, Ohio. The flea market opens at 8:00 am, with auction action at 11:00 am. There will be prizes and displays. Talk-in on 146.52 simplex. Tickets are $2.00 in advance; table reservations are $1.00 per table. For further info, write to Joe Turkal K8EKG, 1234 Concord NW, Massillon OH 44646.

FORT WAYNE IN
NOV 18

The Allen County Amateur Radio Technical Society will hold its 7th annual hamfest on Sunday, November 18, 1979, at the Allen County Memorial Coliseum on US 30, Fort Wayne, Indiana. This will be an all-indoor exhibition and giant flea market. There will be many prizes, including a TS-120/PS and an FT-207R. Admission is $3.00 at the door and $2.50 in advance. Children under 12 are free. A 3' × 8' table rental will cost $4.00. Talk-in on 146.28/.88, 147.255/.855 and 146.52. Hamfest fun starts Saturday night at the Fort Wayne Radio

RIPPED OFF?

If you have a serious problem with a ham firm, send them a letter with all the facts in detail, plainly and simply . . . and send a copy to Wayne Green W2NSD/1, c/o 73 MAGAZINE. 73 protects its readers more than any other magazine.

Ham Help

I am a 54-year-old Novice and have purchased an old Harvey Wells Bandmaster Senior, model TBS 50-C. I would appreciate hearing from anyone who may have the operating instructions for it. I would be most happy to pay for them or have them copied and returned to you.

Al Santi
PO Box 946
Bend OR 97701

I need a schematic and information on an INOUE model FDFM-2 2-meter 6-channel rig. I will copy and return or pay a reasonable price for a copy.

Harold S. Roth WØLFH
602 W. Nebraska
Algona IA 50511

I'm looking for someone competent to repair a Hallicrafters HT-37 that has a poor CW note.

Roy A. Holman WD9GXZ
2124 East Kansas Street
Springfield IL 62703

Club's Saturday Night Funfest. There will be prizes, hot and cold snacks, a cash bar, information, displays, and mini-forums from 7:00 pm to 11:00 pm, Saturday, November 17, at the Holiday Inn, 3330 West California Road. There will be displays by 10-X, ARES, ACARTS, FWDXA, and others, as well as mini-forums on NBVM, DX, Field Day, and more. Funfest tickets (include food and raffle) are $2.00 in advance, $2.50 at the door. For reservations, write to ACARTS, PO Box 342, Fort Wayne IN 46801. For confirmation, include an SASE. Tables are available for setup at 7:00 am.

COLUMBIA MD
NOV 25

The Columbia Amateur Radio Association will hold its 3rd annual Hamfest on Sunday, November 25, 1979, at the Ellicott City National Guard Armory, just east of Rte. 29 on Rte. 103, Columbia, Maryland. Doors will open at 6:00 am for exhibitors and 8:00 am for the general public. Admission is $2.00; tables are $5.00. There will be no tailgating. Food will be available and prizes will be awarded. Talk-in on 147.735/.135, 146.16/.76, and 146.52/.52. For table reservations and information, write Sue Crawford N3SC, 6880 Mink Hollow Road, Highland MD 20777.

OAK PARK MI
NOV 25

The Oak Park High School Electronics Club will present a Swap 'n Shop on Sunday, November 25, 1979, at Oak Park High School, 13701 Oak Park Blvd., Oak Park, Michigan. Donation is $1.50 and tables are $2.50. There will be refreshments and door prizes available.

LANCASTER PA
FEB 24

The Lancaster Hamfest will be held on February 24, 1980, at the Guernsey Pavilion, located at the intersection of Rtes. 30 and 896, east of Lancaster, Pennsylvania. General admission is $3.00, except children and XYLs. Doors will open at 8:00 am. All inside spaces are available by advance registration only and are $3.00 each for an 8-foot space, which includes a table. There will be free tailgating in a specified area outside, if the weather permits. There will be a two-hour Dutch Country tour by an advance registration of $4.00. Food will be served at the hamfest. Also, there are excellent restaurants and accommodations in the area. Talk-in on .01/.61. For information, write Sercom, Box 6082, Rohrerstown PA 17603.

STERLING IL
MAR 9

The Sterling-Rock Falls Amateur Radio Society will hold its 20th annual hamfest on Sunday, March 9, 1980, at Sterling High School field house, 1608 4th Ave., Sterling, Illinois.

✓ Reader Service—see page 243

LETTERS

from page 16

crossmode, regenerated-teletype" contact ever. Not only were KØJUY and WBØSAX glad to get a confirming QSL from Tony, but Tony is still bragging about his accomplishment of working Iowa RTTY on "two meters"!

For a brief while, our unique teletype repeater system actually had begun experimenting with a secondary 6-meter FM input at 52.700 into the two-meter system for the purpose of auxiliary input, extension of range, and full-duplex teletype. Unfortunately, the idea did not get much further due to conflicting club problems.

Crossbanding, if handled intelligently and not just to add another feature-type thing, can be a unique, rewarding, and usable addition to the VHF ham's communication system.

Keep up the good work. We need more RTTY articles and more SSTV articles, too!

Michael W. Stone WBØQCD
Lowden IA

WANE

Congratulations to Wayne on bagging all the New England states on 10 GHz. I guess that makes him the first 3-cm WANE.

John A. Carroll
Bedford MA

CLUB DISCOUNT

It has come to our attention that numerous amateur radio clubs and organizations are conducting CW training programs and are always seeking new and better teaching aids. In order to assist them, Xitex Corporation, Dallas, Texas, is offering a new Morse code "transceiver" at a substantially-reduced club price. The unit connects to any TTY or video terminal (Xitex SKT-100) and can be an extremely useful tool for improving both sending and copying skills.

For further details on how to apply for this limited club discount price, write or call me.

Steve Kriss
Xitex Corporation
9861 Chartwell Dr.
Dallas TX 75243
(214)-349-2490

DEPLORABLE

During the recent passing of hurricane David along the east coast, I was tuned to 14.325 where the Hurricane Watch Net was operating. I have never heard such deplorable conduct by amateurs. There was deliberate jamming, foul language, and amateurs operating so close to the frequency (some I know were running excessive power) that it made copy almost impossible.

At one time, there were two ships in trouble. The Coast Guard was attempting to get a fix on their positions through the amateur frequencies, but, due to the deliberate jamming by these individuals, it was impossible. This alone is enough to turn one that is interested in amateur radio against it.

To think that some amateurs would stoop this low, knowing human lives are involved, is disgusting. I hope that the FCC was able to apprehend some of these individuals and that their licenses are revoked permanently.

Henry Ponder KA4DCQ
Lawndale NC

THE END

I have been monitoring the Hurricane Watch Net on 14.325 for the past 24 hours. At the present time, hurricane David is off the Florida coast and hurricane Frederic is over Barbuda. The net has been operating for the past 7 days. What I heard sounded more like CB (an insult to the Citizens Radio Service). Given the incredible number of lids, SOSers, tuners, etc., on the net frequency (sounded like the majority of US stations), Lynne WA1KKP did a very commendable job. If I were net control, I would have asked for a loaded shotgun. US amateurs make communications almost impossible.

If any of the delegates who will be at the upcoming WARC were listening to this mess, we can kiss each and every amateur band good-bye now! I have been licensed for four years and I have never heard such inconsiderate operators. I refuse to operate under these conditions, so all of my activity was on the Army MARS bands.

This hurricane was not only a disaster for the Caribbean, but also a disaster for amateur radio. I think that this may be *the end*. I will miss hamming very much. To all the operators in other countries, I would like to apologize on behalf of *all* the American hams, the majority of whom are very fine people. It's a shame that a minority can ruin it for us all. Oh well, I guess there's still microcomputing.

Keep up the good work, Wayne, and if you can get us out of this mess, you should be elected President. 73.

Christopher R. Wiener
N2CR/AND1DY
Tenafly NJ

BAD TASTE

I read with deep concern the article on receiving MDS channels in the August, '79, issue of *73 Magazine*. Just where do we draw the line as responsible American citizens, let alone those who have been granted the privilege of operating amateur radio stations in this country?

Why is it that your magazine chose to use an article detailing how to, in effect, *steal* a television signal? The reason these frequencies are not included in home TV receivers is because they are not intended to be received by home receivers.

Instead of printing articles such as this, why not exercise some discretion? You should have printed a fiery reprimand concerning the irresponsible use of technology by so-called "amateurs" who amount to nothing more than "justified" petty thieves. *73 Magazine* should set an example and give us leadership. Amateurs all over the world are crying out for newsworthy PR concerning the reality of service amateur radio affords to the community and to the world. Printing an article such as this is just plain bad taste and shows the deep spiritual need for a reawakening of the American spirit on which this country was founded.

Dale Alan Richman W4NHM
Sevierville TN

SOUR GRAPES

Your response to Vic Clark K4KFC (Letters, August, 1979) was pure sour grapes. Some of the criticisms you have for the ARRL may be well-founded, but you must admit that the League has been the only long-term, stable representative of the radio amateur. Your efforts on behalf of hams can at best be described as mercurial. It's probably more accurate to call them erratic. On the other hand, your criticism of the ARRL has been unflagging.

You are right in saying that the League has led too little, but you have not led either. Too many of us, like you, only react to situations, rather than create them. I, for one, am glad to see the ARRL considering the long-range problems and opportunities of amateur radio, and I'm glad that they are considering the views of all hams.

David Swierenga K4FNE
Fairfax VA

DEAR OM/YL

First, I would like to say that I enjoy reading *73*. My husband and I are both Novices and are working toward our Generals. Our antenna is a five-band dipole worked out from an article in one of your magazines.

However, I do have one thing that bothers me. I keep getting information on subscriptions to your magazine addressed to Dear OM. This particular form of salutation annoys me very much. It is not that I am a woman's libber in the full sense of the word, but I am proud that I am a woman and like to have it acknowledged. I know that this is a standard form of salutation in ham parlance, but it certainly doesn't apply to all hams. Hope that something can be done about this.

Clare N. White WB6WSP
Sonora CA

OK! You win! All reference by 73 in the future will include Young Ladies. How about "Dear OM/YL"?—Robert R. LaPointe, Marketing Director.

Ham Help

I'm looking for a schematic for an ARC-27. Can anyone out there help? I'll be glad to pay a reasonable price for one. Thanks.

Ron Johnson WA5RON
3524 Greystone, #194
Austin TX 78731

I am in need of a schematic and operating manual for a Knight-kit T-60 transmitter. I would be more than happy to pay back any reasonable copying and mailing costs. Any help will be greatly appreciated.

Rick Hampton WD8KEL
275 W. Pinehurst Dr.
Troy OH 45373

Nov. 1979

OSCAR Orbits

Courtesy of AMSAT

The listed data tells you the time and place that OSCAR 7 and OSCAR 8 cross the equator in an ascending orbit for the first time each day. To calculate successive OSCAR 7 orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the day's first ascending (northbound) equatorial crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world from you, it will descend over you. To find the equatorial descending longitude, subtract 166° from the ascending longitude. To find the time OSCAR 7 passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR 7 when it is within 45 degrees of you. The easiest way to determine if OSCAR is above the horizon (and thus within range) at your location is to take a globe and draw a circle with a radius of 2450 miles (4000 kilometers) from your QTH. If OSCAR passes above that circle, you should be able to hear it. if it passes right overhead, you should hear it for about 24 minutes total. OSCAR 7 will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15° east or west of you, add another minute; at 30°, three minutes; at 45°, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

OSCAR 8 calculations are similar to those for OSCAR 7, with some important exceptions. Instead of making 13 orbits each day, OSCAR 8 makes 14 orbits during each 24-hour period. The orbital period of OSCAR 8 is therefore somewhat shorter: 103 minutes.

To calculate successive OSCAR 8 orbits, make a list of the first orbit number (from the OSCAR 8 chart) and the next thirteen orbits for that day. List the time of the first orbit. Each successive orbit is then 103 minutes later. The chart gives the longitude of the day's first ascending equatorial crossing. Add 26° for each succeeding orbit. To find the time OSCAR 8 passes the North Pole, add 26 minutes to the time it crosses the equator. OSCAR 8 will cross the imaginary San Francisco-to-Norfolk line about 11 minutes after crossing the equator. Mode A: 145.85-.95 MHz uplink, 29.4-29.50 MHz downlink, beacon at 29.40 MHz. Mode J: 145.90-146.00 MHz uplink, 435.20-435.10 MHz downlink, beacon on 435.090 MHz.

OSCAR 7 Orbital Information

Orbit	Date (Nov)	Time (OMT)	Longitude of Eq. Crossing °W
22692	1	0031:35	74.1
22705	2	0125:52	87.7
22717	3	0025:12	72.6
22730	4	0119:29	86.1
22742qrp	5	0018:49	71.0
22755	6	0113:06	84.6
22767X	7	0012:27	69.4
22780	8	0106:44	83.0
22792	9	0006:04	67.9
22805	10	0100:21	81.5
22818	11	0154:38	95.1
22830qrp	12	0053:58	79.9
22843	13	0148:15	93.5
22855X	14	0047:35	78.4
22868	15	0141:52	92.0
22880	16	0041:12	76.8
22893	17	0135:29	90.4
22905	18	0034:49	75.3
22918qrp	19	0129:06	88.8
22930	20	0028:27	73.7
22943X	21	0122:43	87.3
22955	22	0022:04	72.1
22968	23	0116:21	85.7
22980	24	0015:41	70.6
22993	25	0109:58	84.2
23005qrp	26	0009:18	69.0
23018	27	0103:35	82.6
23030X	28	0002:55	67.5
23043	29	0057:12	81.1
23056	30	0151:29	94.7

OSCAR 8 Orbital Information

Orbit	Date (Nov)	Time (GMT)	Longitude of Eq. Crossing °W
8444Abn	1	0100:50	62.2
8458Abn	2	0105:59	63.5
8472Jbn	3	0111:08	64.8
8486Jbn	4	0116:17	66.1
8500Abn	5	0121:25	67.4
8514Abn	6	0126:34	68.7
8528X	7	0131:43	70.0
8542Abn	8	0136:52	71.3
8556Abn	9	0142:00	72.6
8569Jbn	10	0003:55	48.1
8583Jbn	11	0009:04	49.4
8597Abn	12	0014:13	50.7
8611Abn	13	0019:21	52.0
8625X	14	0024:30	53.3
8639Abn	15	0029:39	54.6
8653Abn	16	0034:47	55.9
8667Jbn	17	0039:56	57.2
8681Jbn	18	0045:04	58.5
8695Abn	19	0050:13	59.8
8709Abn	20	0055:21	61.1
8723X	21	0100:30	62.5
8737Abn	22	0105:38	63.8
8751Abn	23	0110:47	65.1
8765Jbn	24	0115:55	66.4
8779Jbn	25	0121:04	67.7
8793Abn	26	0126:12	69.0
8807Abn	27	0131:21	70.3
8821X	28	0136:29	71.6
8835Abn	29	0141:38	72.9
8848Abn	30	0003:32	48.4

OSCAR 7 Orbital Information

Orbit	Date (Dec)	Time (GMT)	Longitude of Eq. Crossing °W
23068	1	0050:49	79.5
23081	2	0145:06	93.1
23093qrp	3	0044:26	78.0
23106	4	0138:43	91.5
23118X	5	0038:04	76.4
23131	6	0132:20	90.0
23143	7	0031:41	74.8
23156	8	0125:58	88.4
23168	9	0025:18	73.3
23181qrp	10	0119:35	86.9
23193	11	0018:55	71.7
23206X	12	0113:12	85.3
23218	13	0012:32	70.2
23231	14	0106:49	83.8
23243	15	0006:09	68.6
23256	16	0100:26	82.2
23269qrp	17	0154:43	95.8
23281	18	0054:03	80.7
23294X	19	0148:20	94.2
23306	20	0047:40	79.1
23319	21	0141:57	92.7
23331	22	0041:18	77.5
23344	23	0135:35	91.1
23356qrp	24	0034:55	76.0
23369	25	0129:12	89.6
23381X	26	0028:32	74.4
23394	27	0122:49	88.0
23406	28	0022:09	72.9
23419	29	0116:26	86.5
23431	30	0015:46	71.3
23444qrp	31	0110:03	84.9

OSCAR 8 Orbital Information

Orbit	Date (Dec)	Time (GMT)	Longitude of Eq. Crossing °W
8862Jbn	1	0008:41	49.7
8876Jbn	2	0013:49	51.0
8890Abn	3	0018:58	52.3
8904Abn	4	0024:06	53.6
8918X	5	0029:14	54.9
8932Abn	6	0034:23	56.2
8946Abn	7	0039:31	57.5
8960Jbn	8	0044:39	58.8
8974Jbn	9	0049:48	60.1
8988Abn	10	0054:56	61.4
9002Abn	11	0100:04	62.7
9016X	12	0105:12	64.0
9030Abn	13	0110:21	65.3
9044Abn	14	0115:29	66.6
9058Jbn	15	0120:37	67.9
9072Jbn	16	0125:45	69.2
9086Abn	17	0130:53	70.5
9100Abn	18	0136:02	71.8
9114X	19	0141:10	73.1
9127Abn	20	0003:04	48.6
9141Abn	21	0008:13	49.9
9155Jbn	22	0013:21	51.2
9169Jbn	23	0018:29	52.5
9183Abn	24	0023:37	53.8
9197Abn	25	0028:45	55.1
9211X	26	0033:53	56.4
9225Abn	27	0039:01	57.7
9239Abn	28	0044:09	59.0
9253Jbn	29	0049:17	60.3
9267Jbn	30	0054:25	61.6
9281Abn	31	0059:33	62.9

Review

CONFIDENTIAL FREQUENCY LIST
by Oliver P. Ferrell,
4th Edition, 1979, 104 pages,
6-1/8" × 9", paper, $6.95,
distributed by
Gilfer Associates, Inc.,
PO Box 239, 52 Park Ave.,
Park Ridge NJ 07656

Have you ever wanted to listen to NASA, INTERPOL, the Russian Navy, the US Coast Guard, or the Rumanian Embassy in Washington? Or have you heard stations with strange callsigns like XSV and KKN50 and wondered just who they were? Perhaps you're just curious about "what's out there" other than hams, broadcast, and CB. If any of these descriptions fit you, then you'll probably be interested in this book.

The *Confidential Frequency List* (*CFL*), now in its fourth edition, lists hundreds of stations in ascending order of frequency from 4001 to 25590 kHz. Included, in most cases, are the frequency, mode, callsign, location, type of service, and power. Many entries also have remarks which tell the listener more specifically what to expect on a frequency—aircraft in Southeast Asia and western Australia, weather reports, telephone conversations, etc.

Previous editions of the *CFL* were arranged by type of service—a section for INTERPOL, one for broadcast feeders, one for VOLMET (aviation weather), etc. That was convenient for eavesdropping on a particular service or station. This new edition, listed by frequency, is very good for identifying "weird" stations heard. It's a bit difficult, though, to find (for example) all the frequencies for NOJ (Coast Guard Radio, Kodiak, Alaska) or NASA. Perhaps the future editions of *CFL* will have some type of cross index to eliminate this problem. One further suggestion for future editions would be to include a wider range of frequencies. (There are interesting stations all the way down to about 10 kHz. Nationwide VHF frequencies would be of interest to the many owners of scanning VHF receivers.)

These few criticisms are minor. A book can't be all things to all people. As it is, the *CFL* is a most valuable resource for anyone with access to a general-coverage radio who wonders, "What's going on?"

Readers should note the author's admonition that the "confidential" part of the title is no joke. It refers to the secrecy provision of the Communications Act which prohibits the disclosure of the content of any non-ham and non-broadcast radio transmission.

Dennis G. Brewer
APO New York

Ham Help

I need information on converting a Collins R-390A to product detection or installing a product detector. Thanks.

George Shira WD4BUM
RT. #7, Box 101-I
Anderson SC 29624

I have been trying to find some parts for an AN/ARR-52 Radio Receiver. I have been able to find everything I need except for the channel selector control box (model C-3109/ARR-52) and the signal level meter box (model SB-1084/ARR-52).

It's a little slow changing channels with a screwdriver. Does anyone know where I might find these two items? Thanks.

Craig Winters
Box 79, Federal St.
Wiscasset ME 04578

Nov. — 1979

Microcomputer Interfacing

from page 28

NXTKEY. In ten milliseconds, the 8080 returns from DELAY, which is a sufficient period of time to debounce the switch closure. The 8080 now has to determine which key in column A is pressed. It does this by rotating to the right into the carry the word that was previously input. If a logic one is rotated into the carry, the JNC to RELESE is not executed. Instead, the content of the D register is increased by four. By jumping back to AGAIN, the 8080 can rotate another bit of the A register into the carry. When a logic zero is rotated into the carry, the unique code for the key that is pressed is in the D register, so the jump to RELESE is executed by the 8080.

```
/THIS SUBROUTINE SCANS A MATRIX KEYBOARD
/THAT IS ARRANGED AS FOUR ROWS OF FOUR KEYS,
/A 4X4 KEY MATRIX.  IN ADDITION, INSTRUCTIONS
/HAVE BEEN ADDED TO THE SUBROUTINE TO DEBOUNCE
/THE KEYS.

KEYSCN, MVID    /LOAD D WITH THE CODE FOR THE
        003     /FIRST KEY THAT CAN BE SENSED
        MVIB    /LOAD B WITH THE WORD THAT IS USED TO
        376     /ACTIVATE ONE ROW OF KEYS AT A TIME
NXTGRP, MOVAB   /GET THE TEST WORD
        OUT     /AND OUTPUT IT TO THE KEYBOARD
        003
        RLC     /ROTATE THE TEST WORD LEFT ONE BIT
        MOVBA   /AND THEN SAVE IT IN B
        IN      /INPUT THE DATA FROM THE FOUR
        000     /ROWS OF KEYS
        ANI     /SAVE ONLY THE FOUR LSBS, WHICH CON-
        017     /TAIN THE ROW DATA
        CPI     /SEE IF ANY KEYS ARE PRESSED BY COM-
        017     /COMPARING 017 (0F) TO THE INPUT WORD
        JNZ     /A KEY IS PRESSED IN THIS ROW, SO
        NXTKEY  /DETERMINE WHICH KEY IT IS
        0
        DCRD    /NO KEYS ARE PRESSED IN THE TESTED ROW
        MOVAD   /SO DECREMENT THE KEY CODE BY ONE AND
        CPI     /SEE IF ALL FOUR ROWS HAVE BEEN TESTED
        377     /377 - HEX FF
        JNZ     /NOT ALL FOUR ROWS HAVE BEEN TESTED,
        NXTGRP  /SO TEST ANOTHER ROW
        0
        JMP     /ALL THE ROWS HAVE BEEN TESTED AND
        KEYSCN  /NO KEYS ARE PRESSED, SO KEEP LOOKING
        0
NXTKEY, CALL    /A KEY IS PRESSED, SO EXECUTE THE
        DELAY   /DELAY SUBROUTINE FOR 10 MSEC.
        0
AGAIN,  RRC     /ROTATE THE ROW DATA INTO THE CARRY
        JNC     /FOUND THE KEY, SO WAIT FOR IT TO
        RELESE  /BE RELEASED BEFORE RETURNING FROM
        0       /THE SUBROUTINE
        PUSHPSW /OTHERWISE, SAVE THE PSW ON THE STACK
        MOVAD   /AND INCREASE THE KEY CODE IN D BY 4
        ADI
        004
        MOVDA   /SAVE THE NEW KEY CODE IN D
        POPPSW  /POP THE PSW OFF OF THE STACK
        JMP     /AND THEN TRY FOR A ZERO CARRY
        AGAIN   /AGAIN
        0
RELESE, IN      /INPUT THE DATA WORD AGAIN
        000
        ANI     /SAVE ONLY THE FOUR DATA BITS THAT
        017     /REPRESENT ROWS OF KEYS
        CPI     /COMPARE THIS VALUE TO THE VALUE OBTAINED
        017     /WHEN NO KEYS ARE PRESSED (017, HEX 0F)
        JNZ     /JUMP IF A KEY IS STILL PRESSED
        RELESE  /AND WAIT FOR IT TO BE RELEASED
        0
DELAY,  PUSHPSW /SAVE THE PSW ON THE STACK
        PUSHD   /THEN SAVE REGISTER PAIR D ON THE STACK
        LXID    /LOAD REGISTER PAIR D WITH A COUNT
        101     /OF 003 101 (HEX 0341)
        003
WAIT,   DCXD    /DECREMENT THE COUNT
        MOVAD   /MOVE THE MSBY TO A
        ORAE    /OR IT WITH THE LSBY
        JNZ     /IF THE RESULT IS NON-ZERO, JUMP
        WAIT    /TO THE DCXD INSTRUCTION
        0
        POPD    /WHEN IT IS ZERO, POP D&E OFF OF THE STACK
        POPPSW  /AND THEN POP THE PSW OFF OF THE STACK
        RET     /AND RETURN WITH THE KEY CODE IN D
```

Fig. 4. A subroutine that scans the 16-key keyboard.

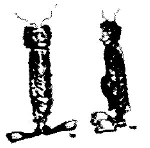
The 8080 now waits for the key to be released, at which time the DELAY subroutine is called again. This causes the key opening to be debounced. The RET instruction at the end of the DELAY causes the 8080 to return to the program that called KEYSCN. When it does, the key code is in the D register.

As an example, let us assume that the nine key is pressed. The 8080 loads the D register with three and the B register with 11111110. The content of the B register is output to the keyboard and is then rotated to 11111101. The row data from the keyboard is then input, but since no key in column A is pressed, the A register contains 017 after the ANI instruction is executed. Therefore, the content of the D register is decremented from three to two and the 8080 jumps back to NXTGRP so that the B column can be tested. When the 8080 executes the instruction at NXTGRP this time, a 11111101 is output to the keyboard, but since no keys in the B *column are* pressed, the 8080 inputs a 017. Because of this, the content of the D register is decremented from two to one, and since this value is not equal to 377, the 8080 jumps back to NXTGRP.

The 8080 now tests the C column by latching out a 11111011 to the keyboard interface. Since a key in the C column is pressed (the 9 key), the A register will contain 11111011 when the IN 000 instruction is executed. The ANI 017 instruction sets bits D7 through D4 to zero, so the A register contains 00001011. Since this value is not equal to 017, the 8080 executes the jump to NXTKEY. The DELAY subroutine is then called, so that the key closure is debounced. The A register still contains 00001011, so a logic one is rotated into the carry when the RRC instruction is executed the first time. This means that the JNC to RELESE is not executed. Instead, four is added to the content of the D register (one) and the result (five) is saved in the D register. By jumping back to AGAIN, the 8080 rotates the 00000101 once to the right, and again, a logic one is rotated into the carry. As before, the JNC to RELESE is not executed, so four is added to the content of the D register (five) and the result (octal 011, decimal 9) is saved in the D register. When the 8080 jumps to AGAIN this time, the 00000010 in the A register is rotated to 00000001, and a logic zero is rotated into the carry. This means that the JNC to RELESE is executed. Once the 9 key is released, the DELAY instructions are executed, and the 8080 returns from the subroutine with the code for the nine key (octal 011, decimal 9) in the D register.

Surprisingly enough, no additional software instructions have to be added to the subroutine in Fig. 4 for the 8080 to scan and encode a 64-key keyboard! In fact, only four immediate data bytes have to be changed. However, the interface would have to consist of an eight-bit output port (so that a test pattern for eight columns of keys could be output) and an eight-bit input port (because there are eight keys in each column). This means that the keyboard consists of eight columns, each containing eight keys. Note that the software in Fig. 4 does not produce ASCII values for the key closures. However, this could be done very easily, simply by using a look-up table that contains 64 entries.

As you have seen, key closures can be encoded by means of hardware or software. A number of integrated circuit manufacturers have keyboard-encoder integrated circuits available which can be used very easily and with a minimum of software. However, they may be too expensive or not flexible enough for your needs. By using a scanned keyboard, the interface electronics are kept to a minimum. However, a long and complex subroutine must now be used to debounce and encode the key closures. This subroutine consists of 38 instructions and requires 67 memory locations for storage. If a look-up table is used to convert the key codes to ASCII values, an additional 72 memory locations will be required to store the look-up table and some additional assembly language instructions.



Ham Help

I would like to get in touch with hams around the world who are under the age of 20 and who are interested in joining the Young Amateurs World Net (YAWN). Please send an SASE for info.

Stephen V. Genusa WD5EAE
2106 Park Ave.
Monroe LA 71201

RTTY Loop

from page 20

for nominal amounts from several of the teletype suppliers mentioned in the column a few months back or from many *73* advertisers.

If only a few symbols are to be changed (say you want to change from press to communications), replacement type pallets also are available. These are simply soldered onto the end of the type bar after the old pallet is removed by desoldering. It takes only a few minutes, and the procedure is painless unless you try to hold the type bar while soldering.

Turning to other matters, Bill Taylor K8TBW writes describing a nice RTTY setup including the Microlog equipment and Drake line. Bill is trying to use the Heath SB-610 monitor scope with the station, but has a problem. The scope requires the mark and space detector outputs, and the Microlog unit does not provide them. He wonders if there is any way to use the 610 with audio input and still get an X or + pattern.

I don't know, Bill. It seems to me that you would have to build the front end of a demodulator to feed the thing. Basically, the limiter and mark/space filters would be needed to get differential outputs. That is really not all that much, but it seems like a waste. If any readers have information on such a wedding, I would be interested in passing it along to Bill and others.

Have received a snazzy publication from the Stark County RTTY Group called *Watts Happening*. Passed along by Joseph Ebner WB8RVM, it points to an active group out there in Massillon, Ohio, and I am sure that they would appreciate hearing from hams in the area who are interested in RTTY.

As of this writing, no word has been received on Teleprinter Art, Ltd., as reported in last month's "RTTY Loop." A communication to the firm has been without response, and several more individuals have reported to me that they have received less than satisfactory service from the company. I urge all readers to be cautious in their dealings with all mail-order firms.

Leaky Lines

from page 24

prices, I don't think that this amount would even cover the cost of the receiver alone! The strange thing about this is that this particular design has not been altered in any significant way since I bought mine. Even more important, it's practically impossible to find reliable sources for quality vacuum tubes. A friend told me that he put forty 12AT7s on his tube checker in an attempt to find a matched pair and no two even came close in transconductance figures. Is it any wonder that hams are switching to more modern equipment?

As far as I know, there are only two major American companies producing gear that is competitive with the imported equipment. All others seem to have fallen by the wayside. Kenwood, Yaesu, Icom, Trio, Tempo . . . these are the names that show up nowadays, and I must confess that they sound at least as good as the best old stuff, and usually a good deal cleaner.

This makes me laugh, really. A fellow I know only slightly gave me a bad going over for driving a foreign car. He said that buying an export is practically treasonous in these times. But about six weeks later, he showed up on 20 meters with a brand new Icom 701 with all the goodies to match!

There's nothing like a little consistency . . . right?

Looking West

from page 18

Now, then, New York and Los Angeles, in our example, are terminal cities or terminal ports. Since in the southwest repeating devices sit atop high mountains, fewer hops are necessary than in areas where such elevation and line-of-sight characteristics are not attainable. Out here, the average repeater has saturated coverage for about 150 miles from a good mountaintop and peripheral coverage for another 50 to 70 miles. A similar repeater atop a building in an eastern or midwestern city might cover 50 to 70 miles saturated and another 15 or so in peripheral. Remember, we are discussing ideal average systems and not the occasional super system that, through some odd circumstance, is able to do what others cannot. Let's go ahead with these figures as our reference. Then, in like manner, we can apply a similar program to the interlinking portion of our intertie.

Again, using 220 MHz as our intertie band and considering normal band conditions most of the time, it should be possible to accomplish between 150- to 275-mile minimum hops, using nominal power and directional antennas at any given linking site. If all things were equal (and due to the variations in terrain they are not), we would come up with an approximate figure of 20 linking sites, giving us coast-to-coast communication between two major American cities with a large two-meter FM population. If we worked with a 275-mile link figure, the number of linking sites would be down to about a dozen. This might be further enhanced if we were to borrow some weak-signal technology from experts in this field and utilize SSB rather than FM for the modulation system on our interlink channels. This would be the ideal situation. However, in real life I suspect that it would probably necessitate more on the order of 30 links to accomplish such a goal. If that sounds like a lot, it is, in reality, less than 1% of the total number of two-meter open systems operational at this time. I think that I am safe in assuming that there are at least 30 repeater owners out there who might find a project such as this an exciting challenge. Making it happen requires only a bit of "bread," some well-thought-out technology, and believing in the motto, "Yes, I can!"

As I write this, I can imagine some of you asking, "How will it be policed? What if it gets jammed—what then?" Or, "Nobody will be able to use it; it will be a madhouse." Things like this can happen and, at least at the outset, I would expect them to. However, if we spend our lives worrying about the "might" and the "maybe," we will live to see nothing of consequence accomplished. Everything in life has an element of risk. There comes a time in any person's life when he must look in the mirror and decide if he is a man or a mouse. Is he willing to look forward to and participate in the future, or does he take the ostrich approach? Sure, we have problems, both technological and sociological, but to run and hide our heads in the sand will accomplish nothing. We amateurs have faced problems before and have whipped them before. Why should this situation be different?

CROSSBAND REPEATER DEPARTMENT

Earlier this month, I spent about a half hour on the telephone with Wayne, and one of the subjects we discussed was crossband repeaters. This idea is not new. In fact, crossband repeaters were in vogue prior to the "18803" dark ages. Lately they are coming back, along with crossband/cross-mode repeaters, to allband HF SSB. I can see only one drawback to such crossband devices: the necessity of carrying two radios wherever one goes. Usually this is not a problem at one's base station. In fact, some of the newest of the five-band HF transceivers feature an FM-mode position. Yaesu and others have pioneered this knowing full well that FM capability, with its intended use on ten meters, makes for a more useful all-around transceiver package. This is fine for home, but a mobile installation is a different story, especially as today's "mobiles" are a lot more cramped for space than were their cousins of a few years back. I drive a compact car myself these days, and trying to fit two adults, radios for both two meters and 220 MHz, and associated tone-pads into the front seat is a bit of a chore. Even if I were to trunk-mount something like a Motrac, there would be little if any room for a control head.

If you are like most amateurs I know, you will want to have both bands with you. For example, most of my operating out here is on 220 MHz. Most of my two-meter operating is done through a remote base accessed from 220 MHz. However, once out of range of the 220 remote, I rely heavily on my Icom 22A and/or Clegg FM-27B, depending on which one happens to be in the car at the moment. A solution to this dilemma may be in using a highly modified mini-CB radio as the ten-meter mobile station. Such radios can usually be had for a song at local swapmeets and CB breaks. With a bit of

time and correct technology, such radios might be excellent ten-meter FM performers. Also, who says that the ten-meter portion of such systems must be FM? Judging by the number of CB-to-ten-meter conversions appearing in *73* and elsewhere, it might be wise to standardize on good old "ancient modulation" for ten-meter crossband operations. This would open things up to many more people. Not everyone is prepared to pay a lot of money to try something new, but they might spend a few bucks to get their feet wet. QRP AM on ten meters blends nicely with two-to-ten crossband operation and, while it cannot match the fade margin afforded by FM operation, it's a nice, inexpensive way to begin. Also, it will fit in the tiniest of vehicles along with the two-meter rig.

If you deal with a crossband repeater in the purest sense (in a classic repeater configuration), then you will require two radios in order to both talk and listen. A true crossband repeater is one that listens on a given band and re-transmits on another. However, there is a better way of doing things, and this is known out west as "remote-base configuration."

We have discussed remote-base operation, but a quick review might be in order. First, the accepted full designator for a remote base is (get ready for this) "the individually owned and operated, advanced format, remotely-controlled amateur base station radio." I prefer the simple term "remote." A classic remote is one in which the base station is at some good site and is controlled by some form of auxiliary intertie. This can be a phone line, direct hard-wire, or a radio link above 220 MHz. In most cases, a remote serves the dual function of repeater (or autopatch repeater) and interlink to other bands. Until recently, most remotes restricted operation to such simplex channels as the national remote-base intertie channel of 146.46 on two meters, along with such others as 146.94, 52.525, and 29.6, all of the latter being nationally accepted simplex allocations.

Frequency synthesis revolutionized not only 2m FM operation, but 2m remote downlink use as well. Many older remotes opted for synthesis over crystal control, and virtually every new remote I run into is fully synthesized on its two-meter downlinks.

It's not uncommon around here to work someone on a two-meter repeater which, in turn, is operating from an area removed from that repeater's normal coverage through a remote-base system that can talk to the repeater. Sound confusing? It really isn't. For example, Newhall, California, is an rf pit. Though only a few miles north of Los Angeles, we are surrounded by several kilofeet of mountains, which makes working most Los Angeles repeaters impossible. However, by operating two meters through a remote base (which sees both my QTH and LA's, as it is located atop a 4800-foot hill that overlooks both), I can operate easily through most area systems using only ten Watts and a Ringo on 220 MHz. Without the remote, my access to Los Angeles would be very limited.

There is much to be said for the remote-base concept of crossband operation. First, since all the crossbanding is accomplished at the repeater site itself, the user of this system need carry only one radio. Second, on a remote (or on a private or closed repeater), every system user is automatically a control operator. He has total control over all aspects of a QSO, including the right to "dump it off" should a problem arise with regard to content of communication. The only problem is that there still exist certain prohibitions with regard to controlling a transmitter on *another* band *from* frequencies below 220 MHz. However, this might really encourage 220-MHz repeater expansion. Though by tradition remotes have restricted themselves to small private groups, there is no law that says this must be the case. The recent establishment of 145.60 as a general intertie channel for any 220 repeater wishing to converse with any other 220 repeater is an obvious step in that direction. (145.6 is the correct frequency, rather than the 145.56 which was printed in the August column.) The repeater that initiated it, WA6VNV on Oat Mountain, is a heavily used 220-MHz open-access repeater. They could just as easily have selected a ten-meter frequency, a twenty-meter frequency, and a crossband open remote-base system. It is not a traditional remote base by any means, but nowhere in part 97 does it state that, to be a remote base, a system must be private or restricted access. Most are, for traditional reasons, but as more and more systems join WA6VNV on 145.6 MHz, that tradition, like many others, begins to slip away.

It was suggested several months ago by a "Looking West" reader in Chicago that we should establish a national remote-base intertie channel on ten meters as a common meeting ground for such operations nationwide. At that time, it drew very little response and we let it go. However, the infusion of new crossband VHF relay activity to ten meters brings this concept into the limelight once again. I'd appreciate your input on this subject. A spot lying between the top of the OSCAR downlink and 29.6 has been suggested by some. Maybe you have a better idea. If so, pass it along to the rest of us.

In the meantime, give some serious consideration to the remote-base concept of downlink operation. The user need not buy any extra radio, and only a linking radio is needed at the repeater site. The rewards are great and the cost is minimal.

MORE CHANGES AT WESTLINK DEPARTMENT

I really was not planning to write the following for reasons that will soon become obvious. To some it may sound as though I am tooting my own horn, and that's not true. I am furnishing the following information after having been urged to do so by Wayne, as he convinced me that it is quite newsworthy.

In mid-July, Westlink's network director, Jim Hendershot WA6VQP, asked me if I would consider producing the weekly Westlink Amateur Radio News "QSTs." I told him that I would if I could get both the space to set up a production facility and some assistance. Jim was away on vacation earlier this year, and I filled in for him. During that time, I managed to put together a good news team. It consisted of myself as writer/producer, Bill Orenstein KH6IAF as engineer/production coordinator, and Al Kaul W6RCL and Burt Hicks WB6MQV as anchorpersons. I felt that Bill would be gung-ho. I was right. He was not only elated at the prospect, but even donated office space and much of the production equipment. We then contacted Burt and Al, who were also interested. I spoke with Jim and arranged to take over on the first Sunday of August.

During the transition period, Bill introduced me to a very talented man named Zeke Manners. Zeke is not a ham (not yet), but I think we are getting to him. Zeke is, however, a professional broadcaster who has emceed many radio programs and, thanks to Bill, he agreed to become part of the Westlink news team as well. With this many people involved in Westlink, no one person is totally responsible for the burden of weekly production except for Bill Orenstein, who edits the programs for time and continuity. He does so in the time-honored tradition of hand-cutting the newscast and then transferring it from reel to cart for dissemination. We hope to enlist the aid of at least one other editor to minimize Bill's workload in the future. Keep in mind that this is a voluntary effort on our part, and that each of us has another "real" job. Having produced a fair number of newscasts, I find it hard to believe that any one individual could have done this alone for over two and a half years. Jim did, and he is to be commended for his work.

We are disseminating the newscast in only one way at present. There is no cassette exchange program any longer. Jim discontinued it about six months ago and, after much consideration, we decided not to revive it, though not for the same reasons. For Jim the problem was the time it took for duplication. This would not be a problem for us since we could have utilized high-speed duplication processes and paid for it ourselves. However, there is another reason for not reviving it, and that is the quality of duplication. Bill happens to be an audio engineer by profession, and if there is one thing he knows like the back of his hand, it's tape recording techniques. Bill feels that the main problem with cassette exchange is one of quality control. It seems that no two people ever send the same type or quality of cassettes, and this gives rise to complaints about recording quality. We have therefore elected to utilize an automated telephone system fed from a Collins broadcast cartridge machine. The newscast is first recorded on reel-to-reel tape, then edited by Bill, and finally transferred to cart. It is available from 9:00 pm Sunday to 10:00 pm Wednesday, local Pacific time. The rest of the week, the equipment is tied up in production. Also, the first half hour (9:00 to 9:30 pm Sunday) is reserved for local Los Angeles/San Diego feeds, after which the facilities are available to any repeater or handicapped amateur on a first-come, first-served basis. We will continue this way for the foreseeable future.

Finally, along with those already mentioned, we have added a number of other volunteer correspondents, including Joe Merdler N6AHU (law) and Pat Corrigan KH6DD (Pacific Islands). We also found someone to cover major national conventions and are trying to add a European correspondent from Germany. This is where we currently stand. We admit to being a shoestring operation, trying to do out-of-pocket what other stations do by spending hundreds of thousands of dollars. The amazing thing is that it all seems to be coming together

for us, and this makes me very happy. By the way, if anyone out there happens to have some usable "Fedlilpak" cartridges (large or small) that they are willing to give away, we would be happy to receive them. In fact, it would be much appreciated.

If you would like to get more information on Westlink, have a story you feel is air-worthy, or want to arrange to get the weekly service (which is still free), then drop a note to us at Westlink, 7046 Hollywood Boulevard, Suite 718, Hollywood CA 90028. Also, if you are among those who sent cassette tapes to Jim prior to the discontinuation of the cassette exchange program, they will be returned to you in the near future. We ask that you be patient a bit longer.

Contests

from page 30

QSO points times the IPA countries multiplier.

FREQUENCIES:

SB—3650, 7075, 14295, 21295, 28560 kHz ± 25 kHz.

CW—3575, 7025, 14075, 21075, 28075.

ENTRIES AND AWARDS:

US stations wanting a copy of Sherlock Holmes Award rules, IPARC membership list, contest logs, and results of the 1978 contest should send an SASE with 2 stamps (others send 2 IRCs) to: Vince Gambino WB4QJO, 7606 Kingsbury Rd., Alexandria VA 22310. Any station fulfilling the conditions of the SHA may apply with an application sheet. The approval of 2 licensed amateurs is not necessary when the SHA application is submitted with the contest logs. See SHA rules for more information. The contest winners, the 3 operators with the highest score, receive a certificate and are honored in the Award Chronicle of the International Police Association RC. Logs must be postmarked no later than December 31st and sent to: Bureau National IPA, Section Francaise, CNAS, Mr. Gerard Dupuis, 15 Rue Cambaceres, 75008 Paris, France.

DELAWARE QSO PARTY

Starts: 1700 GMT Saturday, November 10
Ends: 2300 GMT Sunday, November 11

Sponsored by the Delaware Amateur Radio Club (DARC), the contest is open to all amateurs. Non-DE stations work only DE stations.

EXCHANGE:

DE stations send QSO number, RS(T), and DE county. Non-DE stations send QSO number, RS(T), and ARRL section or country.

SCORING:

DE stations score 1 point per QSO and multiply by the total of ARRL sections and countries. Non-DE stations score 5 points per QSO and multiply by the total sum of counties worked per band per mode (max. possible 36, assuming 160 through 10 meters). DE counties = New Castle, Kent, and Sussex.

FREQUENCIES:

CW—60 kHz from low end of each band and 1805.

Phone—1815, 3900, 7275, 14325, 21425, 28560.

Novice—3710, 7120, 21120, 28120.

Check 160 at 0500 GMT and 0600 GMT or make skeds.

ENTRIES:

Send logs by December 15th to: Stephen J. Momot, K2HBP, 14 Balsam Rd., Wilmington DE 19804. If you work all three counties and wish the WDEL Award, include two 15¢ stamps and an address label. Include an SASE for results only.

INTERNATIONAL OK DX CONTEST

Starts: 0000 GMT November 11
Ends: 2400 GMT Sunday, November 11

Participating stations work stations of other countries according to the official DXCC Countries List. Contacts between stations of the same country count as a multiplier but 0 points. Use all amateur bands from 160 through 10 meters on both CW and phone. Cross-band and cross-mode contacts are not valid.

EXCHANGE:

RS(T) and two-digit ITU zone number. Note: ITU zones are different from the ARRL zones. A list and map of the ITU zones are available from the contest sponsors for 2 IRCs.

SCORING:

A station may be worked once per band. A complete exchange of codes counts one point, but three points are earned for a complete contact with a Czechoslovak station. The multiplier is the sum of the ITU zones from all bands. The final score is then the total QSO points times the total multiplier.

ENTRIES:

Categories of participating stations: A) single-operator, all bands; B) single-operator, one band; C) multi-operator, all bands.

Any station operated by a single person obtaining assistance, such as in keeping the log, monitoring other bands, tuning the transmitter, etc., is considered as a multi-operator station. Club stations may work in category C only. A separate log must be kept for each band and must contain the following data: date and time in GMT, stations worked, exchange sent and received, QSO points, and ITU zone multipliers (with first QSO in each zone only). The log must contain in its heading the category of the station (A, B, or C), name, callsign, address, band(s), etc. There is also a sum of contacts, QSO points, and multipliers and the total score for the participating station. Each log must be accompanied by a declaration that all rules and operating procedures were observed. A performance list of participants will be created for each country by the contest committee. A certificate will be awarded to the top-scoring operators in each country and each category. The "100 OK" award may be issued to the stations working 100 OK stations, and the "S6S" award may be issued to a station for contacts with all continents. Both awards will be issued upon written application in the log and no QSL cards are required. Logs must be sent to: the Central Radio Club, Prague 1, Czechoslovakia, postmarked no later than December 31st.

27TH ANNUAL BREEZE SHOOTER TEN-METER GROUND WAVE CONTEST

Starts: 2100 EST November 24
Ends: 0100 EST November 25

Sponsored by the Breeze Shooters, Inc., of Pittsburgh PA, this contest will feature separate categories for Novice/Technician, QRP, mobile entries, and fixed stations. For log sheets and rules, send an SASE to: George Proudfoot K3GP, 3472 Ivy Hill Lane, Finleyville PA 15332.

Awards

from page 22

years, the net has become a popular meeting place for 160-meter hams. The golden frequency was and still is 1818 kHz, and you'll find the net originating from the eastern shores of the United States each and every Wednesday evening at 2100 Eastern Time.

Keep in mind, should you wish to join the net, good conditions are more prevalent in the winter than in the summer months. This is important to mention due to the fact that many have listened on the frequency before and have copied nothing more than a high noise level in their respective areas. As will be noted by all of us at one time or another on 160, some nights are better than others.

Naturally, the net recognized the popularity of an awards program and now offers a very handsome certificate to those applicants meeting the requirements outlined below.

THE TOP BAND SSB NET AWARD

The Top Band SSB Net Award program was started in February, 1977, and is dedicated to those operators who check into the net either on three consecutive nights in which the net meets or on five non-consecutive nights in which the net meets. You should mail a copy of your log entries showing check-ins to the net registrar, Vic Misek W1WCR, 142 Wason Road, Hudson NH 03051, and be sure to enclose the award fee of $1.00 to cover the cost of printing, postage, and handling. Do not send an SASE since the award fee covers this cost.

Should any of our readers have 160-meter capabilities, why not join the fun? Should antennas be your obstacle, why not contact Vic and the group as there are several surprising antenna designs which are compact and cost under $5.00 to put you on the air with a respectable signal! And, of course, don't forget that in January, for the first time ever, *73 Magazine* will be sponsoring the 160-meter Phone Contest. More on this next month.

Traveling abroad, I wish to share with you information about a very respectable award being sponsored by the International Telecommunications Union (ITU) and the International Amateur Radio Club.

DIPLOME DES 100

This award is given by the ITU to radio amateurs and shortwave listeners everywhere in recognition of their achievement in communicating with, or logging the reception of, amateur radio stations in the territory of 100 or more member administrations of the ITU. Any licensed radio amateur or shortwave listener is eligible for this award. It is given to the individual, and the qualifying con-

tacts may be made over any period of time subsequent to the dates shown in the ITU official countries list available from the awards manager.

Applications shall be made by letter and shall include a list of stations claimed in alphabetical order, showing claimed dates. No special form is required for this purpose. Only frequencies, modes, and prefixes approved by the Radio Regulations of the ITU may be used. To qualify, 100 or more contacts must be made.

QSL cards or proper log entries will be considered proof of contact to back up an award application. Attached to the application should be a statement from two licensed amateurs or an ITU administration representative to the effect that all claimed contacts have been verified. No other proof is required. Do not send QSL cards! Do not send logs!

There will be no endorsements for special conditions. Stickers will be given for each ten (10) additional contacts.

The administration of this award has been delegated to the International Amateur Radio Club, 4U1ITU, PO Box 6, 1211 Geneva 20, Switzerland. The IARC has named Mr. L.M. Rundlett K4ZA as awards manager. All applications should be accompanied by 10 IRCs or US $2.00 for the award, and one IRC or a US self-addressed, stamped envelope for each sticker. Mail all applications to L.M. Rundlett K4ZA, Route 3, Box 447, Lake Placid FL 33852.

I received a very complete package of information from the Central Radio Club in Moscow and take pleasure in featuring their award program in more detail. It is unfortunate they did not send samples of their certificates, as I'm sure they are unique diplomas to possess.

R-100-O AWARD

This award (as is the case for all awards listed below) is issued to all licensed radio amateurs and shortwave listeners throughout the world who can meet the requirements. For the R-100-O, radio amateur applicants must carry out two-way contacts with, and shortwave listeners must log reception reports of, radio stations in 100 oblasts (provinces) of the Soviet Union.

There are three categories of R-100-O awards. The First Class is for two-way contacts on the 3.5-MHz band only, the Second Class is for two-way contacts on the 7-MHz band only, and the Third Class is for two-way contacts on any amateur band. All contacts must be made on phone or CW only. Endorsements will be given for each mode of operation, but cross-mode or mixed-mode contacts are not allowed. All reports exchanged between stations must be RST 337 or RS 33 as a minimum. All contacts or observations must be made on or after January 1, 1957, to be valid.

Applications must include a list of contacts or observations with date, calls, mode, and frequency shown in order of callsign prefix. QSL cards must be submitted along with the award fee of one ruble or 14 IRCs to cover the cost of the award and safe handling of your QSL cards back to you. One should allow three to six months for the processing of any of the awards I am describing. Send all applications and inquiries related to this or any of the following awards to The Central Radio Club USSR, Postbox 88, Moscow, USSR.

W-100-U AWARD

The W-100-U Award (worked 100 radio stations in the USSR) was established in 1959 on the occasion of the 100th anniversary of the birth of A.S. Popov, the great Russian scientist claimed to be the inventor of radio. For this award, amateurs must carry out two-way contacts on one or more amateur bands with 100 different amateur stations of the Soviet Union, including 5 radio stations of the 9th region (Minskaya). All contacts must be on either phone or CW, and applications must state which mode is to be credited for the award. Cross-mode or mixed-mode contacts do not count. All contacts must have been made January 1, 1959, or after and all signal reports exchanged must be at least RS 33 or RST 337 to be claimed. As with the R-100-O award, the applicant must prepare a list of contacts claimed and give the calls, date, frequencies, and type of emissions used to achieve the contacts. The cost of the award is 1 ruble or 14 IRCs, to be sent with your application, and QSL cards are required. The award fee is used to provide for the safe return of your confirmation cards.

R-6-K AWARD

The worked-all-six-continents award is offered by the Central Radio Club to amateurs and to shortwave listeners who can carry out 12 two-way contacts or observations on SSB, CW, and phone with radio amateurs as follows: one contact each in Europe, South America, Africa, Asia, North America, and Oceania, plus 3 contacts each in the European USSR (UA1, UN1, UW1, UA2, UC2, UP2, UQ2, UR2, UA3, UW3, UV3, UA4, UW4, UB5, UO5, UT5, UY5, UA6, or UW6) and the Asiatic USSR (UD6, UG6, UF6, UL7, UI8, UJ8, UH8, UM8, UA9, UW9, UV9, UAØ, or UWØ). The award has three categories: First Class is for two-way contacts on 3.5 MHz only, Second Class is for two-way contacts on 7 MHz only, and Third Class is for two-way contacts on any amateur band. As with all awards of the Central Radio Club, confirmation cards must be sent with your application. To qualify, all contacts must have been made May 7, 1962, or after. The award fee is 1 ruble or 14 IRCs—the same as it is for each of the awards of the Central Radio Club.

R-10-R AWARD

The R-10-R Award (worked 10 radio amateur regions in the USSR) is available to those who carry out, on one or more amateur bands, two-way contacts with 10 radio amateur regions in the USSR. These regions may also be termed call districts; in any case, numbers one (1) throughout zero (Ø) must be worked. All contacts must be made on either phone or CW. Mixed-mode or cross-mode contacts will not count. All contacts must be made after July 1, 1958, and signal reports must be a minimum of RST 337 or RS 33. The submission of applications and the cost of the award is the same as noted with the other awards in the Central Radio Club portfolio.

R-15-R AWARD

The R-15-R Award (worked with radio stations in 15 USSR Republics) is offered to those who work at least 15 of the 18 USSR Republics within a period of 24 hours. They are: European Russian SFSR, Franz Josef Land, Kaliningradsk, Asiatic Russian SFSR, Ukraine, White Russian SFSR, Azerbaijan, Georgia, Armenia, Turkoman, Uzbek, Tadzhik, Kazakh, Kirghiz, Moldavia, Lithuania, Latvia, and Estonia.

All contacts for the R-15-R Award must be made on CW or phone on or after July 1, 1958. Applicant must submit a list of claimed contacts giving date, emission, and frequency for each contact and must provide a QSL card for each contact claimed. Cost and mailing directions are the same as for the other Central Radio Club awards.

R-150-S AWARD

Probably the most sought-after award in the program offered by the Central Radio Club is the R-150-S Award. Amateurs and shortwave listeners throughout the world are eligible to compete for this award and must complete the following operating requirements to qualify.

The R-150-S Award requires the applicant to work at least 150 countries of the world and 15 Republics of the USSR from a special USSR DX Countries Listing.

There are no band restrictions, but contacts must be made on either phone or CW. All contacts must be made on or after June 1, 1956. Signal reports exchanged must be a minimum of RST 337 or RS 33.

Submission of applications and cost of the award is the same as noted for the other Central Radio Club awards.

Be sure to tell your friends to obtain a copy of *73 Magazine* next month, as we will surprise you with two more awards to add to our already famous *73 Magazine* Awards Program. Until then, continue to climb the ladder of recognition.

Ham Help

I am attempting, as part of full-time retirement, to combine family hobbies, the main ones being amateur radio and camping. I would like to hear from all amateurs who combine any form of RVing with amateur radio (QSLs, please).

Also, I am interested in obtaining information that could be used as a basis for future magazine articles and a possible book on the subject. I'm interested in pictures of stations inside RVs, information on antennas, etc. Do not worry about details, just the basics. If I need to, I will get back to you for more details. Credit for original ideas will be recorded and published when used.

Ward B. Baker K7YUC
PO Box 553
Prescott AZ 86302

I would appreciate hearing from anyone who has converted a Realistic TRC-52 23-channel CB rig to 10 meters.

John P. McCormick WB3IQW
110 Hilltop Drive
Severna Park MD 21146

Many thanks to all of you who mailed complete instructions on the Mosley TA-33 Jr. beam (Ham Help, July, '79, p. 180). I was amazed at the response.

Now I would like a circuit diagram of a Harvey Wells Bandmaster transmitter. I'm trying to rebuild an old unit, as it was the first commercial unit I used many years ago. Will pay for copy or I'll reproduce and return diagram.

Hubert J. Harlow KA5COS/4
1600 Raven's Place
Charlottesville VA 22901

Corrections

There has been considerable feedback on my article ("Hit The Panic Button!") in the August, 1979, issue. Most of the comments took issue with the statement that the reset switch "needn't be especially reliable" and pointed out further that the reset switch would carry the entire shack load, if any, until the contactor had time to close. These are excellent points.

Many of the comments suggested using a multi-pole contactor, with one set carrying the entire shack load, the other only the coil current; in this case the reset switch need handle only the coil current and can be light-duty. While multi-pole contactors with high current ratings are prohibitive in cost, heavy-duty relays can be had with a set of light-duty "auxiliary contacts," which would do the job just fine. The revised circuit is enclosed.

One suggestion proposed an enhancement including a number of reset switches in parallel with each other. This probably is not a good idea from the standpoint of safety. While the switches may be 99.99% reliable, paralleling a number of them increases the chance of one failing in the closed position defeating the system.

By the way, the contactor should be rated to *break* a current of at least three times the current limit of the shack circuit breaker. If you have a 30-Amp breaker feeding the shack, the contactor should be able to break a 90-Amp load. This is independent of the current *carrying* rating which, in this case, could safely be specified as 30 Amps. The reason for this is that the peak current differs from the rms current (just as peak voltage differs from rms voltage) and you have to design for worst case—and then add a safety margin.

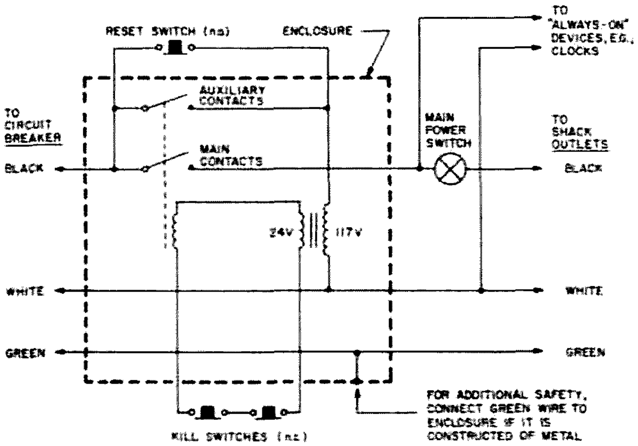
One comment raised an excellent question: How do you know when the reset switch is open so the kill switch will work when you need it? In my case, I use a key-lock switch for the reset function. When I reset the system, I know the shack is alive because the clock starts running again. When I turn the switch back to remove the key, I can *feel* the switch operation. If the contacts were welded shut or somehow broke loose from the actuator, the switch wouldn't have the same "snappy" feel.

Another comment proposed using the kill switch as a "main power" switch, to make sure everything was shut off at the end of operation. This is probably not a good idea, for a number of reasons. First, you probably don't want to kill *everything* (the clocks, for instance) routinely. Second, shutting down a lot of equipment drawing a heavy load can, over a period of time, damage the contactor contacts and they may get sticky and not open when you really need them to open. A better solution, I think, is to use a separate "main power" switch, as I do, and as is shown in the circuit.

Interestingly, if you use a separate main power switch, you don't need the auxiliary contacts on the relay. Before resetting, turn the main power switch off. Then the only load on the reset line is the contactor coil (and perhaps a clock or pilot light). Once reset, turn the main switch on.

All of the comments are greatly appreciated. I would especially like to thank K8KK, WB2OVQ, and WD6FGX, along with others who omitted calls or from whom I haven't heard as of this writing.

Frank Bates AA6C
San Jose CA



Revised Fig. 1, "Hit the Panic Button!"

Channel	Frequency*
4A	4,125.0 kHz
4B	4,143.6 kHz
4C	4,419.4 kHz
6A	6,218.6 kHz
6B	6,221.6 kHz
6C	6,521.9 kHz
8A	8,291.1 kHz
8B	8,294.2 kHz
12A	12,429.2 kHz
12B	12,432.3 kHz
12C	12,435.4 kHz
16A	16,587.1 kHz
16B	16,590.2 kHz
16C	16,593.3 kHz
22A	22,124.0 kHz
22B	22,127.1 kHz
22C	22,130.2 kHz
22D	22,133.3 kHz
22E	22,136.4 kHz

2-MHz frequencies

2,182 kHz
2,638 kHz
2,670 kHz (U.S.C.G.)
2,738 kHz

*Revised Table 3, "Marine-Band Activity." HF ship-ship (plus limited coast) simplex channels. *Carrier frequencies are listed; listen on USB. The above 2-MHz frequencies are not, strictly speaking, in the same category, but are often used for similar purposes.*

I am enclosing a corrected Table 3 for my article "Marine-Band Activity," which appeared in the July issue on page 155. It lists new frequencies for ship-to-ship simplex operation. A change in assignments by the FCC occurred shortly after the article was written, and I missed this table in my proofreading. The remainder of the info is correct. Also, KQM in Hawaii has closed down, and station UIS is actually VIS.

Karl Schulte WA2KBZ
Hoffman Estates IL

Please note the following correction to my article "Add-On Keyboard for Your Keyer," which appeared in the August, 1979, issue. Fig. 2 contains a wiring error. As shown in the accompanying schematic, the following changes should make the Letter-Space oscillator work:

1. Pins 3, 9, and 13 of U3 should be connected together. Pin 3 should not be connected to the cathode of CR2.
2. Pins 6 and 1 of U3 should be connected to the cathode of CR2.

Edward J. Faber K4BZD
Columbia SC

This letter is in reference to my article "A Poor Man's CW Memory" in the June, 1979, issue of *73*. A number of people have written asking for ways to expand the memory. We now have a schematic available for a 4K version (twice the memory capacity) for 50¢.

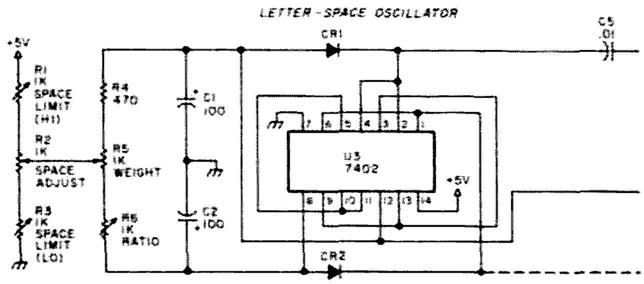
Eric Unruh WB0RYN
Rt. 2, Box 56A
Newton KS 67114

In my article "70-Watt Shoes for the IC-502," which appears on page 128 of the September issue, there is a minor mistake in the schematic diagram. The connection of the bias pot to relay RLY 1 should be reversed so that during standby periods the bottom of the bias pot is lifted above ground as described in the text. I hope this problem has not caused any inconvenience for readers constructing this project.

George Hovorka WA1PDY
Milton MA

There is an error in our article on constructing the E-Z Loader for the TRS-80 in the September, 1979, issue of *73* (pages 96 to 99). The circuit will work as shown as long as the optional LED driver is *not* used. If you wish to incorporate the LED minimum level indicator, the pick-off point for R12 should be the emitter of Q2, *not* the base of Q2 as shown in the article.

Additionally, a transformer for use as T1 is available from Radio Shack (part no. 273-1380), but only ½ of the 1k winding should be used. A note of caution: Several reports of reverse-



Revised Fig. 2, "Add-On Keyboard for Your Keyer."

biased Radio Shack 2N2222 transistors have been received. In these devices, the emitter and collector leads are opposite of normal, and even opposite of what is shown on the back of the bubble package!

If you are having problems with the circuit, drop us a note describing the symptoms along with an SASE and we will be glad to offer any help that we can.

Paul Goelz WA9PUL
2228 Madison Place
Evanston IL 60202
Dave Miller K9POX
7462 Lawler Avenue
Niles IL 60648

In the September issue of *73*, on page 116, my article "The Amazing Audio Elixir" was published. Unfortunately, the TL081 called out does not seem to be available anymore. Builders should use the RCA CA3140E in its place. If one end of resistor R4 is lifted and a 1-uF capacitor is placed in series with it (with the positive end of the capacitor pointing away from pin 2 of the IC), a common 741-type op amp may be used.

A reader has correctly pointed out that there is an error in the article. The wire running from the gate of FET Q1 to the junction of C4 and CR2 *does not tie* to the junction of R2, R1, R4, and R5. If it were connected as shown, the circuit would not work, since the gate of the FET would be shorted to the source.

The article stated that the unit would drive even a small speaker. This was misleading, as the loaded down amplifier would work poorly, but you would hear something and it would not hurt the circuit. If a person wants to drive a speaker, he should use the Audio Elixir in front of another amplifier which can drive a speaker properly.

The demand for the PC boards was beyond expectation and my entire supply was used up within the first few days of the magazine mailing. I have ordered more PC boards from my supplier and hope I will have them before this letter is printed. If anyone is trying to deal with me and wonders why I am so slow, hang in there—I am buried in a mountain of mail.

One final note: If anyone is having trouble getting the CA3140E and the MPF111, I will supply them with the PC board if an extra $1.50 is enclosed.

C. W. Andreasen N6WA
PO Box 8306
Van Nuys CA 91409

New Products

from page 36

my version 1.1 of the M80 includes sections on operation and theory so that the great versatility of the system can be exploited. Ron Lodewyck N6EE, the president of Macrotronics and the system copyright holder, deserves much credit for the product. Directions for setup are clear, and the system has functioned well in the few months I've had it on the air. (I understand that version 1.2 will be available soon. This has some improvements in the machine-language timing routines.)

When the system is in operation, the user loads the machine and BASIC programs and can then select either Morse or RTTY operation. Several special functions can be selected in each mode so that the user has control of what will be keyed in transmit, speeds, etc. The unit transmits flawless CW and RTTY. Reception of strong TTY signals is possible with the onboard loop, but anyone really interested in RTTY will want to use an external demodulator. Reception of CW is perfect if one is copying W1AW or a station sending with a keyboard. Someone with a good fist will produce readable though not perfect copy, and many fists cannot be copied well. (Version 1.2 is supposed to help with this problem.)

I am going to describe a number of operating hints which may improve the enjoyment or versatility of the system. If you study the BASIC program, you can see how the program initializes various things such as keying polarity and speed. You can then modify a few statements to change the initialization. For example, the machine is set to key the "negative" transistor. The program permits the operator to change this to "positive" transistor and relay keying, but since I use the relay most of the time, I wanted it to initialize that way. The following statement changes the initialization routine to "positive" and relay keying: POKE 31346,4:POKE 31353,4:POKE 31364,3.

I use the system with the MLK-1 optoisolator instead of the relay and I have found that the loop is often latched up open at start-up. This presents no problem if a character is sent, since the first character will leave the loop closed, but if you don't notice the latch up and switch to RTTY receive, you can never get back to send. To help this I included the following: 6 X = INP(4).

Now when the program is run, the loop circuit is closed automatically. Furthermore, since my TRS-80 has a ROM error in the RESTORE routine, I include POKE 16553,255 in statement 6. That POKE fixes up the RESTORE routine and lets the M80 program run with no problems.

The program includes a routine which permits sending a CW ID while in the RTTY mode. The routine then forces the program to RTTY receive. That is fine at the end of a transmission, but when you send the ID at the beginning of a transmission, the system goes to receive and you then have to put it back to transmit to send in RTTY. To get around this, I added a routine that sends the CW ID but then keeps the system in transmit mode. I use the * key to enter this routine. The program steps are as follows: 13851 If B$ = "*" then 17050.

Statements 17050-17053 are then copies of program statements 17000 through 17010 except that instead of ending with GOTO20000, I end with GOTO10000 and the system stays in transmit. If you find that the loop latches open during this transition, just add X = INP(4) after X = USR(X) and the loop will get closed again.

I have found that these few modifications custom-tailor the system to my operation, but probably you will find some other minor changes that you would prefer. I also am using the system to drive my old Model 15 as a hard-copy output from the computer. The manual provides the necessary steps for doing that. Since a number of POKEs are required, I wrote these POKEs as a short program which is on tape just to save myself the typing each time I use the system. The following short program will let you use the system to get a hard copy of anything which is on the screen:

```
2  CLEAR 800
10 C$ = "":FOR I = 15360 to
   15614:C$ = C$ + CHR$
   (PEEK(I)):NEXT
20 POKE 30208, 1:POKE 30209,
   LEN(C$):POKE 30211,PEEK
   (VARPTR(C$) + 2): POKE
   30210,PEEK(VARPTR(C$)
   + 1)
30 MS = INT(30214/256):POKE
   16527,MS:POKE 16526,
   30214 - MS*256:X = USR (X)
   :LPRINT:GOTO10
```

To use this little program, you do the following. Enter the M80 machine-language program according to the instructions. Do the POKEs required for line-printing according to instructions. CLOAD this program. The statement numbers in this program must all be *smaller* than those in the program you are actually planning to use. Follow the method outlined by Roger Pape (*Kilobaud Microcomputing*, July, 1979, page 39) to permit saving this program while CLOADing another. When you get some material you want to save on the screen, you break out of the program which is running and type RUN 2. This program will run and will line-print the first three lines of the screen. It will pause at that point. If you want further line output, just hit CLEAR and three more lines will be printed. You then can break out of this program and begin your original program again.

Obviously, this little program could be incorporated as a routine in any other program to avoid the problem of loading two BASIC programs at the same time. These few lines create a string variable called C$ which consists of the characters on the first 3 lines of the screen (locations 15360 through 15614). This variable is then treated by the machine-language program as a "message" to be sent by TTY. The CLEAR command returns to the BASIC program.

These are just a few of the ideas I've had for the M80 system. As the originator says, the possibilities are virtually limitless since the board permits easy access to the computer. As you use the system, you will certainly come up with many other ideas.

Macrotronics, Inc., PO Box 518(S), Keyes CA 95328; (209)-634-8888. Reader service number M48.

Buzz Gorsky K8BG
Cleveland Heights OH

THE RADIO SHACK® QUICK PRINTER II

Last year around Christmas, I convinced my wife that I should get a TRS-80 microcomputer. I justified it on the basis of my part-time business, which is statistical consulting. In reality, I use a much larger university computer system and didn't think a microcomputer would be of much help. Well, sure enough, the kids loved the games (even the wife enjoyed blackjack) and I learned a little about BASIC language, but not much statistical work was done. It wasn't long, however, before I expanded the system to 16K RAM and Level II BASIC and slowly but surely began doing more and more of my consulting work on the TRS-80.

One of the more frustrating aspects of getting into microcomputing is the growing desire

```
!"#$%&'()*+,-./0123456789:;<=>?
@ABCDEFGHIJKLMNOPQRSTUVWXYZ↑↓←→_
'abcdefghijklmnopqrstuvwxyz{|}~█
 ! " # $ % & ' ( ) * + , - . /
0 1 2 3 4 5 6 7 8 9 : ; < = > ?
@ A B C D E F G H I J K L M N O
P Q R S T U V W X Y Z ↑ ↓ ← → _
' a b c d e f g h i j k l m n o
p q r s t u v w x y z { | } ~ █
```

Fig. 1. Quick Printer II character set.

for more and more hardware. I could just visualize an expansion interface with 32K additional RAM and maybe a couple of disks. More important, I was really drooling over the possibility of some sort of hard copy. At the time, Radio Shack's cheapest printer was "only" $500, but that required the expansion interface (another 300 bucks). Now, for that kind of money my wife would probably divorce me, so my longings remained longings.

When troubleshooting (I guess the proper word is debugging) programs on the TRS-80, you use paper and pencil a lot if you get beyond 16 lines (the display capacity of the CRT). Since I was developing statistical programs of 100 or more lines with several hundred data entries, I was going nuts. Then Radio Shack came out with their Quick Printer II, a small and inexpensive ($219) hard-copy device measuring 3-5/16" × 6-3/4" × 9-1/4" (8.4 cm × 17.2 cm × 23.5 cm). I quickly ordered one and then waited close to a month for delivery.

The Quick Printer II uses aluminized paper 2-3/8" wide, similar to (but narrower than) the paper used in the larger Quick Printer. Some people say they don't like the black letters (5 by 7 dot matrix) on silver paper, but either they have a lot more money than I do or they enjoy looking at the CRT scroll through their lovely long programs. No expansion interface is required and the unit can be plugged directly into the TRS-80 bus on the back. If you happen to own the expansion interface, you also can plug into it using an optional ribbon cable. A third option is a serial (RS-232C) input at 600 baud. I suspect that this last option would enable owners of other systems to use the Quick Printer II.

Printing speed is 120 lines per minute at 64 characters per second. Pretty fast stuff, this printer. It isn't as quiet as the CRT, but it sure beats the old Model 15. (I use it a lot at night.) The characters available are a modified subset of ASCII-96 with uppercase *and lowercase*. (See Fig. 1.) Yep, lowercase! Lowercase is supported by the TRS-80 although, unmodified, it does not display lowercase on

```
HERE IS AN EXAMPLE OF TEXT OUT-
PUT IN REGULAR WIDTH
AND HERE IT IS
IN DOUBLE WIDTH
```

Fig. 2. Sample output showing double-width option.

the CRT—just on the printer.

Now for the bad part—at least some of you might think so—the characters per line: only 32 (or 16, software selectable; see Fig. 2). Now, admittedly, that doesn't seem like very many characters, but for my purposes I find it totally adequate. I'm not into word processing and I'm sure that 32 characters per line would be grossly short for that use. But for listing programs and data and providing hard copy of program results (such as statistical analyses), 32 characters per line is great. By the way, don't worry about exceeding 32 characters, as there is automatic wraparound (up to 263 characters). That is, if the output exceeds 32 characters, the unit automatically carriage-returns and line-feeds and prints out the rest on subsequent lines, but it certainly splits words in funny places!

The unit is well built, using an ABS plastic housing which matches the TRS-80. Besides the friction paper feed, there is only one moving part (the seven-dot print head). Expected print-head life is 30 million characters. Now that's a lot of output! Each roll of aluminized paper costs about two bucks and lasts and lasts and lasts. For one very large run, I bought four extra rolls and I'm still using paper that came with the printer.

If you carefully look at Fig. 2, you will see an example of variable vertical spacing. This is not a planned feature, nor is it desirable. However, it happens very rarely and only after you

```
Las Cruces,New Mexico USA 88001
     W 5 S X L
CONFIRMING QSO WITH K C 6 J D F
Date: 6 / 13 / 79 Time: 0856 Z
Freq: 14.3 MHZ  Mode: SSB
UR RST: 59  RIG: TEN TEC 509
with 405 Linear @ 50 Watts
Ant: 2 el. Quad uP 27'
Tnx fer QSO, 73's, & PSE QSL
OP: Tim Pettibone
Adr: 2625 Huntington Drive
This QSL Printed bY TRS-80 Micro
comPuter from data in memorY
```

Fig. 3. Paste-on QSL.

have aggressively torn off the previous printout. The paper is a bit sensitive to oil and dirt, but once printed on seems to be very resistant to handling. Sometimes I do get a fingerprint smudge or two on it, but then I just wash my hands and run it off again. The printout reproduces very well and readily takes pencil or ink.

Now, how about ham radio use (this *is* a ham publication, isn't it)? Well, so far, I do two things: I keep my log in memory (sometimes) and print paste-on mini QSLs to attach to picture post cards of New Mexico for those special contacts. (See Fig. 3.) I also modified an excellent program for both the logging and QSL functions written by Charles Zappala WA7VZR for the October, 1978, issue of *73*.

All in all, I'm quite satisfied with my new printer. So if you need hard copy and operate on a slender budget, consider the Quick Printer II. I don't think you'd be going wrong.

Radio Shack, 1300 One Tandy Center, Fort Worth TX 76102; (817)-390-3272.

Tim Pettibone W5SXL
Las Cruces NM

IC-551 50-MHZ FIXED STATION TRANSCEIVER

This microcomputer-controlled 50-54-MHz (SSB-AM-CW) fixed station transceiver uses a built-in microprocessor for frequency control and scanning. The 551 also uses the new style digital readout in green phosphorescent digits similar to the IC-RM2 controller. The no-backlash, no-delay dual vfo, light chopper system similar to the IC-701 and IC-211 is included as a standard feature. The handsome styling and small size of the unit provide function with flair to please the eye while matching the other Icom fixed station units.

Three memories are available for programming and beacon watching. Using the SSB squelch and scan mode, three beacon frequencies may be scanned and the 551 set to stop on the first one heard, thus alerting the user to the presence of conditions producing DX excitement. When not scanning, the three memories and two vfo provide five different frequencies for use by the 551.

The dual vfo system provided by the microprocessor allows split-frequency operation for contest and DX work as well as completely variable offset operation for six-meter FM (optional unit EX106 required for FM operation). The 551 uses the now-famous 100-Hz-per-step digital tuning system. Many thousands of satisfied users on SSB-CW and FM have proven the suitability of this system. For faster QSY, a touch of the button next to the main tuning results in 1 kHz steps. (In FM, tuning rates are 10 kHz per step normal, and 1 kHz per step with tuning speed button depressed.)

The 551 is an all-mode six-meter unit in a compact easy-to-use instrument. The large tuning knob (50 mm) provides the comfort and feel of a big unit while the small size provides the room you need at the console.

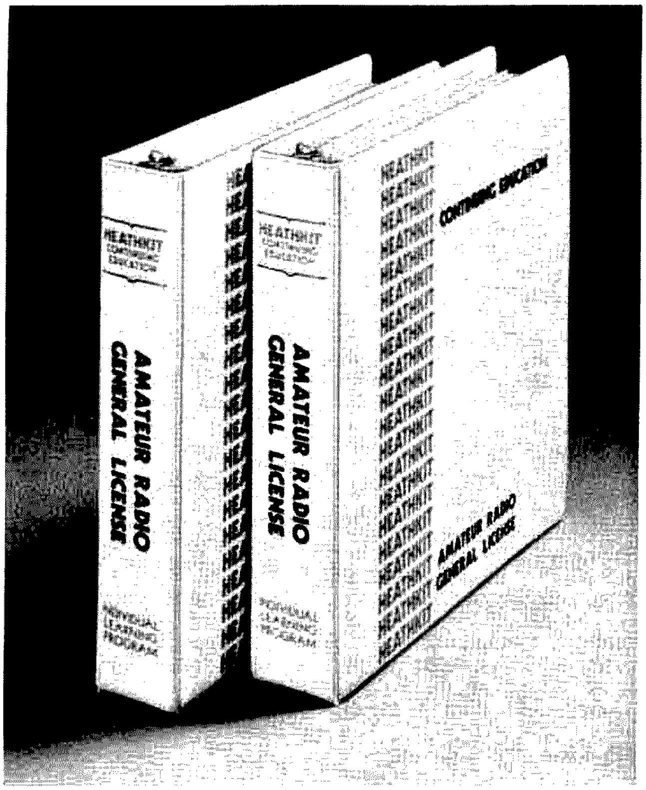
Icom, Suite 307, 3331 Towerwood Drive, Dallas TX 75234; (214)-620-2780.

Icom's IC-551 transceiver.

FCC GENERAL CLASS AMATEUR RADIO LICENSE SELF-INSTRUCTION PROGRAM NOW AVAILABLE FROM HEATH

A self-instruction program for passing the FCC Technician and General class amateur radio license exams has been introduced by Heath Company, world's largest manufacturer of electronics kits.

The program, divided into 15 units, covers the materials that FCC exams are based on. Unit exams check the student's progress while giving practice at exam-taking. Also included are cassette practice tapes said to prepare the individual to send and receive Morse code up to 15



Instruction program now available from Heath.

words per minute, two words per minute above the FCC General class requirement.

The program also includes a code-practice workbook, a world map of call areas, a booklet on solving radio and TV interference problems, a logbook, a copy of FCC amateur radio rules and regulations, FCC Form 610 required to apply for the exam, and a schedule of exam dates and locations.

The program carries a money-back guarantee should the purchaser fail the Technician or General class FCC exam. The program is described in the latest free Heathkit catalog. For a copy, write *Heath Company, Dept. 350-890, Benton Harbor MI 49022; (616)-982-3417.* Reader service number H5.

3½-DIGIT PORTABLE 0.1% DMM OFFERS LCD READOUT AND RF INTERFERENCE SHIELDING

A unique new portable DMM has just been announced by the B&K-Precision product group of Dynascan Corporation. The Model 2815 is a compact instrument that is protected and shielded against rf interference so that it retains its accuracy in rf fields. As a result, the 2815 can be used near two-way radios or broadcast transmitters up to 450 MHz. This new design features high resolution, excellent overload protection, and 0.1% dc accuracy.

The resolution of the 2815 permits its use in exacting R and D applications. For example, the 10-Ohm range offers 0.01-Ohm resolution for accurate resistance measurement of switch and point contacts, motor and coil winding, wire lengths, or any low-resistance circuit. Current resolution is 100 nA and the 100-mV scale permits voltage resolution to 100 uV.

A major feature of the 2815 is its protection against accidental overloads on all ranges. In the Ohms range, where this protection is needed most, the 2815 excels. Its design will resist damage from momentary overloads up to 1000 volts dc or ac peak. Continuous Ohms protection is +1000 V dc and −450 V dc or 350 V ac. The 10-Ohm range will momentarily sink currents of 3 Amps without damage. Current ranges are double-protected by both diodes and a fuse.

The large LCD readout of the 2815 is designed to be used in bright sunlight, making the unit ideal for field-service applications. An inexpensive 9-volt alkaline battery powers the 2815. Low-battery warning indication is automatic. Auto-zero and auto-polarity are also featured.

According to Gus Rose, Director of Engineering, "the B&K-Precision 2815 employs new LSI technology for accuracy and reliability. Our LSI integrated circuit is highly immune to stray rf fields, but for still more protection, we provide internal case shielding. We strongly believe that for dependability, a DMM should be able to perform accurately in rf fields."

The B&K Precision Model 2815.

The new B&K-Precision 2815 portable DMM is now available at local distributors. It includes test leads, built-in tilt stand, detailed operating manual, and spare fuses. A wide range of optional accessories is available. For additional information, contact your local distributor or *B&K-Precision, Dynascan Corporation, 6460 West Cortland Street, Chicago IL 60635; (312)-889-9087.* Reader service number B45.

OPTOELECTRONICS K-7000 FREQUENCY COUNTER KIT

It doesn't seem too many years ago that hams were clamoring for surplus BC-221s and LM frequency meters for frequency calibration in their shacks. To be sure, these venerable vfos did provide good stability and fair readout accuracy for the user—by consulting look-up charts. But the scene has changed dramatically. Digital technology has opened up no-nonsense measurement techniques. Visual displays feature bright readouts of frequencies directly—no interpolation required.

The term "frequency counter" refers to the fact that the actual periodic pulses of the source being measured are summed for a period of time (called the gate time), and the total number of pulses per time unit is displayed. Assuming the reference frequency of the time-base or "clock" is accurate, the frequency counter can't miss. It's about as absolute a measuring device as you can find.

The new K-7000 550-MHz frequency counter from Optoelectronics is an excellent example of this new technology. Featuring seven bright, large (.4") LED characters, actual frequency performance will typically reach 600-700 MHz! At this writing, the K-7000 is advertised as the cheapest 550-MHz counter kit ever available—less than fifteen cents per megahertz!

This neat little package costs less than $80 in kit form. The K-7000 is compactly contained in a rugged metal cabinet, not in a flimsy plastic shell as are many competitive units. It measures down to 10 Hz, making audio applications a natural. With a top end in ex-

cess of 550 MHz, measurements of rf through UHF are a snap.

Input impedance is 1 megohm, shunted by 20 pF (up to 55 MHz) or 50 Ohms (up to 550 MHz). Gating times are switch-selectable between .1 and 1 second. An automatic decimal point is included. Resolution of the display is 10 Hz at 55 MHz or 100 Hz at 550 MHz. Sensitivity is better than 10 millivolts up to 55 MHz, increasing to 50 millivolts (nominal) at UHF. It is typically 20 mV at 2 meters.

A temperature-compensated quartz crystal timebase (TCXO) features first-order linear compensation, providing stability of better than ±1 part per million at room temperature. Aging of the oscillator is less than 2 ppm per year, making calibration unnecessary for long periods of time.

While many pieces of test equipment require sophisticated power supplies, the little K-7000 will accept anything between 7.5 and 15 volts ac or dc that can supply 250 milliamps! Internal rectification and regulation will take care of the rest. An optional ac power supply is available (#AC-70 for $4.95), as is a nicad battery pack/charger circuit (#Ni-CAD-70K for $15.00). A telescoping whip antenna with a right-angle BNC connector is available for $9.95. A wide variety of additional accessories is available to extend the flexibilities of this versatile counter even further. The K-7000 measures only 1-3/4" H × 4-1/4" W × 5-1/4" D and weighs less than a pound.

Kit assembly involves 40 short steps, including checkout procedures. Directions are concise and clear.

The manual which accompanies the K-7000 is well-written and liberally illustrated. It contains an excellent theory section to acquaint the newcomer with operational theory as well as practical applications of the instrument.

An endless variety of applications for the frequency counter appears around the ham shack. Sitting adjacent to the rig, whip extended, the counter will display your actual transmitted carrier frequency (assuming some stray rf leakage during transmit). Whether or not you have digital readout already or think you know your band edges, the counter provides backup protection against pink tickets!

Loosely coupled to the oscillator of a receiver, the unit will display your receive frequency (plus or minus the intermediate frequency used in conversion). A simple outboard mixer circuit will enable the user to read received frequencies directly without having to consider i-f offset.

Hooked to the output of an rf signal generator, even the most inexpensive generator suddenly becomes an accurate piece of test equipment.

Various mixer products in receivers and transmitters can be checked for proper alignment, as well. And, by probing various points throughout the circuitry, the counter can be used to determine which stages are operational. For example, if a receiver appears to be dead from a received signal standpoint, the oscillator and mixer stages can be sampled for frequency output.

And finally (and certainly more esoteric), for the frustrated spies among our readers who always wanted to know the output frequency of a transmitter at a government office: Watch the display for a few minutes in the vicinity of the antenna in question. The closer the better. With reasonably short distance between the little unit and the transmitting antenna, a sudden stable readout is a direct giveaway of the transmitted signal frequency!

For more serious applications of this nature, Optoelectronics also offers a model AP-8015 broadband amplifier capable of providing a nominal 25 dB gain from 10-1000 MHz or more. Used in conjunction with the K-7000, discrete transmitted frequencies may be measured from considerable distances.

We would rate the K-7000 an outstanding value for hams as well as service technicians.

The K-7000 frequency counter kit is $79.95 from *Optoelectronics, 5821 N.E. 14th Avenue, Fort Lauderdale FL 33334.* Reader service number O3.

Robert B. Grove
Brasstown NC

Ham Help

How long can amateur radio survive in Arizona or anywhere else if a "closed-shop" atmosphere prevails? How can a newcomer enter this select group unless a friendly hand is extended? Where are the new hams going to come from if there is no Novice program functioning?

Since moving to Tucson 5 months ago, I have been unable to make contact with any radio club, and I have seen no evidence of any effort to teach or introduce would-be hams to our hobby. This comes as a real shock to me, and I can only hope that my initial impressions are wrong.

As a federal employee, I have spent 20 of my 32 years overseas, where the spirit of helpfulness and friendship was dominant among my fellow MARS members and the Canadian and British hams whom I came to know. We worked together in maintaining and repairing our rigs, held antenna-raising parties, operated various emergency nets, and studied and later taught code and theory classes that were free and open to all interested parties. I am proud of the friends I have known, and I count these years as the most enjoyable years of my life.

If my admittedly bleak impressions of Arizona are correct, and if they are generally applicable to the rest of our country, then amateur radio is unquestionably doomed! If the amateur spirit dies, then the question of survival in the face of possible losses in spectrum becomes academic. Hopefully, this situation is reversible.

I am now retired, but I am not dead yet. I am available to teach code or theory or to help in any way that I can to ensure that amateur radio is alive and well in the state of Arizona.

Thomas J. Gilliam W4NHX/7
4426 E. 22 St., Lot 93
Tucson AZ 85711

I have picked up a transmitter/receiver system and don't have any manuals for it. I have asked many people, but nobody has ever seen it before! The system consists of four units, and the only numbers on them are RR-6, RP-6, RT-6, and RA-6.

The receiver, RR-6, covers two bands: 3-6.5 and 6.5-15 MHz. It is a superhet with an rf amp. It is all tubes, has a bfo, crystal calibrate, and can use crystal control. Size is 6½" x 5" x 2½".

The transmitter, RT-6, covers two bands: 3-7 and 7-16.5 MHz. It is crystal controlled only with output for a longwire antenna. Tubes are a 2E26 final and a 6AG5 osc.-driver. It is CW only, with built-in key. Size is 6½" x 5" x 2".

The power supply, RP-6, provides all voltage required for both receiver and transmitter with any one of the following inputs: 70-270 V ac, 40-400 Hz, a GN 58 hand generator (I don't have this), or a 6-volt storage battery. The RP-6 will also charge a 6-volt storage battery with an ac input. Size is 4" x 8" x 2". The RA-6 unit is a function box. Size is 4" x 8" x 2".

I would appreciate any help in identifying this gear.

John Oppenheimer WD5GNY
165 Woodruff St.
San Angelo TX 76903

I have been unable to locate a source for manuals for the following pieces of test equipment from the original manufacturers and hope someone out there can help. I will pay for a photo copy, or I'll copy and return. Write first to prevent duplication.

Technology Instruments Co., Inc., model 311-A rf Z bridge;
Eico signal generator, model 324, and ac VTVM and Audio Load, model 260;
Midland CB xcvr tester;
Bell & Howell Schools electro-lab design console.

Any help would be appreciated.

Robert Monaghan W5VC
PO Box 2182, SMU
Dallas TX 75275

I am in great need of a service manual, user's manual, schematic, or any other information for the Hammarlund HQ-129X receiver. Hammarlund is, unfortunately, out of business and this manual seems to be very hard to find. I will pay postage and duplicate promptly, or reimburse your copying cost. Thanks.

Fred Goldberg WA2BJZ
29 Clearview Road
East Brunswick NJ 08816

I would like to obtain a ham-band receiver (not necessarily working) for up to $25. Type and vintage are immaterial. I will pay by bank draft before shipping.

Daniel Bell ZL1AKV
Box 5676
Auckland NZ

We would like to swap QSL cards with anyone. We would also like to make contact and exchange information on radio communications.

George Szekely AK4458
PO Box 348
Auckland NZ

I need a schematic and operating instructions for a Data Engineering Co. Memory Matic 500B keyer. I will gladly pay copying costs and postage.

M. H. Hansen
Route 1
Windom TX 75492

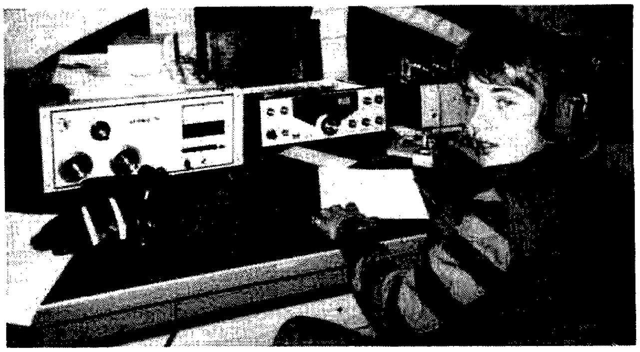
I'm interested in locating amateurs who have operated from US possessions in the Pacific, including the Marshall and Caroline Islands.

Gary Mitchell WA1GXE
PO Box 1003
Fairfield CT 06430

Faces, Places

Jonelle Lewis KB4RS of Franklin, Georgia, was the first female ever to graduate from the electronics study program at Troup County Area Vocational Technical School in LaGrange, Georgia. She was at the top of her class academically throughout the program and accomplished some remarkable things. She acquired her Radar Endorsed First Class Radio Telephone License and her Advanced amateur license within a period of two weeks. Each was acquired on the first attempt and in one sitting.

On June 7, 1979, Captain Thomas C. Watson, Jr., Commanding Officer of the aircraft carrier USS Independence (CV-62), presented awards to Norfolk area ham operators in recognition of their handling of phone patch traffic between the Indy's crew and their relatives and/or friends while the ship had been at sea. Ham operators aboard the Independence were also cited for their efforts. The awardees have been handling Indy's phone patches since she left the Portsmouth Naval Shipyard last September and will also handle the phone traffic while the ship is underway during its upcoming deployment. Pictured left to right: Marty Roberg N4BKL, Wayne Walker WD4MNP, Kevin Newberry WB2NGL, Gib Patterson WB6VIE, Jeff Parker WA1WXL, George "Ike" Ikonen WB4NEE, Bill Keller WA4FCK, Bill Ames WB4CUY, Ralph Chamberlain N4AXM, Jerry Oxenburg WA4RQU, Bob Edward WB4ZSE, and Wes Woessnen WB4ZSQ. (Official U.S. Navy photograph by Phan Webb)



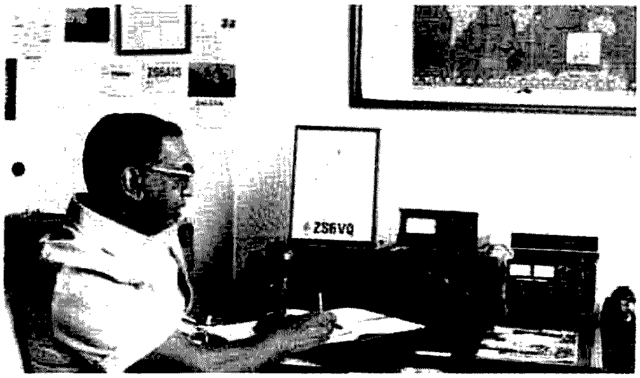
Contrary to what our October, 1978, article stated, Dick Torrey WB1EEM (age 13) of Rockland, Massachusetts, was KM1CC's youngest operator.

FIELD DAY, 1979, FOR THE SOUTH EAST AMATEUR RADIO CLUB (K8EMY) OF CLEVELAND, OHIO

Photos by Al Willinger WB8PMB

The Novice/Tech station of K8EMY. This station was run totally on dc using an auto battery charged by a small gas generator. At left is Ron Headley WD8QAZ and at right is Ron Wexler KA8CBQ. Also pictured is a minicomputer lent to the club by "Computerland." This Apple was used to log contacts and keep track of points. The antenna for the station was a mobile one located on WD8QAZ's Honda.

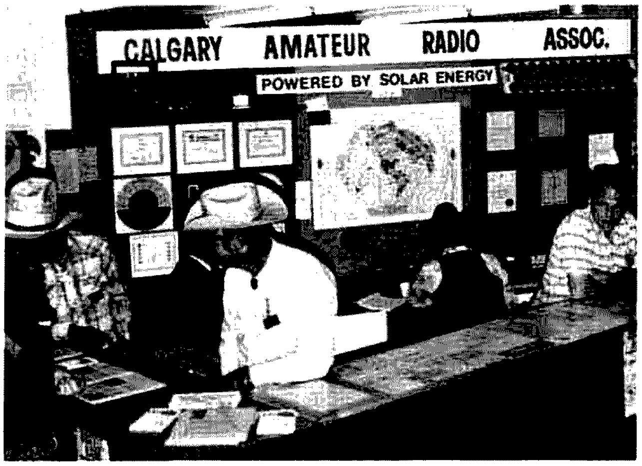
K8EMY's phone station. Left to right: Kevin Ritchey WB8YXU, Dave Hubbert WD8KIS, and Jon Taylor WB8TTP. This station ran off a gas-powered generator donated by Ohio Bell Telephone. The antenna for this station was a TA-33 Jr. on a monopole mounted alongside the pavilion at the city park in Shaker Heights that was the club location.



Goolam Karim ZS6VQ was the first Indian ham in South Africa to obtain an operating license. He is a doctor practicing in Bethal, an Eastern Transvaal town. To encourage improvement of their Morse code speed, new South African hams for the first 12 months are restricted to CW on the HF bands.

SOLAR-POWERED AMATEUR RADIO STATION AT THE CALGARY STAMPEDE

Photos by T. Mountjoy VE6MX



The Calgary Amateur Radio Association station VE6UN with some of its volunteers manning the booth. Approximately 75,000 people visited the booth and got a first-hand, first-class glimpse of an operating ham station. The station operated 13 hours a day and while in operation was the subject of two well-produced television documentaries.

The power supply and tribander up on the roof of the exhibition building housing the station. The solar panels shown provided enough power to keep the six 105-Amp batteries stored at the base of the panels always close to full charge.

Billy Hassler KA7DOV (age 7) recently became the youngest member of the Cheyenne, Wyoming, ham family which also includes Dad, Jim WB7TRO, Mat KA7CPD (age 14), and Jean KA7CWO (age 12). The Hasslers give much credit to instructor Bob Madden WA7YHK.

Promoting amateur radio on a 30-minute television program on KRIS-TV in Corpus Christi, Texas, were (from left) David Horton K5GT, Bob Douglas W5GEL, and Joe Cowen WA5TUM, with show host Judy Wenger of the Texas Coastal Bend Council of Governments. The program, "State of the Region," was aired at noon July 14 and again July 18 and traced the history of amateur radio, gave insight into the public service benefits of the hobby, and stressed the versatility of the hobby and its technical contributions to communicative art. A radio version of the program with Cowen and Wenger was broadcast over 10 commercial AM and FM South Texas radio stations. Horton is a board member of the Texas VHF-FM Society, Douglas is widely known in amateur radio circles due to his affiliation with Douglas Electronics, a Corpus Christi ham store and wholesale elelctronics parts network, and Cowen, secretary of the Beeville, Texas, Amateur Radio Club, is public information director of a college in the Texas Coastal Bend. (Photo by W5PIL)

Pictured in front of the Chicago Area Radioteletype Repeater System are (left to right) Ben Delaney WB9RTX, Neil Petlock K9WRL, and Howie Olson WA9KEK. The CARRS repeater went into service on July 9, 1979, and is the first teletype-only repeater in the Chicagoland area. This repeater is located in the new two-meter subband at 144.71 in/145.31 out.

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7A	7	7	7	7	7	7	14	21	21A	21
ARGENTINA	21	14	7A	7B	7	7	14	21A	21A	21A	21A	21
AUSTRALIA	21	14	14	7B	7B	7B	7B	14	21	21	21A	21A
CANAL ZONE	14A	14	7	7	7	7	14	21A	21A	21A	21A	21
ENGLAND	7	7	7	7	7	7B	14	21A	21A	21A	14	7A
HAWAII	21	14	7A	7	7	7	7	7B	14	21A	21A	21A
INDIA	7	7	7B	7B	7B	7B	14	21	14	14B	14B	14B
JAPAN	14	14B	7B	7B	7	7	7	7B	7B	7B	14B	14A
MEXICO	14	14	7	7	7	7	7A	14A	21A	21A	21A	21A
PHILIPPINES	14A	14B	7B	7B	7B	7B	7B	14	14	14	14B	14
PUERTO RICO	14	7	7	7	7	7	14	21A	21A	21A	21	21
SOUTH AFRICA	14	7	7	7B	7B	14	21	21A	21A	21A	21	21
U. S. S. R.	7	7	7	7	7	7B	14	21A	21	14B	7B	7
WEST COAST	21	14	7A	7	7	7	7	14	21	21A	21A	21

CENTRAL UNITED STATES TO:

ALASKA	21	14	7	7	7	7	7	7	14	21	21	21A
ARGENTINA	21	14	14	7B	7	7	14	21A	21A	21A	21A	21A
AUSTRALIA	21A	21	14	7B	7B	7B	7B	14	21	21	21A	21A
CANAL ZONE	21A	14	14	7	7	7	14	21A	21A	21A	21A	21A
ENGLAND	7	7	7	7	7	7B	7B	14A	21A	21A	14	7B
HAWAII	21A	21	14	7	7	7	7	7	14	21A	21A	21A
INDIA	14	14	7B	7B	7B	7B	7B	14	14	14B	14B	14B
JAPAN	21	14	14B	7B	7	7	7	7	7	7B	14B	21A
MEXICO	14A	14	7	7	7	7	7	14	21A	21A	21A	21A
PHILIPPINES	21A	14	14B	7B	7B	7B	7B	7	14	14	14B	14A
PUERTO RICO	21	7A	7	7	7	7	14	21A	21A	21A	21A	21
SOUTH AFRICA	14	7A	7	7B	7B	7B	14	21A	21A	21A	21	21
U. S. S. R.	7	7	7	7	7	7B	7B	14	14A	14B	7B	7B

WESTERN UNITED STATES TO:

ALASKA	21	14A	7	7	7	7	7	7	14	21	21	21A
ARGENTINA	21	14A	14	7B	7	7	7B	14	21A	21A	21A	21A
AUSTRALIA	21A	21A	21	14	7B	7B	7B	7	14	21	21A	21A
CANAL ZONE	21A	14	7	7	7	7	7	14	21A	21A	21A	21A
ENGLAND	7B	7	7	7	7	7B	7B	14	21A	21A	14	7B
HAWAII	7B	21A	14A	14	7	7	7	7	14	21A	21A	21A
INDIA	14A	14A	7B	7B	7B	7B	7B	7B	14	14	14B	14B
JAPAN	21A	21	14	7B	7	7	7	7	7	7B	14	21A
MEXICO	21	14	7A	7	7	7	7	14	21A	21A	21A	21
PHILIPPINES	21A	21	14	7B	7B	7B	7B	7B	14	14	14B	21A
PUERTO RICO	21	14	7A	7	7	7	7	14	21A	21A	21A	21
SOUTH AFRICA	14A	14	7	7B	7B	7B	7B	14	21A	21A	21A	21
U. S. S. R.	7B	7	7	7	7	7B	7B	14B	14	14B	7B	7B
EAST COAST	21	14	7A	7	7	7	7	14	21	21A	21A	21

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor
SF = Chance of solar flares

november

sun	mon	tue	wed	thu	fri	sat
				1 P	2 G	3 G
4 G	5 G	6 G	7 G	8 G	9 G	10 G
11 G	12 F/SF	13 P/SF	14 F	15 F	16 G	17 G
18 G	19 F/SF	20 P/SF	21 F	22 G	23 G	24 G
25 G	26 G	27 G	28 F	29 F	30 F	

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—a must for headphone haters . . . McClellan

54 **Working with FETs**
—part II: experiments with gain and supply voltage . . . WA2SUT/NNN0ZVB

58 **Build this $50 Mini-Counter**
—three-IC design goes to 135 MHz . . . McClellan

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W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

WARC RESULTS

By the time this gets into print, the WARC results will probably be known—such are the delays of the magazine biz. This is being written considerably before the event in order to set the record straight.

One of the questions which came up during my recent visit to the Philadelphia Area Repeater Association meeting in Valley Forge was my opinion of what would happen at WARC. My answer has not changed in the last couple of years . . . I have no opinion on what will happen . . . there are just too many unknowns involved. I know that I would feel a lot more positive about it if I had seen any significant evidence that amateur groups were doing something in preparation to meet some of the problems which were evident.

In my editorials and talks, I have given the facts on events which have happened which I think are pertinent and which could influence the WARC results. I try hard to make amateurs understand that these are facts of history and not my opinions. It is a fact that amateur radio went into the ITU conference on satellite frequencies with allocations for over 100,000 MHz above 500 MHz and came out with zero . . . nothing. This is not opinion, and it is verifiable in the most revered of sources: *QST*. The ARRL people admitted that they had not done their homework and this was the reason for this catastrophic loss. I think I am not exaggerating when I categorize the loss of virtually the entire future of amateur radio by satellite as catastrophic. Below 500 MHz, we also lost 90% of the 450-MHz band and 100% of the 220-MHz band for satellite use.

The maritime ITU conference in 1972 resulted in another terrible loss of frequencies by white nations as the African and Asian countries banded together, ignoring all technical recommendations, to grab their "share" of the frequencies . . . no matter any intended use or not. This again is not opinion, it is a fact.

If the Third World countries get off this kick of getting everything they can at ITU meetings, we may come out okay, so when I'm asked for my predictions of what will happen, I can't be optimistic . . . nor can I say that I think we will lose 40m, etc. I do say this: If we do lose frequencies, we know where to place the blame for it . . . on those who had the responsibility to protect these frequencies and did so little in that line. Oh, they knew what had to be done, but they just didn't do it. They learned nothing from their debacle in 1971.

Should amateur radio come out with everything we have at present . . . plus a couple of extra bands, no one will cheer more loudly than I. And no one will be luckier than the League. I still won't be able to honestly give them one bit of credit because they have gambled with our future by not doing everything reasonably prudent to try to preserve it. Just hoping for a lucky break hardly constitutes providing the service we expect of them and pay them for.

AN ACCOUNTING

Once this is over, I think the members should flatly demand an accounting of the funds spent in Geneva. The last I heard, they had $140,000 in their wallet and were sending out more letters begging for money for the WARC "crew." Many angry members sent me copies of an August 31st letter . . . a bit late in the game for hat-passing, I'd say.

It may be almost time for League members to stop ignoring what is going on and start asking questions.

MONSTER GREEN

Rather than come up with figures to show that I was wrong in my questions about the ARRL living it up at the expense of the deluded members, they've chosen to attack me personally. "Green is anti-amateur radio," I hear. Or "Green is egotistically trying to torpedo ARRL participation at WARC 79."

I suggest that the facts be brought out. Either I am right about the $100,000 fund for protecting amateur radio or I am not. And all anyone has to do is read the yearly ARRL report. Whitewashed as it is, the fund is right in there for anyone to see. If I am wrong about the fund, then I think a lot of members are due an explanation of why the fund is listed (and has been for years) in the annual reports.

Let's suppose that eventually they will admit to the fund. How then can they justify the hat-passing for more cash? This strongly suggests that they intend to spend more than $100,000 at Geneva! How much can a couple of people spend in a few weeks? Sure, Geneva is expensive, but even at the finest hotel, which I am sure they have engaged, and at the most expensive restaurants, which I'll bet they are patronizing, it should be difficult to spend *that* much money in so short a time.

Say, I'm willing to bet $100 cash that not one of the ARRL members will be able to get a list of the monies which have been spent from that $100,000 fund since it was set up. It has been brought back to strength each year by the directors, and no report has *ever* been made that I have seen on where the money went which was spent. The first person to come up with a list of the expenditures, by whom, for what purpose, and when, gets my $100. Boy, am I safe on *that* bet. I *know* what some of the money was spent for and I *know* it will never be made public.

My apologies to ARRL insiders for stirring up skeletons in closets, but when the direc-

Info

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tors go out to clubs and start trying to smear me, as a cover-up for their crimes of omission and commission, then I speak up.

Me anti-amateur, huh? And pro what? Let's put it this way . . . I will say flatly that there is not one official of the ARRL at any level who can even come close to my background in amateur radio. For those new readers who might get taken in by a director, let me give just a brief resumé of some of my ham activities.

In the DX field, I've got well over 300 countries confirmed . . . have visited almost 90 countries and operated from over 40. I've been active on OSCAR and have some 30 countries worked through the satellite. On 10 GHz, I have the world's record for states worked: seven. I was one of the pioneers of RTTY and wrote several of the early books on the subject. I also was an early experimenter with slow scan and forget how many countries I've worked on that mode. I had one of the early repeaters and pioneered multiband repeating . . . with my first work on repeaters being in 1949, thirty years ago.

How about contests? If you look back, you'll find that I've won my section several times in the Sweepstakes, DX, VHF, and other contests. Love 'em. The rarest countries I've worked from? Probably Afghanistan as YA1NSD, Nepal as an op at 9N1MM, Tahiti with my FO8AS call, Fiji as VR2FD, and Jordan as JY8AA. I will have been on from Korea as HL9WG and from Hong Kong, with call as yet unknown, in October.

These days I'm active mostly on 20, 15, 10, 2, 1¼ meters, and 10 GHz. But then, I lead a fairly busy life and haven't time for everything. Anti-ham? How many ARRL HQ people have you heard on the air? I haven't heard 'em and I drive right through Hartford every now and then operating on two meters.

FCC BEING PUT DOWN

Not only hams are getting sick of the FCC. I see more and more newspaper clippings from readers about the FCC, none complimentary. Having attended more hearings at the FCC than I like, I can see why the outfit is constipated. Some of my petitions for rule changes have been in the works for ten years and are still hanging around waiting for action.

We might be able to put up with this glacial speed if the results were well considered and fair. They are anything but. Politics is the rule of the day, along with temporary expediency.

One of the major problems at the FCC is that it is being run by seven people, none of whom have the background needed to make decisions on the complex matters involved. This means that every problem has to be explained in tedious detail, written for the complete novice, and it also means that the writer of these details can sway legislation easily by biasing the position papers.

The FCC is trying to handle a wide range of regulations, each requiring a technical background which the commissioners do not have. The result is that some of the commissioners realize the futility of their jobs and just sit back, voting whichever way seems best, but not even trying to make sense of the situations. Some virtually sleep through the long boring hearings.

If the FCC is going to be able to make any intelligent decisions, they are going to have to find some way to get career people with the needed background into the job—not uninterested political appointees. No one can have all of the background needed, so some splitting up of the divisions is needed, with separate heads. The present system of endless oral hearings must be curbed in some way. It is just too much of a waste of time for too many people.

I think it was about a year or so ago that a reader (an old friend who used to work for me) wrote, suggesting that he start a movement to get me appointed to the FCC as a commissioner. I wrote back and said no way. I wouldn't last a week in that bureaucratic environment. I believe that the shortest distance between two points is a straight line, even if it bisects the White House and two other commissioners.

No rational body would have come up with the ten-meter linear ban, which doesn't make any sense. And now that CB sales have dwindled off to where there is virtually no problem with HFers or illegal CBers of any magnitude, I would expect the Commission to go right ahead with plans for dealer registration of ham equipment . . . the requirement of a ham license to buy, etc. The molasses speed of the FCC forces it to provide rules long after the need for them has gone away. Remember the repeater rules, if you will . . . totally unneeded when they arrived because amateurs had already solved the problems which had originally brought on the request for the rules years earlier.

Part of the trouble lies with hams. All too often I see petitions to the FCC intended to solve some temporary problem . . . and I know that years in the future this petition may well cause great mischief. And then we have hams who are afraid to go ahead and experiment with something. They want to make sure that it is all okay with the FCC before they go ahead. The result of that is that the bureaucrats at the FCC are not about to open themselves to any possibility for criticism, so they say no. If the damned ham would just go ahead, but shut up about it, the chances are good that nothing would happen and then we could point to a year or two of operation using the experimental system with success and, at that time, get it okayed. Bureaucrats say no . . . they have to if they want pensions.

If I could see examples of our government providing benefits to us, I might be less critical. I suppose the police system we have is better than none at all, but, at times, I am not sure of this. I see people quitting work because they can make almost as much on welfare and not have any responsibility. After a couple years of that, who will ever hire them? And so it goes . . . many books have been written about this mess we've gotten outselves into . . . and no one has even a hint as to how to get out of it.

About the only good thing you can say about our government is that, crummy as it is, we don't know of a better one anywhere.

WHICH ONES WORK?

Unless you are brand new to *73 Magazine*, it should come as no great surprise to you that I have a considerable interest in 10 GHz . . . and this even extends to the neighboring band of 10.5 GHz, where the police have set up a great little moneymaker by zapping motorists. This nets them well over $3 billion a year in cash for their municipalities, making it possible for a $1,500 radar unit to pay for itself in a weekend!

The *73 Magazine* mobile office and portable laboratory has four different radar detectors mounted across the top of the front window. This is not so much because the lumbering Dodge van is operated above 55 mph as it is to test the ability of these units to detect signals of importance and reject those of insignificance.

The four units currently in test in the van are the Bearfinder, the Fuzzbuster, the Super Snooper, and the Radio Shack Micronta unit. Up here in New Hampshire, we have no shortage of radar in the hands of police . . . In fact, virtually every state police car has one and many of the town cars sport them. A simple trip to Manchester, some 35 miles away, can often supply three or more tests of the detection devices.

One of the best we have tested recently has been the Radio Shack Micronta unit. It looks very much like the Super Snooper unit in the ads, but when ours arrived, we were surprised to find that though the shape was quite similar, the size was substantially smaller. The Micronta generally advises us of a lurking bear a second before the Fuzzbuster, which has come to be a good standard to use.

I'm partial to the Fuzzbuster for a couple of reasons . . . firstly, because it does always give the alert in time to check speed and slow down a hair, if needed. Secondly, this firm, Electrolert, has been by far the most active in fighting illegal laws put through to limit the use of these radio receivers.

As I've mentioned before, on most of the larger highways and turnpikes, the traffic tends to run from ten to fifteen miles per hour over the 55 limit, which means that the bears have a field day when they set up shop. The use of CB and an ear on channel 19 can save you a stiff fine, the hassle of coming back to some crummy place for a court hearing a week or two later, and an increase in your insurance premiums. It may also save your driving license.

I had a very good friend who used to go with me on sports car rallies. A cop. He said that his friends would give almost anything to get parkway duty, since this meant an added nontaxable income of several hundred dollars a day. The patrol cars kept track of commuters in expensive cars and stopped them about once a month for speeding. Unless the motorist was particularly dense, there would be a $50 bill neatly folded within the driving license. The police would look at the license and hand it back, less the $50.

The radar detectors are handy because it is all too easy to go along with the traffic and find yourself a few miles over the speed limit. You're not going fast enough to get there any sooner, but it is fast enough for

NBVM

Because of some late developments, we were unable to present in November the article on NBVM mentioned in "Never Say Die." Tim Daniel N8RK's report will be featured in our January, 1980, issue.

a ticket, court appearance, fine, and insurance increase. When the detector sounds off . . . which is a cacophony in the van, with four going at once . . . I have about one second to hit the brakes before the police radar units can read out my speed. Their radars have to read the incoming Doppler audio tone and change it to miles per hour. This takes a couple of seconds. If the target car is changing speed, the radar unit can't get a fix on it, so you always have time to slow down, if you are properly warned.

If it wasn't for the 55 mph speed limit, I doubt if I would even have the van. It burns gasoline ridiculously, averaging about 11 miles to the gallon. But it has a 36 gallon tank, so we have a range of nearly 400 miles with it. When someone else is driving, I can read manuscripts, answer letters, keep up with literature, and things like that . . . all without the constant interruption of the telephone.

For faster trips, we generally use the Mazda RX-7 . . . which we like very much. There are only three radar detectors on it normally . . . a Fox, a Whistler, and a Bearfinder. The Whistler sometimes sounds off when within twenty feet of a radar transmitter and on the more severe bumps . . . but that's all. The Fox and Bearfinder are about even. The RX-7 burns less than one gallon of gas for every 20 miles when driven at speed (80 mph), even with air-conditioning and automatic shift.

The Fox and the Micronta are pretty close when I plug a Fox into the van system for a comparison. It is difficult to see any real difference in sensitivity . . . both are very good.

Like many other gadgets, once you get used to the warnings from a radar detector, you feel worried without it. Since I'm often chatting away on two meters while I'm driving, generally keeping up with traffic unless I am in a hurry for an appointment, I don't keep my eye on the speed at all times. The warning buzz is appreciated and often saves me a brush with the government.

JAMMING—CAN ANYTHING BE DONE?

Who can fail to get angry when they hear amateurs trying to jam out an emergency net during an earthquake or hurricane? Sure enough, right in the middle of a recent extended period of critical traffic handling, there were some jammers making life miserable for everyone. I understand that the FCC was called and, using their sophisticated direction-finding equipment, quickly located the scoundrels.

Jamming is certainly nothing new in amateur radio and perhaps it is past time to bring it out in the open and stop pretending that it isn't happening. By discussing it, we may be able to better come to grips with the problem . . . and also come up with some plans for dealing with it.

Though there are obviously some common causes and common remedies which apply to jamming, we may be able to tackle the phenomenon better if we break it down into categories. We have the jamming of emergency nets, probably one of the worst types of jamming. Then there is the jamming of what we term service nets . . . such as the Eastcars, Midcars, and Westcars nets. We also have jamming of just plain nets. We have jamming of special modes such as RTTY and SSTV, a sort of specialized breed of jammer. And most of us are familiar with the kerchunker on repeaters . . . and we've even heard the bad-language fan lousing up repeaters.

In addition to those jammers, we have a whole host of jammers working in our DX bands . . . and I'm not speaking about commercial or military stations which are intruding. I'm talking about your sanctimonious DX chaser who slams his signal into a pileup, knowing full well that it is flatly against the law to intentionally interfere with another operator. In this case, jamming is not only condoned, it is a way of life, complete with high-powered amplifiers and giant antenna arrays, all set up with the sole purpose of being able to jam the hell out of several dozen other stations who are trying to reach a choice DX station. Choice, did I say? I've heard pileups on a YV or even a DL when there is nothing rarer to fight over.

WHY?

In some cases, there is obviously a screw loose in a ham's head. They don't give tests of sanity when they hand out ham tickets, so we have our share (and more) of loonies. I've heard more than one ham wife claim that all hams are nuts and, after forty years of this and knowing several thousand hams personally, I'm in no shape to argue the point. I know there are hordes of hams who would sign commitment papers for me if they were passed around.

But let's get down to the nitty-gritty . . . *why* this happens. I'm immediately reminded of a time when I was operating from Curacao (PJ3) and I checked the band carefully for a relatively empty spot . . . found one . . . asked twice if anyone was using it . . . called CQ and got into a contact. About five minutes into the QSO, a woman from Florida broke in on the channel and demanded that I get off the frequency immediately, saying that I had one hell of a nerve operating there, since this was the YL International Phone Net channel. Without giving me a chance to say anything, she proceeded to make a ten-minute call for net members to gather . . . and got some. If ever I wanted to jam a net, that was it.

There is no question but that there are times when a repeater control operator is unobtrusive and considerate and the repeater still gets jammed, but in every case I've heard personally, this was not the case. I've heard dozens of jammings of repeaters, but I've also heard some of the stuff that precipitated the jamming . . . usually a very arrogant control op who has made someone mad. In other cases, I've heard whole groups join in to aggravate a poor situation and make it impossible.

Something happens to many (if not most) people when they get power over others, even if it is so insignificant as being a net control or a repeater control operator. They seem to immediately forget what it is like for the other chap, and they start throwing what weight they have around. This often calls for retaliation . . . and we have jamming. I'd be surprised if 90% or better of the jamming hasn't been instigated by an officious operator who has a severe personality problem . . . like a well-deserved inferiority complex . . . who irritates someone else beyond their capacity of acceptance. Oh, I know the feeling . . . for instance, when someone comes on a repeater where I've been talking for a while and says in an official voice that it is an FCC regulation that I identify my station.

WHAT TO DO

For many amateurs, the first port in a jamming storm is a call to the FCC for help. Then they get all bent out of shape when they find that the FCC boys have better things to do than help us find some yo-yo we've irritated who is busy "getting even."

Speaking of nets, it may come as a rude shock and chilling news, but the FCC has a rule which is fairly explicit . . . no ham, or even net, has a claim to a frequency. The fact that a net has used the same channel daily for fifty years is not an excuse for running roughshod over any stations who are using it come net assembly time. I would suggest that one or two stations be designated to act as peaceful

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LETTERS

GODBOUT

Recently, due to failure of one or more RAM chips in my TRS-80, which had been purchased from Godbout (Bill Godbout Electronics) 10 months previously, I returned all eight chips to Godbout under the terms of their one-year's warranty. I requested that they test these chips to determine which were defective and replace as required. I offered to pay for the testing, if necessary, as I was not equipped to do so.

I was pleasantly surprised to receive within a week a complete eight-chip RAM kit from Godbout—no charge whatsoever, and postage paid! Now, I am sure that all eight original chips were not defective and can conclude only that once again Godbout is performing in their characteristic "the-customer-must-be-pleased" manner.

This attitude will go far to ensure the future success of this outstanding supplier.

Arch Wicks W6SWZ
Agoura CA

DAVID

Here is some updated material regarding the emergency operation of the Florida Crown Net (Jacksonville) and the Florida Midday Traffic Net (FMTN) during hurricane David Sept. 2-5th.

Local Red Cross Director Buck Willocks of Jacksonville praised the amateurs saying, "If there was any one group who shined during the emergency, it was the amateur radio operators of this community." He was referring to the 55 operators who volunteered to link the 16 Red Cross evacuation shelters to Red Cross HQ. Personal commendation certificates are being given to each participant. In addition, stations were set up at Civil Defense HQ, the Weather Bureau, WTLV-Channel 12 studios, and the Mayor's office.

Jacksonville Mayor Jake Godbold and his staff also expressed their deep appreciation and it is reported that the Mayor will attempt to visit at least two local amateur clubs, The North Florida Amateur Radio Society (NOFARS) and the Jacksonville RANGE Assn., to express his thanks personally. City officials monitored the transmissions on two meters to get the latest evacuation count.

Telephone lines at Red Cross were completely jammed and the only communications were via amateur radio.

On the statewide level, complimentary reports continue to pour in concerning the operation of the Florida Midday Traffic Net on 40 meters (day) and 75 meters (night). The net stayed in session for over 55 continuous hours providing the only coverage of the entire state. At least three major Weather Bureau offices in Florida were linked together by FMTN.

Ironically, the FMTN was kicked out of the ARRL last month because, after 23 years of operation, they refused to accept the SCM's wish to dissolve the net administration and have all officers appointed by him. Please see the following for additional information.

Billy Williams N4UF
Assistant Manager, FMTN
Jacksonville FL

STATE ARRL OFFICIAL KICKS FLORIDA MIDDAY TRAFFIC NET OUT OF LEAGUE

On August 11th, ARRL South Florida Section Communications Manager (SCM) Woodrow "Woody" Huddleston informed Florida Midday Traffic Net (FMTN) Manager Al Suhr WB4AID that FMTN was no longer a part of the American Radio Relay League (ARRL).

In his letter, Huddleston gave no other reason for the revocation of the ARRL section of Florida's largest traffic net other than to say that the "FMTN does not qualify as either a section net or a local net in the ARRL National Traffic System. The net and its management have steadfastly refused to respond to the wishes of the ARRL Administration within this section. Therefore, I cannot justify expending ARRL funds issuing certificates to FMTN members," said Huddleston.

This last statement is considered enlightening because most FMTN members are ARRL members.

To summarize, after 22 years of operation, the FMTN was asked by Huddleston to hand over control of the net and the frequency to him last September. He said that he felt uncomfortable with so many nets operating in "his" section. The FMTN members voted 55 to 2 for rejecting Huddleston's demands.

Shortly thereafter, Huddleston was instrumental in establishing a new net just four kHz up in frequency at the same hour. Evidently, he was hoping to use his influence and the ARRL's prestige to lure FMTN members away since most FMTN members belong to the League. Most officials expected this to happen, but, surprisingly enough, the opposite occurred. The new net, called the Combined Florida Net (CFN), created more hard feelings by "clearing" its 7,251 kHz frequency at net time by just opening up on top of stations already in QSO. It seems that Huddleston and CFN underestimated the strength of those upon whom they tried to trample, because after two rocky ineffective months in which several sessions were cancelled, the CFN was forced to move just to survive.

Despite the move, CFN continued to falter as daytime traffic operators rallied behind FMTN and its democratic stand. FMTN has been the top net of any in Florida for the last 11 months running, based on official statistics in *Florida Skip*, in messages per session handled. The long anticipated wilting of FMTN was not to be, as many operators became incensed about losing their right to elect their own manager and not have it dictated by Huddleston. CFN went begging for traffic while people waited in line to pass messages on FMTN. A telephone campaign by some Florida ARRL officials to recruit CFN members also was a dismal failure.

When the latest *Skip* statistics showed FMTN on top again last month, it must have been more than Huddleston could take. After failing to get FMTN cut out of the national nets, he sent the letter expelling FMTN from the ARRL because they wouldn't let him take over.

For the 70 FMTN members, reaction was immediate. Included among the members are several club presidents and officers statewide. Comments ranged from "dumb" to "smacking of a dictatorship" describing Huddleston's action.

The big sting came last December when one member of the then-new CFN net was told by a North Florida ARRL official that he couldn't eat at 5 pm any more because he was needed to make the new system of nets work in conjunction with linking CFN with a later net. A lengthy shouting match occurred on the CFN frequency with the poor soul saying he just wanted to continue eating at 5 o'clock as he had done for the last 25 years. Fortunately, it's all on tape so it can't be denied.

We have no reaction from North Florida ARRL officials on Huddleston's mass ejection, but they have backed him up in the past to the point that some have said that the statewide policies are all made by Huddleston in Largo and rubber-stamped in the rest of the state. It will be interesting to see if this holds true now.

Meanwhile, Florida Midday Traffic Net officials have declared themselves an independent net whose members operate on the legal basis of their FCC licenses and not through the sanction of the ARRL. Meanwhile, the controversy continues about the tactics involved and daytime operators continue to support FMTN in growing numbers.

This may be one case where David rises up and slaps Goliath!

From NOFARS *Balanced Modulator*, September, 1979

DRIVEL

Although I have long been an admirer of you and *73 Magazine*, one who has enjoyed your growling and caustic comments, all of which put amateur radio on its toes, made us aware, and stirred amateurs into thinking for themselves, I wonder what has happened to *73* et al this past year. I am really doubting the values and goals some of your articles are exhorting. Also, it sure seems as if you are dumping the average amateur, the guy without the megabucks, for the manufacturer and big interests. Maybe you no longer need the individual ham as long as you have the big or seemingly big, the manufacturer, and the guy who calls building a ham station or minicomputer an assembly of components. It sure looks like the so-called builders merely plug in boards and equipment according to many of your articles (or build power supplies).

Another trend in *73* that is really disturbing has been Pasternak, and his trying to foist on us control of FM and amateurs by clique-appointed committees with power to have yea or nay over other hams. Let's leave California and its dubious means of operation on the earthquake side of the mountains. Also, I object to his begging support of HFers as he tries to tell us how wonderful they are.

Then we get articles on jamming police radar and the re-

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Looking West

Bill Pasternak WA6ITF
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On Saturday, September 22, 1979, it was announced that the nation's second oldest repeater, currently operating under the callsign WA6KOS/RPT on Mt. Wilson, would be permanently terminating operation on or about October 13. The announcement came in the form of a letter from system equipment owner/sponsor Burt Weiner K6OQK, in which it was stated that after 18 years of continuous operation, he had proven to himself that he could make a system function and do so at the extreme limits of the state of the art available. Further, that due to the increasing amount of willful and malicious interference, with him as a prime target of it on a personal level, he had reached the decision that it was time to terminate the operation and proceed in other directions.

The system now known as WA6KOS/RPT started life as WA6TDD in 1962. It was put into service as an open repeater and has remained such ever since. Dockett 18803 caused a callsign change in 1972 and WA6TDD became known as WR6ABE. In 1976, Burt Weiner bowed out of the responsibility of licensee of the repeater, turning that obligation over to Bob Thornburg WB6JPI. At that time, the system became known as WR6AMD. Some 10 months ago, Bob bowed out of the position of licensee and the reins went to David Faraone WA6KOS whose callsign now appears on the system. Throughout these latter years, Burt Weiner has remained as equipment owner and has maintained the system's high technical standards for the licensees who followed him.

In his letter to Faraone and the repeater's users (about 450), he stated that though he has tried to remain a disinterested party in the operation of the system, he could not, and with the increasing amount of personal abuse being hurled at him, he realized that the only way to solve the problem was for him to take the system out of service and disappear from the scene entirely. He hopes that, in time, those now abusing both him and his equipment will forget that he ever existed.

In commenting on the demise of WA6KOS, Faraone also stated his intention to establish a new repeater and to commence operation when Burt removes his system from service. The new repeater, again under the callsign WA6KOS/RPT, is to be located atop Santiago Peak in South Orange County at 5800' MSL. However, it is rumored, though not confirmed, that opposition to the new system from politically powerful remote-base owners who want no part of an open two-meter repeater on that hill is mounting. WA6KOS operates with a transmit frequency of 146.40 MHz. With 146.46 MHz being the recognized national remote-base intertie frequency, the remote owners fear that the overall ambient noise factor of the band will be raised by the new device and impede communications on .46. It should be mentioned that not all remote owners seem to feel this way. At least three have offered Faraone help in establishing the new system and technical assistance in clearing up any interference problems that might ensue.

Also unconfirmed are rumors that a number of major southern California repeaters, fearful that the same type of abuse that has caused the demise of KOS will descend on them, are planning to "private out" and turn toward selective usership operation. The political climate is viewed as being that should two or three major systems make this move, it would initiate a domino effect that would write an end to open repeater communication in the southwest in short order. More next month.

THE GOOD GUYS WEAR WHITE HATS DEPARTMENT

In the old western movies, the ones made in black and white and prior to the advent of television, it was easy to tell the hero from the villain. Heroes always wore white hats and rode white horses. Your friendly local neighborhood villain usually wore black clothing, a black hat, and rode a black horse. Maybe these were not the actual colors, but who could tell? You went to a flick to cheer the hero and hiss the villain. Wasn't it easy in those days?

Villains are not supposed to be good guys and vice versa. Unfortunately, something has run amok in our society that, at times, causes the tables to be turned. Suddenly, a villain appears to be a hero and is able to build support for a position that appears totally wrong to the majority. In a nutshell, this describes a situation now running rampant on many Los Angeles two-meter repeaters. A small but highly-vocal group of people have come to demand their "right" to utilize any form of language they may desire, regardless of how offensive such utterances might be to the rest of the area amateur community. They defy anyone, including the FCC, to stop them, claiming that any action in that direction would be a direct violation of their First Amendment rights. There even appear to be a few in this group who are not even amateurs, but who have amateur equipment and use it on the air. Their claim seems to be that since the "airwaves" belong to the "people," they have a right to operate a radio without subjecting themselves to the will of any government or agency thereof.

This group believes that anything goes, anything said is "right," and anyone they wish to abuse on the air is fair game. It is quite interesting that they only seem to inhabit busy wide-coverage open repeaters, where there exists a vast audience for their rhetoric. They rarely bother the smaller local systems, and I have yet to hear a report of them "taking on" a private repeater's usership, though many super-wide-coverage "privates" do abound. Two things are evident. First, to exist, they require a large audience to fulfill their egos, and second, they probably live in fear of the reprisals they might endure if they assailed a private system. It's no secret that the history of this area in relation to protecting one's domain, especially in regard to the sanctity of private repeaters, is one of retaliation for any such attack. So, they continue to feed their egos on the "average" amateur who operates on the "average" open repeater.

For many years, I have wondered how a situation such as this could possibly develop. Many theories have come forth, but few were very conclusive, and, until now, none offered any real solution. Recently, I had the opportunity to meet and speak with Russ Andrews K6BMG. Russ is not new to the amateur fraternity. He holds a General class license and has been a ham for over 25 years. Like myself, he has witnessed the move toward lawless operation and disrespect for the will of the majority by the aforementioned minority. He has taken the time to develop a short thesis on the subject that we now present for your approval and commentary.

LAWLESSNESS ON THE HAM BANDS

What follows is one man's opinion. It is based on over 25 years as a licensed ham and on my observations and understanding of human nature and foibles. In part, it takes the form of a scenario. Its purpose is to possibly give a wider view of the problems on the ham bands and stimulate thought, discussion, and, ultimately, a solution.

How Did We Get Where We Are?

1. There is, in society today, a general disrespect for government, bureaucracy, and authority.

2. The creation of the CB band resulted in such an explosion of personal radio activity that the FCC resources were overwhelmed. This inability to provide needed policing resulted in the "lawless" nature of CB the FCC is now struggling to overcome.

3. This CB lawlessness soon spread to the creation of HFers, operating on non-CB frequencies.

4. Many of these CBers and HFers found out about ham radio and moved up (either legally or by various illegal methods).

5. Other hams simply became corrupted, or fearless, and allowed their negative sides greater rein.

Why Has the Traditional Self-Policing of Ham Radio Failed?

Self-policing is based on three things:

1. Respect for the privileges and for others who have earned similar privileges. This factor has been weakened in several ways:
   - •Eased entry requirements.
   - •Examinations "given" by other hams—and falsified.
   - •Bootleggers.

2. Peer pressure. The new breed of offender is immune to peer pressure from the general ham fraternity.
   - •They have a different set of values.
   - •There are enough of them now to form their own subculture, or peer group, that *supports* them in their lawlessness.

3. Fear of exposure. They have built a rationalization which convinces them that they are in the right and the rest of the fraternity is wrong. So, why should they be afraid of being exposed, if they believe they are right? In addition, the prevailing opinion is that even if exposed to the FCC, the FCC will do *absolutely nothing*; therefore, why should they fear being "turned in" by other hams?

Where Are We Now?

We have a growing group of antisocial, lawless individuals whose governing force is an ego-driven desire to have power through the use of radio technology. This group is self-stimulating, that is, it encourages within itself increased technical competence toward jamming

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The following are excerpts from unsolicited letters and registration cards received from owners of the new TEN-TEC OMNI transceiver.

"I sold a Yaesu to buy this and am very impressed" —*WB5ULA*

"My first QSO with OMNI-A was LA1SV on CW and second was EA8SK on SSB." —*N2CC*

"Excellent rig, just as advertised." —*WB5TMD*

"Very pleased with performance. QSK feature very slick." —*WB0ELM*

"This is my 5th TEN-TEC transceiver in less than 2 years. I loved them all and still have 3." —*WB0VCA*

"Through the years I have had complete Drake and Collins stations. I tried a 544 Digital and liked it the best so decided to purchase the 546 OMNI-D Digital." —*WA4NFM*

"Your OMNI is the best rig I have had in 20 years of haming." —*K4IHI*

"As a owner of Collins rig, your OMNI-D is the best." —*K9JJL*

"I already have an OMNI-A, 544 and a TRITON IV. You may ask why I own so many TEN-TEC rigs. In case there is a great RF famine, I want to be ready!" —*WD4HCS*

"You guys really know how to turn on an old timer!" —*K8ELS*

"Best operating & most conveniences of any transceiver I've ever used." —*W6LZI*

"I like CW. Compared OMNI against IC701 (rcvr) and OMNI won hands down. XYL WD6GSB really enjoys rig on SSB. Finds rig is very stable and digital readout accurate." —*AC6B*

"Have checked it out on both modes from "top band" (160) all the way to 29 MHz. Terrific!!!!" —*W4DN*

"Works well, parts layout and design much better for any possible servicing than other ham gear. The Japanese hybrid sets can't compare to TEN-TEC for audio. Audio reports excellent without special speech processors, etc., to distort the signal." —*AG8K*

"I have been using the S-Line over 15 yrs and never thought anything could outperform it. I got the biggest surprise and THRILLED with this OMNI-D even though I have been a ham since 1936." —*KV4GD*

"This must be the greatest. I've spent enough money on final tubes to almost pay for this." —*KA4BIH*

"This transceiver was recommended to me by old time hams (Xtras) whom I have known for 40 yrs. Has excellent break-in." —*N6AVQ*

"Best package job I've ever seen! First licensed 6AAV in 1926. Now in operation—a sweetheart!" —*W7LUP*

"From a 32V2/SX115 to an OMNI is a big step!" —*K6YD*

"Receiver prominent—transmitter likewise—working comfortable—pleasing design." —*OE1FAA*

"First new rig for me in 10 years but seems to be very good." —*W5GBY*

"The best transceiver I ever used or owned." —*W3TS*

"I wouldn't swap my OMNI for anything on the market, regardless of price." —*WD0HTE*

OMNI/SERIES B FEATURES

All solid-state; 160-10 meters; Broadband design; Standard 8-Pole 2.4 kHz Crystal Ladder I-F Filter + Optional 1.8 kHz SSB Filter & 0.5 kHz 8-Pole CW Filter; 3-Bandwidth Active Audio Filter; Choice of readout — OMNI-A (analog dial), OMNI-D (digital); **Built-in VOX and PTT, Selectable Break-in, Dual-Range Receiver Offset Tuning, Wide Overload Capabilities, Phone Patch Interface Jacks; Adjustable ALC; Adjustable Sidetone; Exceptional Sensitivity; 200 Watts INPUT; 100% Duty Cycle, Front Panel Microphone and Key Jacks; Zero-Beat Switch; "S"/SWR Meter; Dual Speakers; Plug-In Circuit Boards; Complete Shielding; Easier-to-use size:** 5¾"h x 14¼"w x 14"d; **Full Options:** Model 645 Keyer $85; Model 243 Remote VFO $139; Model 252MO matching AC power supply $139; Model 248 Noise Blanker $49; Model 217 500 Hz 8-Pole Crystal Ladder CW Filter $55; Model 218 1.8 kHz 8-Pole Crystal Ladder SSB Filter $55.

Model 545 Series B OMNI-A . . . $949
Model 546 Series B OMNI-D . . . $1119

To add your name to the fast-growing list of OMNI owners, see your TEN-TEC dealer, or write for full details.

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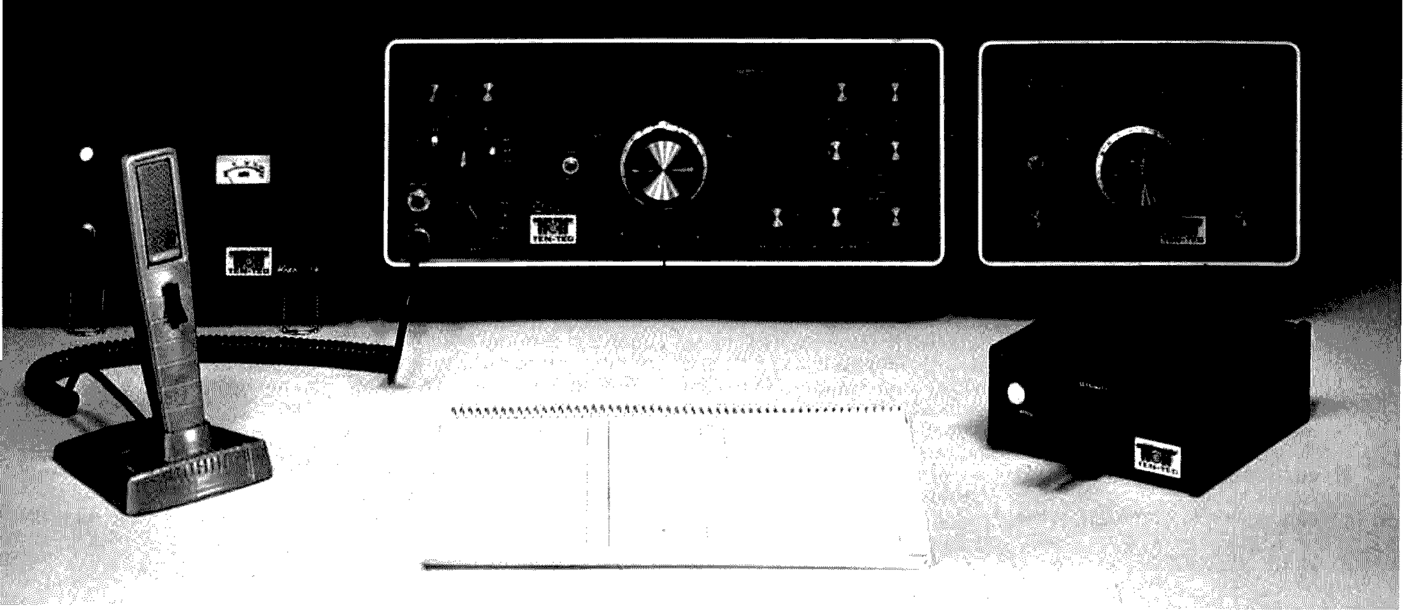
OMNI OWNERS SAY:



RTTY Loop

Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

I made a mistake. Now, now, don't try to talk me out of it or minimize it. I made a mistake! Let's call it an error of omission. You see, a few months ago I listed articles on "silent RTTY," grouped by system types. I said that the list was complete. Well, I was only partially right; I inadvertantly left out reference to articles appearing in *73*'s sister magazine, *Kilobaud MICROCOMPUTING*.

Fig. 1 is an attempt to correct this error. As you can see, several types of articles have been published in *Kilobaud MICROCOMPUTING*, encompassing many computer families. Rather than list them strictly by type, the figure includes a brief statement on each article's content so that you may guide your search accordingly.

Interest in microcomputer-assisted RTTY is running quite high and clearly constitutes the majority topic in mail received. One correspondent, Victor C. Johnson from Minneapolis, Minnesota, is interested in the Heath H-8 RTTY program. I hope the program printed in the June, 1978, issue of *Kilobaud MICROCOMPUTING* is of use to him.

Victor also is looking for a Teletype™ Model 28, receive only, and is apparently having a hard time finding one in the Minneapolis - St. Paul area. Anyone in that region who might help him is asked to drop a line to him, in care of this column; I will forward it along to him. As far as commercial sources go, Victor, we have covered several sources in the past, but, as always, checking with local hams for reliable sources is the best way to go.

I have been quite upset over the number of complaints received about several of the known firms dealing with Teletype equipment. While most of the complaints center around unanswered inquiries (several of which I have also suffered) or prolonged shipment times (ditto), there is also the occasional, as pointed out over the past few months, paid-for order which is never heard from again. Incidentally, no work yet on the problem source noted last month.

Dave Phillips W7GZ writes that he will be coming up on the air soon with a Kleinschmidt machine and home-brew TU. This is to be replaced in short order by a 6800 microprocessor system and CRT terminal. Quite an order of magnitude difference! Dave is in need of wiring diagrams or maintenance manuals for his Kleinschmidt model TT-99. He notes that he has Teletype Model 28 ASR/KSR data available for the costs of postage and reproduction. If anyone is interested, contact Dave at 802 S. Eli Drive, Tucson, Arizona 85710.

A letter received from Wayland Osborn WØRRG poses a "big question." Wayland asks, "Are you aware of any RTTY gear, other than the Microlog system, which can be used to key the Kenwood TS-820 in transmit utilizing its built-in FSK feature?" My first inclination is to suggest using one of my favorite devices, a reed relay, in the loop to key the transmitter. It occurs to me, however, that you may be using only a CRT setup, without a conventional loop. In that case, you would have to adapt some form of on-off switching to the system, and I can appreciate your problem. Readers with similar systems are invited to drop a line and tell Wayland, and all of us, how *you* solved it!

Wayland also touches on the reported rf sensitivity of the Microlog system and my note last year that information promised me was yet to be seen. Well, as of this writing, one year has passed, and I still have received zip. This is not unique to Microlog, however. In fact, several companies, visible and well advertised, have promised to send various data sheets and literature in the past; not one has followed up on the offer. I don't know why—oh, well!

The final letter this month comes from Jim New WA4DHD, a newcomer to RTTY, as he puts it. Jim is using the TRS-80 with a Model 19 for hard copy and is having great fun on the air. He wants to know where most RTTYers hang out. Well, starting on 80 meters, you might try 3620 kHz, and 14080 kHz on 20. Forty-meter RTTY is an iffy thing, and other bands frequently depend on conditions. Twenty and 80 are pretty well populated, and a QSO is almost always available.

Yes, I do have a station, for those of you who have asked, but I have not been on the air much. I promise to try, so that those of you who think that I am but a pseudonym for Wayne Green will learn better. I know that I exist, and I hope to be more visible.

March, 1977—"Using The '$50' Terminal," James Brown. The author presents, in flowchart fashion, ASCII-to-Murray conversion. No particular microprocessor is mentioned.

November, 1977—"SC/MP Goes Baudot," Benjamin Blish. An SC/MP microcomputer is used to interface a Murray machine to an SWTPC 6800. Both software and hardware are presented.

June, 1978—"Baudot . . . er . . . Murray, Meet The H8," Howard L. Nurse. Interfacing to the Heath H8 is covered with full source listing and hardware needed. A solid article.

June, 1978—"ASCII to Baudot . . . er . . . Murray (the Hard Way)," John A. Lehman and Ray Graham. A tale of an experience with one supplier's conversion board.

September, 1978—"Baudot Interface Cookbook," J. R. Haglund and W. B. Reed. A scheme for interfacing to an 8080 based microprocessor. A note states that the program has been tried on and runs well on a Z-80 system.

August, 1979—"Teleprinter Output for TRS-80," David G. Morr. A hardware and software scheme for using a Murray-encoded printer as an output device. Full listings and hardware are covered for this Z-80 system.

September, 1979—"Make PET Hard Copy Easy," Dr. James M. Downey. Interfacing both ASCII and Murray-encoded machines to the PET IEEE bus through use of a UART and specially encoded ROM. This is a hardware modification with no software requirements. The machine is used strictly as a printer.

Fig. 1. Articles from Kilobaud MICROCOMPUTING *on computerized RTTY.*

Corrections

In my article, "Dual-Band Smokey Detector," which was published in the May issue, two errors in the drawing dimensions slipped by me when I reviewed the proofs.

On page 49 of that issue, the last paragraph calls for the circular waveguide to be made from ½-inch water pipe. It should be ¾-inch water pipe.

The dimensions shown on the rectangular waveguide E plane view on page 51 should show the hole for the circular waveguide as 7/8 of an inch in diameter (or the outside diameter of a piece of ¾-inch copper water pipe). The horn mounting hole is also shown as ½-inch; this descrepancy can be easily rectified by making the tab cuts deeper so that they can be bent to fit the o.d. of the circular waveguide. All hole cuts into the circular waveguide retain the same dimensions. One thing not described in the article, however, is the fact that the WR42 guide must be trimmed on the inside of the circular guide to be flush with the inside wall of the pipe.

I have also received many calls regarding the omission of the value of the series resistor shown where the 12-volt feed is located; this resistor is rated at 10 Ohms. It connects to the junction point where it feeds the main dc into the two 741 ICs and a 390-Ohm resistor. The point marked +12 volts on IC5 should also tie to the same junction point since that resistor serves as part of the filter from the source.

I have found a supplier for waveguide and other microwave components where amateurs can get small quantities. This supplier has an excellent catalog and offers it to the public for the asking—no microwave experimenter should miss it. The company is Lectronic Research Laboratories, Atlantic and Ferry Avenues, Camden NJ 08104. Ask for Sales Bulletin 107.

Stirling Olberg W1SNN
Waltham MA

Ham Help

I was an amateur, but lost my license because I could not construct my own transmitter and operate. I am trying to again get my license, but also I am badly in need of some equipment to continue with my other experiments. Unfortunately, this equipment is not available in India.

If anyone can send me construction details, along with circuit diagrams, etc., of a Van de Graaff electrostatic generator, a Wimshurst electrostatic generator, and biofeedback machines, I would be most grateful.

Any names of books and their publishers, from whom I can buy those books, also would be appreciated. Thank you very much.

Hemant K. Patel
1008 Nilanjana, 10th Floor
Marve Road
Malad-West
Bombay 400064, India

Awards

Bill Gosney WB7BFK
2665 North 1250 East
Whidbey Island
Oak Harbor WA 98277

This past fall we announced for the first time our new amateur radio awards program. Featured in a two-part series in the September and October issues, we outlined a total of eight *73 Magazine* achievement awards available to amateurs the world over. Since then, letters of support have been received from all parts of the globe, each showing dedicated interest in pursuing the challenges our awards program has to offer.

This month, we offer two new awards, each of which is very unique in its own right.

THE Q-5 AWARD OF EXCELLENCE

This award, sponsored by the editors of *73 Magazine*, is available to amateurs throughout the world possessing any class license who operate periodically in the American Novice band.

To be valid, all contacts must be made on or after January 1, 1980. Likewise, all contacts must be made using only the CW mode on those frequencies assigned to the American Novice. Maximum power allowed will be limited to 250 Watts input. There are no band restrictions for this award.

To qualify, the applicant must work all ten US call districts and receive no less than a Q-5 report. A qualifying RST might be, for example, 559, 539, 579, etc., while an RST of 449, 349, 479, would not qualify the applicant for the award.

This award is not meant to be an overnight accomplishment. Stations meeting the challenge of these requirements will be proud to display this unique award depicting the excellence and superiority of their station's transmitted signal.

To apply for this award, the applicant must prepare a list of all claimed contacts, logging each contact in order of the US call district. Indicate the station worked, the date and time in GMT, the frequency utilized, and, most important, the RST report as noted on your confirmation card. Also required is a brief description of the station equipment and antenna system used to complete this award.

Do *not* send QSL cards! Have your list verified by two amateurs, a local radio club secretary, or a notary public. Enclose your verified list along with the award fee of $3.00 or 8 IRCs to: Bill Gosney WB7BFK, 73 Awards Editor, 2665 North 1250 East, Oak Harbor, Whidbey Island WA 98277 USA.

A significant number of amateurs throughout the world find their primary interest in the operation and development of specialty-type communications. It is the efforts of these many pioneers in their field which have created many state-of-the-art improvements which we know today. The editors of *73* wish to recognize those amateurs who make positive steps toward expanding the use of their respective mode or type of amateur operation. As a result, in the paragraphs to follow, you will learn of our latest communications award dedicated to "communicator specialists."

SPECIALTY COMMUNICATIONS ACHIEVEMENT AWARD

Sponsored by the editors of *73*, this award is dedicated to amateurs worldwide who take pride in active participation in the field of specialty communications.

To be eligible for this award, some very rigid requirements must be met. First of all, contacts must be made on or after January 1, 1980. In addition, only communications via SSTV, RTTY, EME (Earth-moon-Earth), and/or OSCAR will be recognized for this award. Contacts between stations on OSCAR or EME may be made using any mode authorized in your country. Applicants must be cautioned, however, that mixed-mode contacts will not be valid.

This award will be offered in two levels of operating achievement, each a worthy award in itself:

Class A requires applicant to work all 50 US states.

Class A-1 requires applicant to work a minimum of 10 DX countries from the WTW DX Countries List.

To apply, the applicant must prepare a list of claimed contacts. For the Class A award, this list must be arranged in alphabetical order by US state; for the Class A-1 award, prepare the list of contacts in order by callsign prefix. Either list must also include the date and time in GMT, the band and mode of operation, and a signed declaration of the type and description of equipment and antenna systems used to make your contacts.

Do *not* send QSL cards! Have your list verified by two amateurs, a local radio club secretary, or a notary public. Enclose each list with an award fee of $3.00 or 8 IRCs to: Bill Gosney WB7BFK, *73* Awards Editor, 2665 North 1250 East, Oak Harbor, Whidbey Island WA 98277 USA.

Should any readers of this column care to possess our new awards program booklet, you are urged to send for your free copy now while the supply lasts. The only requirement is that you send a large business-size SASE when making your request. At the same time, I would like to encourage you to write any comments you may have about this column or our awards program being offered.

Traveling abroad as we do every month, I wish to share a very unique series of awards being offered by the Swedish Amateur Radio Society (SSA—Sveriges Sandareamatorer).

Karl Friden SM6ID wrote to inform us about the WASM II achievement award and sent along this very attractive diploma which is issued upon successful completion of the award requirements.

WORKED ALL SM LAENS WASM II

The WASM II, awarded by SSA, is available to amateurs throughout the world. Class A is for amateurs located in those countries with prefixes LA, OH, OZ, and SM. The Class B award is for amateurs in the rest of the world.

To be valid, all contacts must be made January 1, 1953, or after. Any one of the amateur bands is allowed and contacts made in CW or phone or any combination of both are allowed, providing it is not cross-mode.

Amateurs in Class A areas must submit proof of having established two-way communications with each of the 25 laens (counties) on two different bands (50 QSLs). Amateurs in Class B areas must submit proof of having established contact with each of the 25 laens without any band restrictions.

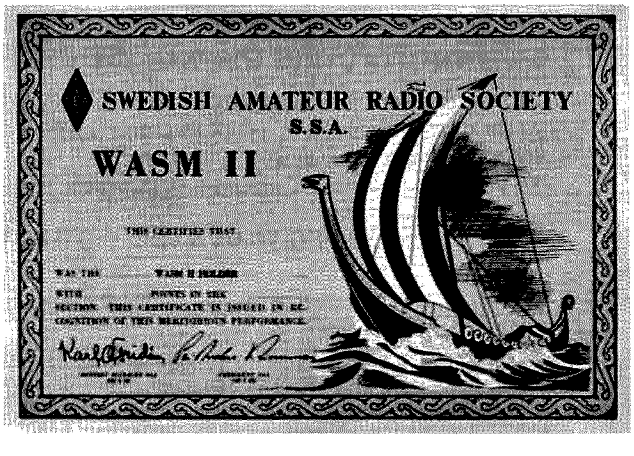
Sweden is divided into 25 laens or counties:

A—City of Stockholm (SM5 and SM0)
B—Stockholm laen (SM5 and SM0)
C—Uppsala laen (SM5)
D—Södermanland laen (SM5)
E—Ostergötland laen (SM5)
F—Jönköping laen (SM7)
G—Kronoberg laen (SM7)
H—Kalmar laen (SM7)
I—Gotland laen (SM1)
K—Blekinge laen (SM7)
L—Kristianstad laen (SM7)
M—Malmöhus laen (SM7)
N—Halland laen (SM6)
O—Göteborg och Bohus laen (SM6)
P—Älvsborg laen (SM6)
R—Skaraborg laen (SM6)
S—Varmland laen (SM4)
T—Örebro laen (SM4)
U—Vastmanland laen (SM5)
W—Kopparberg laen (SM4)
X—Gavleborg laen (SM3)
Y—Vasternorrland laen (SM3)
Z—Jamtland laen (SM3)
AC—Vasterbotten laen (SM2)
BD—Norrbotten laen (SM2)

Application for the WASM II must be accompanied by a verified list of claimed contacts. This list may be verified by two amateurs, a local club secretary, or a notary public. Enclose this list with 7 IRCs or US stamps of equivalent value and send to the attention of: Karl O. Friden SM6ID, Awards Manager SSA, Pl. 1084, Morup, 310 56 Langas, Sweden.

And, while speaking of the Swedish Amateur Radio Society, I received a very nice letter from Kjell Edvardsson SM0CCE who is awards manager for the WASM I award being offered by this national organization. It is very unfortunate that a sample of this award is not available for reproduction. This is due to the fact that the award is a very large cloth depicting scenic highlights of this beautiful and picturesque country and personalized to display the identity

Continued on page 228



Leaky Lines

Dave Mann K2AGZ
3 Daniel Lane
Kinnelon NJ 07405

Some irritations are of great importance; others are of relatively less concern. Since it is in the very nature of the incorrigible malcontent to nitpick, I decided a long time ago to leave significant questions for others to discuss. I deal with those niggling little matters that produce heartburn rather than peptic ulcers. If you seek the earth-shattering exposé, the juicy scandal, or the noble crusade, move on; you will not find it here. Let others pursue man-eating sharks and tigers . . . I swat flies and mosquitoes.

A case in point: Here, I think, is one of those small insanities that's right up my alley. It calls for some protest, however slight. I would have hoped that Newington, Connecticut, would have registered some opposition, but none was forthcoming. There are times, I suppose, when the lamb will willingly lie down with the lion.

The present system of callsign allocations is an abomination. It more closely resembles some sort of random selection than a structured plan which could clarify grade of license, seniority, or geographical location. The unfortunate inclusion of a great number of garbled prefixes has botched up the whole thing but good.

There is no longer any dependable way, short of asking directly (which somehow goes against the grain), to know whom you are working or whether your contact has been licensed for sixty years or for sixty days. It is claimed that this arrangement will tend to democratize the ham bands, but it will not. It will merely produce an element of uncertainty in an area once highly organized. One used to know beyond peradventure that the KA he hooked up with was a member of the U.S. military stationed in Japan; now he may be some guy right around the corner . . . there's no way to tell just from the prefix.

I'm not disturbed merely by the confusion. I simply dislike the idea of creating equality where it really has no place. Don't misunderstand me. I am one hundred percent in favor of political, racial, sexual, and social equality . . . a true advocate and champion of democracy. But it has no more place in ham radio than it has in any other such avocation . . . photography, stamp collecting, gardening, woodworking, astronomy, or Sunday painting. What is this sudden impulse to create equality everywhere? I believe that those who have been around for a very long time deserve to flaunt the distinction to some extent. No human endeavor in which skill is a factor should be subjected to some artificial leveling process. I speak not of reward, but of simple recognition. And if this should happen to consist of a distinctive callsign, as it used to, what's so terribly wrong with that?

The simple truth is that, in the words of an old adage "When everybody is somebody, nobody is anybody."

By all means, reward diligence, talent, and industry. But not by taking something away from somebody else. They've now removed the distinction of the preferred callsign, the only thing that differentiated the oldtimer from the Johnny-come-lately. I rise to my hind legs and bay loudly at the moon. The new callsigns are lousy!

But things might have been far worse. I read a proposal that would have utilized the 3-letter, 3-digit system presently employed in the assignment of some state's auto license plates. If our present callsign system is bad, that one would have been infinitely worse. Some other joker got the brilliant idea that because Social Security numbers, like snowflakes and fingerprints, are unique . . . no two alike . . . they should be used to replace the standard callsigns. Don't expect me to analyze the logic that prompts such suggestions; I'm no expert in abnormal psychology.

It may be that the present revision of the callsign structure was designed for the convenience of the FCC monitoring stations, so that they could more easily determine who may be operating illegally in the restricted subbands.

This notion presupposes that these monitors are doing a conscientious job of policing in the first place . . .staying on top of the situation and nailing violators with swift efficiency. But they are not. A recent incident confirms the very opposite. The monitor at Anchorage, Alaska, issued notices of violation to a number of amateurs who had contacted Thailand stations. Obviously, the monitor labored under the mistaken impression that there still exists a banned countries list.

We have not had such a list for a very long time. This misadventure reminds me of the great flap that occurred when police were issuing summonses to hams who were transmitting while driving, despite a change in the law. This took place some fifteen years ago, and notwithstanding the repeal of the measure which had formerly prohibited such transmissions, these misguided minions of the law were highly reluctant to accept the change. Hams were advised to carry copies of the new regulation so they could show them to arresting officers. Despite all this, there are still some cops who attempt to hand out tickets to this day! To be sure, such cases are thrown out of court. But those who receive the summonses must answer them . . . a needless inconvenience. In like manner, those who have received these notices of violation from the FCC are being penalized. They have been informed that they "must respond to the citation in the manner outlined in 97.137, and the reply must be sent via registered or certified mail." (See *QST*, August, 1979.)

What would happen if one of these cited amateurs were to fail to reply to the notice? Bureaucratic conceit and self-conferred omnipotence being what they are, it would not be at all strange if they were to face actual revocation of license. Such is the nature of bureaucracy . . . agencies of the government are known to foul up from time to time.

Not only do these erroneous citations demonstrate that a bureaucracy can be wrong, but they also confirm a persistent conviction held by many that even when they are wrong, they pretend that they are right, and they insist upon having everyone else take part in the pretense, too.

Would it have been so embarrassing for the FCC to have issued a simple statement to the effect that all persons who had received the citation should simply ignore it? Why couldn't they acknowledge that there had been an inadvertent human error? Would this have been such a terrible humiliation?

It appears that the Commission is committed to the perpetuation of a grand illusion; it must maintain an aura of infallibility. Perhaps even more important, licensees must constantly be made aware of the awesome power of Big Brother.

Phooey and double phooey!

If the FCC were one-tenth as capable as it would have us believe, it would long since have succeeded in cleaning up the horrendous mess on CB . . . it would have been able to do something significant about the "woodpecker" that has plagued and bedeviled operations on the DX bands . . . it would have been able to nail all the CW intruders on fishing trawlers who constantly appear on unauthorized frequencies within our allegedly sequestered portions of the amateur spectrum. It would have been able to deal with the problem of unauthorized linear amplifiers on 27 MHz without having to eliminate 10-meter capability from amplifiers intended for use among legitimately licensed amateurs . . . it would have been capable of devising some nationally applicable regulation which would, once and for all, take uncompromising precedence over community zoning restrictions on radio tower installations. It would also have been able to force manufacturers of home entertainment devices to install adequate filtering so that TVI and BCI would be minimized, if not eliminated altogether, thus lifting the burden of ostracism and public condemnation from the shoulders of thousands of blameless amateurs and placing it where it rightfully belongs.

The fact is that there's nothing perfect in this all-too-imperfect world. But this has its compensations. It's great for the likes of me . . . a guy who derives personal satisfaction in pointing out foibles and flaws. How could I function if this were a world without faults? Yet, somehow I have the feeling that even if it were perfect, we grumblers and groaners would still manage to find something to gripe about.

Ham Help

I need a parts list and assembly and tuning instructions for a Telrex TC-99 triband beam antenna. Will copy and return.

A. McGinnis WA2DTQ
55 Patton St.
Iselin NJ 08830

I am in desperate need of a schematic and alignment instructions for a National NC-300. I would really appreciate any help.

Bob Amos
607 N. Madden
Shamrock TX 79079

I would like some help in studying for the General exam. Any person or group in the Bronx area interested in helping me?

Smideth Shuler
60 Clason Pt. Lane
Bronx NY 10473

Microcomputer Interfacing

David G. Larsen
Peter R. Rony
Jonathan A. Titus
Christopher A. Titus

The characteristics of the Intel 8253 programmable interval timer were introduced in our October column. This 24-pin chip is very useful in counting and timing operations. This section will discuss two test programs for the 8253. One is a demonstration program that illustrates the various modes of operation of the timer, and the other is a program that demonstrates the reading of counter data "on the fly."

The counter is wired to an 8080A-based microcomputer, as shown in our October column. The details of the test circuit are provided in Fig. 1. Although the use of an oscilloscope is handy to monitor output signal OUT0 from counter #0, it has been found just as useful to provide a single 7490 decade counter chip to detect negative-edge transitions at OUT0. The 25-kHz input clock frequency, which has a period T of 40 μs, is input at CLK0.

Before the 8253 chip is used, the nature of output signal OUT0 must be understood as a function of the six different modes of operation, MODE 0 through MODE 5. We have found the manufacturer's literature to be somewhat confusing, so their diagrams have been simplified by omitting all signals other than OUT0. This permits all six modes to be compared simultaneously, as shown in Fig. 2. Note that MODES 0 and 1 provide a negative monostable clock pulse of duration NT; MODE 2 provides a series of negative clock pulses of pulsewidth T and period NT; MODE 3 provides essentially a square wave of period NT; and MODES 4 and 5 provide a single strobe pulse of pulsewidth T at a time NT after a trigger pulse has been applied to counter #0. The quantity N is a 16-bit timing byte initially loaded into counter #0. In our program, the timing byte is 000 000, which corresponds to the decimal number 65,536.

At this point, it is appropriate to comment on the two possible actions of the GATE0 input:

1. GATE0 functions as a *gating* input; when at logic 0, pulses input at CLK0 do not reach counter #0 and no counting occurs. This type of behavior occurs with MODE 0, MODE 2, MODE 3, and MODE 4.

2. GATE0 functions as a *trigger/reset* input; a positive-edge transition at GATE0 resets counter #0 and initiates counting. Each time there is a positive edge at GATE0, counter #0 is reset. This type of behavior occurs with MODE 1, MODE 2, MODE 3, and MODE 5.

These different actions can best be observed with the aid of a counter and a value of NT in the range of 3-10 seconds. In our case, N is 65,536 and T is 40 μs, so $NT = (65{,}536)(40 \times 10^{-6}) = 2.62$ seconds.

The program used to test the 8253 chip is provided in Table 1. Note that we have employed memory-mapped I/O, in which the control register has an address of 200 003 and counter #0 has an address of 200 000. The program is quite simple. First the control word 060 (MODE 0) is output into the control register. Next, we successively load the LO and HI counter bytes, both of which are 000, into counter #0. Finally, we enter a wait loop. Table 2 in the October issue shows that a control word of 060 means that counter #0 is chosen; the least-significant byte is loaded first, then the most-significant byte. Observe

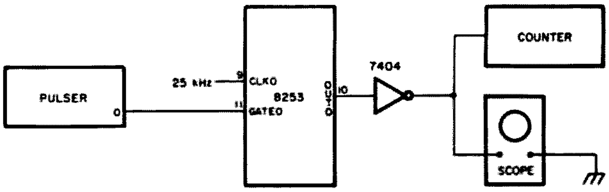


Fig. 1. Circuit for counter #0 on the 8253 timer to be used with the demonstration program given in Table 1. It is assumed that the counter counts negative-edge transitions.

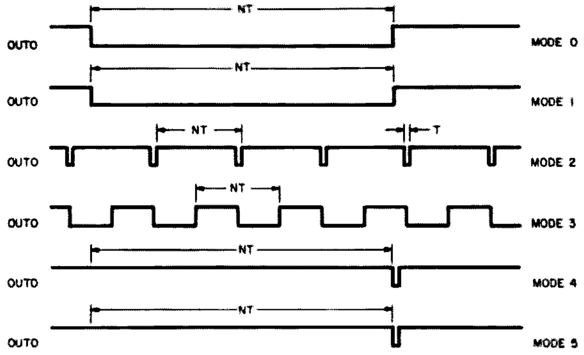


Fig. 2. Timing diagrams for the OUT0 output signal for each of the six operating modes of the 8253 timer.

the MODE 0 operation of the counter and count down in binary.

When executing this program, observe that OUT0 goes immediately to logic 0 and remains at this logic state for NT seconds, after which it returns to logic 1. This behavior can be repeated only by executing the program a second time, starting at memory address 003 000.

If the control word is changed at location 003 001 to 062 (MODE 1), the execution of the program begun, and the pulser

Continued on page 225

003 000 076	TIMER,	MVIA	/Move control word into accumulator
003 001[a] 060		060	/Mode control word
003 002 062		STA	/Store it within control register
003 003 003		003	/In 8253 interval timer chip
003 004 200		200	
003 005 076		MVIA	/Move LO counter byte into accumulator
003 006 000		000	/LO counter byte
003 007 062		STA	/Store LO byte in counter #0
003 010 000		000	
003 011 200		200	
003 012 076		MVIA	/Move LO counter byte into accumulator
003 013 000		000	/HI counter byte
003 014 062		STA	/Store HI byte in counter #0
003 015 000		000	
003 016 200		200	
003 017 303		JMP	/Wait
003 020 017		017	
003 021 003		003	

If you wish to observe the counting process on a pair of output ports, replace the last program instruction by the following sequence of instructions:

003 017 076		MVIA	/Move new control word into accumulator
003 020 000		000	/Move control word to read counter #0
003 021 062		STA	/Store it within control register
003 022 003		003	
003 023 200		200	
003 024 072	RPT,	LDA	/Read LO counter byte into accumulator
003 025 000		000	
003 026 200		200	
003 027 323		OUT	/Output LO counter byte to Port #2
003 030 002		002	
003 031 072		LDA	/Read HI counter byte into accumulator
003 032 000		000	
003 033 200		200	
003 034 323		OUT	/Output HI counter byte to Port #0
003 035 000		000	
003 036 303		JMP	/Continue to output the counter bytes
003 037 024		RPT	
003 040 003		0	

[a]The control word at address 003 001 is changed to demonstrate the behavior of the different modes of operation.

Table 1. Demonstration program for the 8253 interval timer.

DX

DXPEDITION TO MT. ATHOS BY SV1DC, SV1IW, AND SV1JG

This expedition to Mt. Athos was the outcome of long discussions with the community of the Holy Mountain and great efforts on the part of all concerned. The operators were notified on July 20, 1979, that they would be permitted to transmit from Mt. Athos; they departed Athens on Monday, August 6.

SV1DC drove twelve straight hours, and the group was on the air at 1430 UTC, August 7. Since getting to the operating spot involved walking and hand-carrying, only a 12AVQ Hy-Gain vertical was taken; no antennas were available for other than 20, 15, and 10 meters. A Kenwood TS-520 with external remote vfo and a Honda E300 generator rounded out this field operation.

In 70 hours, over 8000 contacts were logged, including a thousand on CW by SV1IW. Most operation was on 20 and 15, with 10 meters being its usual obstinate summer self. In general, conditions were OK except toward Asia—only a few stations from Asia got through.

The Mt. Athos operation shut down at 0200 UTC on August 11; SV1IW and SV1JG along with SV1KP (Ms. SV1IW) proceeded to the island of Crete for a "vacation-style" expedition. In ten days, the three made 6000 more contacts, including many by Natasha, who signed SV9YL. During this period, propagation reversed itself, with conditions being better toward Asia than to North America.

The operators of this Mt. Athos and Crete expedition express their appreciation to all who called in and made their trip a successful one. We, in turn, thank them for putting two new countries in so many logs around the world.

On Crete (l-r), SV1IW, SV1KP, and SV1JG.

SV1IW works SSB from Mt. Athos, while SV1DC observes.

NOVICE CORNER

Let's talk about the perennial Novice, the one who never seems to learn. This is a rare case, actually, as most amateurs advance to being reasonably competent operators as they gain experience. Today's topic is how to work through a pileup on CW while causing minimal interference to others.

This morning, VQ9MR was working the US on the long path at 14,036 kHz, using relatively high-speed CW. The stations he was working were all about one kHz higher in frequency. That is, VQ9MR was "listening up one" without saying so, enabling those who grasped the pattern to easily have a quick QSO. One poor K4 station insisted on calling exactly on VQ9MR's frequency, which was bad enough; that same K4 also seemed inclined to transmit at the worst possible times, like when VQ9MR was also sending. What boggles the mind is that our K4 friend has been a ham for over twenty years! It was 8:00 am, so maybe he was asleep at the key?

First, our K4 person slowed down the whole operation by causing many to miss their report from VQ9MR; indeed, often one could not hear the Chagos come back through those still calling. This is not an uncommon problem. But if one particular K4 caller had had his act together, with the strong signal he had, he surely could have worked the DX on one or two calls, and he would have been gone, instead of fouling up the works for a long period of time.

The procedure for handling a situation such as this is simple and the rewards are great, especially with an excellent CW operator like VQ9MR handling the pileup. The goal, of course, is to transmit to the DX off fre-

Continued on page 223

New Products

SWAN ASTRO 150 SSB TRANSCEIVER

Swan is back! After a several year hiatus, during which little was heard from the company, Swan has returned to amateur radio with an impressive array of all-new, state-of-the-art equipment.

Swan, for those who have short memories, was a dominant force in amateur gear in the late '60s and early '70s. I was one of thousands of young hams of that era who yearned to own a Swan rig, but my high school and college finances never gave me that opportunity. That's one reason I jumped at the chance to put one of Swan's new breed, the Astro 150 SSB Transceiver, through its paces.

The Astro 150 bears scant resemblance to the transceivers of that earlier time. If you haven't shopped for an allband rig in the last five or ten years, you'll be amazed at just how compact and convenient they are.

General Description

The Astro 150 is a five-band SSB and CW rig covering 10-80 meters. A sister model, the Astro 151, covers 15-160 meters. The frequency coverage on each band extends well beyond the upper and lower limits of the amateur allocations, making the 150 a fine choice for MARS operation. With the bandswitch in the 20-meter position, for example, the transceiver tunes from 13.8 to 16.0 MHz. The other bands offer a similar overlap.

While the 150 is designed for SSB and CW operation, the owner's manual advises that SSTV and RTTY operation is possible if you take precautions. It recommends providing a small cooling fan for the heat sinks of both the transceiver and its power supply. In addition, the mike gain control should be used to reduce output to 50 Watts or less. A rear panel RCA jack is provided for inputting AFSK or SSTV signals.

Inside the 150

This transceiver is a ruggedly built modular rig. Virtually all components, including most of the front-panel controls, mount on printed circuit boards. Connections between the boards are mostly of the plug-in variety, so removing a board for service should not be difficult. A profusion of heavy metal brackets and plates provides rf shielding as well as mechanical rigidity. My lone reservation about the construction of the 150 is that a few of the metal brackets inside the rig have sharp edges which *might* erode the insulation on nearby wires. Admittedly, this is a minor point, as an enormous amount of abuse and vibration would be necessary for such damage to occur. A couple of well-placed pieces of plastic tape would set my mind completely at ease. Unless you plan extensive mobile and portable operation with your Astro 150, it is not cause for concern. This rig will last.

Swan's Astro 150 SSB Transceiver.

Despite its small size (3.75" H x 9.75" W x 11.75" D), the 150 weighs in at a hefty 13 pounds. The companion PSU-5 Power Supply/Speaker is of similar size. Both the transceiver and its power supply have their own on-off switches, a nice feature for those who don't like to connect a "hot" lead to any piece of equipment.

With few exceptions, there is no shared circuitry between the receiver and transmitter. The receiver is a single-conversion design with a 9-MHz i-f. The claimed sensitivity is .35 uV for 10 dB (S + N)/N. For CW operation, a 300-Hz i-f filter can be selected, or you can opt to use the SSB filters.

The transmitter is of a broadbanded design with an output power of 100 Watts PEP. As with most "no tune-up" transmitters, a low swr is important. The 150 will perform up to specifications only if it is operated into an swr of 2:1 or better. At higher ratios, the transceiver protects itself by automatically reducing output power so that the final transistors do not overheat. For this reason, Swan recommends using an antenna tuner to keep the swr, as seen by the transceiver, as low as possible.

The 150 offers full break-in (QSK) on CW, something found on few rigs at any price these days. Break-in is accomplished by leaving the final amplifier always connected to the antenna through the low-pass filters. In the receive mode, the final power transistors are biased off, effectively creating an open circuit on the transmitter output transformer. The receiver input is coupled to the secondary of this transformer via a high-speed reed relay.

Perhaps the most unique technical feature of the Astro 150 is its method of frequency selection and tuning. This transceiver is one of a small handful of amateur HF rigs incorporating true digital frequency synthesis. Much of our 2-meter equipment (and even some CB gear) has used synthesizers for several years, but only recently has it become available in multiband HF radios.

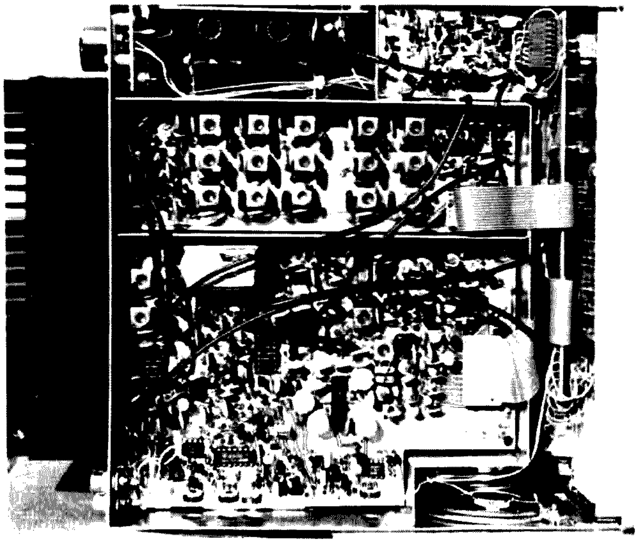
Incidentally, just because a transceiver has a digital display, this does not necessarily mean that it's synthesized. In many rigs, the operating frequency is determined by conventional vfo circuitry, and a frequency counter is used to produce the digital display. The principle of synthesized frequency control is completely different, as we shall see.

Swan's design uses a pair of phase-locked loops (PLLs) to provide precise crystal-controlled reference frequencies to six voltage-controlled oscillators (vco's). Five of these are designated as "band" vco's. The outputs from the band vco's are divided by a diode-programmed divider so that band vco frequencies are variable in steps of 500 kHz. The transceiver's bandswitch selects the proper vco and diode program for each band. The 7-32-MHz output of the selected band vco is summed with the 5-7-MHz output of the sixth or "tuning" vco to produce a local oscillator frequency in the 12-39-MHz range. The local oscillator is thus always about 9 MHz above the operating frequency, and indeed, the Astro 150 uses a 9.0165-MHz i-f.

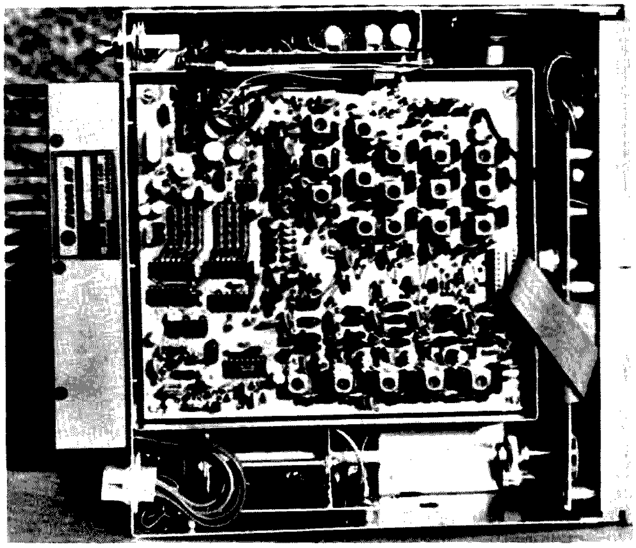
Directing traffic inside the synthesizer is an 8048 microprocessor chip, a device from the same family as the popular 8080 chip found in thousands of microcomputer systems. A small amount of read-only memory stores a program containing the instructions which allow the 8048 to control this complex radio.

The microprocessor accepts as inputs the band and mode you have selected, along with signals from the tuning controls. It uses this data to produce signals which determine the frequency of the tuning vco. The 8048 also sends the proper information to the readout board to enable it to display the correct frequency. The microprocessor and its program also carry out other functions which would otherwise require much additional logic. For example, as long as power to the 150 is not interrupted, the microprocessor will remember the last frequency used on each band. If you want pileups on five different bands simultaneously, the Astro 150 can do it!

With this high-technology frequency-determining scheme, you wouldn't expect the 150 to



Top view of Astro 150 chassis.



Bottom view of the Astro 150 (with metal shield removed).

have a conventional tuning knob . . . and it doesn't. The main tuning control is called the VRS (variable rate scanning) knob. The shaft of this knob is attached to a cam which actuates either of two microswitches, depending on which way the knob is turned. When actuated, these microswitches send signals to the 8048 microprocessor. For example, when the VRS knob is rotated clockwise from its neutral 12 o'clock position, the left-hand microswitch is tripped, sending a signal to the 8048, which then issues commands causing the transceiver to begin scanning upward in 100-Hz steps. If the VRS control is turned counterclockwise, the right-hand microswitch is tripped, and the transceiver begins tuning downward in frequency. A potentiometer attached to the VRS knob shaft determines the scanning rate. The further the knob is rotated from the neutral 12 o'clock position, the faster the frequency changes. Once the desired frequency is reached, the VRS knob is returned to the neutral position, and the scanning stops. Scanning control is also available via up/down push-buttons on the included hand-held microphone, making mobile operation safer and more convenient.

Other front-panel controls include both RIT and Fine Tuning. RIT changes only the received frequency (up to ±300 Hz), while the Fine Tuning control alters both transmit and receive

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INTERNATIONAL 160 METER PHONE CONTEST

SPONSORS .... 73 Magazine, Peterborough, New Hampshire 03458.

DATES & TIMES .... 0000Z 19 January 1980 to 2400Z 20 January 1980.

OBJECT .... To work as many stations as possible on 160 meter phone in a maximum of 30 hours of allowable contest operation. Multi-operator stations may operate the full 48-hour period.

ENTRY CATEGORIES ... (1) Single operator, single transmitter, phone only; (2) Multi-operator, single transmitter, phone only.

EXCHANGE .... Stations within the continental 48 US states transmit RS report and US state; all others transmit RS report and DX country.

POINTS .... All contacts score FIVE (5) POINTS each. The same station can only be worked once for contest points.

MULTIPLIERS .... ONE (1) multiplier point is earned for each US state worked within the continental US; THREE (3) multiplier points are earned for each DX country worked outside the continental US.

FINAL SCORE .... Total QSO points times total multiplier points equals claimed score.

CONTEST ENTRIES ..... Each entry must include logsheets, dupe sheet for 100 or more contacts, a summary sheet, and a multiplier checklist.

ENTRY DEADLINE ..... All entries must be postmarked no later than 20 February 1980.

DX WINDOW .... All stations are expected to observe the DX window from 1.825-1.830 MHz as mutually agreed upon by top-band operators.

DISQUALIFICATIONS ... Contest disqualification may result if contestant omits any required entry forms upon submission of results; operates in excess of legal power limitations or frequency allocations within his given area; manipulates operating times to achieve a score advantage; or fails to omit duplicate contacts which would reduce the overall score more than 2 per cent.

AWARDS .... Contest awards will be issued in each operator category in each of the continental US states and DX countries.

CONTEST ADDRESS .... Those wishing contest information or entry forms or who desire to submit a contest entry should enclose an SASE and write to:

Dan Murphy WA2GZB
Post Office Box 195
Andover NJ 07821 USA

Contests

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

TOPS CW CONTEST
Starts: 1800 GMT December 1
Ends: 1800 GMT December 2

General call is "CQ QMF" and entry classes include single- or multi-operator. Use 3.5 to 3.6 MHz, USA Novices between 3.7 and 3.75; all contacts must be on 80 meters, CW only.

EXCHANGE:
RST and QSO number from 001.

SCORING:
Contacts with own country score 1 point. Each call area in A/K/N/W, VE/VO, VK, and UA, etc., counts as a separate country. Contacts with stations in the same continent are 2 points, other continents are 5 points. Contacts with HQ station, GW8WJ or GW6AQ, score 25 points. It is hoped to have a special station, perhaps GB2TAC, for another 25 points. Total score is total QSO points times number of prefixes worked (prefixes as per WPX award).

ENTRIES:
Send logs to: Peter Lumb G3IRM, 14 Linton Gardens, Bury Saint Edmunds, Suffolk IP33 2DZ, United Kingdom. Logs should be sent no later than January 31st. Contest results will be sent to all stations except eastern Europeans, which will be sent via the bureau. Due to postage costs, stations are asked to help by enclosing IRCs.

NORTH CAROLINA QSO PARTY
Starts: 1900 GMT December 1
Ends: 0100 GMT December 3

This contest is sponsored by the Alamance Amateur Radio Club. Suggested frequencies are plus/minus 10 kHz:

CW—3560, 7060, 14060, 21060, 28060.

Novice—3720, 7120, 21120, 28120.

SSB—3900, 7270, 14290, 28590.

EXCHANGE:
Out-of-state stations send RS(T) and state, province, or country. NC stations send RS(T) and NC county.

SCORING:
Out-of-state stations count 1 point per NC contact. The same station may be worked on different bands, modes, or in different NC counties. Multiply QSO points by number of different NC counties worked for final score. NC stations count 1 point per QSO and multiply by total number of states, provinces, or countries for final score. NC mobiles use the number of counties operated from for an additional multiplier.

ENTRIES AND AWARDS:
Your log must be signed; none will be returned. Logs must show RS(T)s, bands/modes, time (GMT), state, province, country, or NC county. On a separate sheet, please show name, call, and mailing address plus your total score and where operated from. In the case of multi-operator stations, this sheet must also list the call of the operators. Awards will be issued as usual. Logs must be postmarked no later than January 10th and sent to: Alamance ARC, Inc., 2822 Westchester Drive, Burlington NC 27215.

CONNECTICUT QSO PARTY
Starts: 2000 GMT December 1
Ends: 0200 GMT December 3
Rest period from 0500 to 1200 GMT December 2

The Candlewood ARCA invites all amateurs to participate in this year's contest. Phone and CW are the same contest. Stations may be worked once on each band and mode including OSCAR (and RS) as a separate mode. Novices will please identify themselves by ?n. W1QI, the club station, will operate CW on odd hours and SSB on even hours. Connecticut mobiles working in other than their home counties will receive special certificates provided they make at least 20 out-of-state QSOs. Mobiles count as a separate station in each county.

EXCHANGE:
Send QSO number, RS(T), ARRL section for out-of-state stations, and Connecticut county for Connecticut stations.

FREQUENCIES:
Suggested frequencies are 40 kHz up from the bottom of the CQ bands plus 3927, 7250, 14295, 21370, and 28540 for SSB. Watch for Novices on 3725, 7125, 21125, and 28125.

SCORING:
Each completed QSO counts 1 point, 2 points if with a Novice, and 3 points if via OSCAR. Also, contacts with W1QI count 5 points. Only one DX multiplier is allowed although all DX QSOs count for QSO points. Out-of-state stations multiply QSO points by the number of Connecticut counties worked (8 max.). Connecticut stations multiply the number of QSO points by the number of ARRL sections worked plus a maximum of 1 DX multiplier.

ENTRIES AND AWARDS:
Certificates for the top station in each ARRL section and each Connecticut county if the winner has at least 5 QSOs. Certificate to top-scoring station in each DX country. A Worked All Connecticut Counties certificate will be awarded to each station working all 8 counties during the contest. Logs must show all QSO info plus band, mode, and single- or multi-operator class. Entries must also show QSO points and claimed score. Enclose a large SASE for results. Logs must be postmarked no later than January 2nd and sent to: Skip Paulsen W1PV, 2 Ryders Lane, Danbury CT 06810.

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Calendar

Dec 1-2	ARRL 160 Meter Contest
	TOPS CW Contest
Dec 1-3	North Carolina QSO Party
	Connecticut QSO Party
Dec 8-9	ARRL 10 Meter Contest
	Garden City Contest
Dec 22-23	Teenage Radio Sprint
Jan 5-6	QSL Exchange Contest
Jan 12-13	International Island DX Contest
Jan 19-20	North and South America RTTY Flash
Feb 2-3	South Carolina QSO Party
Mar 9-10	Europe and Africa RTTY Giant Flash

Results

RESULTS OF 1979 NEW JERSEY QSO PARTY

NEW JERSEY

Atlantic	K2NJ/2	50
Bergen	N2CR	1584
Burlington	W2XQ	11352
Camden	WA2MNO	9540
Cape May	K4FFM/2	176
Cumberland	K2OG	2599
Essex	WA2LWT	1060
Gloucester	AB2E	4011
Hudson	K2NJ/2	70
Hunterdon	KA2EGO	490
Mercer	W2ZQ*	14202
Middlesex	WA2NPP*	94599
Monmouth	AF2L	24939
Morris	WB2POG	8621
Ocean	K2NJ/2	78
Passaic	WA2OVE	27264
Salem	WA2RAN	18232
Somerset	K2PF	114
Sussex	W2RQ	26400
Union	WB2RMI	15288
Warren	K2NJ/2	84

OUT-OF-STATE

Maine	N1PL/1	846
Conn.	WA1TZY	585
N.H.	K1KA**	1470
E NY	WB2THN	1380
W NY	N2ARG	496
Del.	K3UEI/3	25
E Pa.	K3NB**	3591
W Pa.	AD8J	63
Ga.	AI4X	18
Tenn.	WB4WHE	30
La.	W5WG	1445
East Bay	WB6IYS	64
Los Ang.	N6HE	16
Wash.	WB7QEL	60
Ohio	WA8ZNC	704
W Va.	W8UI	1660
Ill.	W9QWM	240
Wisc.	K9GDF	9
Kans.	WD9HAP	120
Ont.	VE3DAP**	2268

* = multi-operator
** = worked all 21 counties

H. Paul Shuch N6TX
Microcomm
14908 Sandy Lane
San Jose CA 95124

Low-Cost Receiver for Satellite TV

—this modular design uses readily available technology

Author's Note: This article was originally presented by the author as part of the professional program, "Satellite TV and the Private User," at WESCON/79 in San Francisco CA on September 20, 1979. WESCON, the annual Western Electronics Show and Convention, is a large-scale trade show which features films, exhibits, and professional sessions related to all facets of the electronics industry.

The technological revolution which is making possible the distribution of television programming via satellite has been discussed in both popular and technical publications and at conferences and seminars.[1] In this article, I will explore the trade-offs involved in designing a wideband, tunable FM video receiver for processing and displaying DOMSAT (Domestic Communications Satellite) signals.

It should be recognized that there are at least as many conflicting receiver design philosophies as there are microwave engineers, and no claim is made that the concepts presented here are necessarily superior to any other approach. Nevertheless, this receiver does provide adequate performance at low cost, and the trade-offs encountered

mystique of microwave receiver design.

Signal Characteristics

Unlike the vestigial-sideband AM video standard used for terrestrial TV broadcast, DOMSAT video incorporates a wideband FM format, with audio multiplexed onto a subcarrier prior to modulating the composite. The resulting wideband channel (see Table 1) affords considerable "FM advantage" (signal-to-noise enhancement for a given carrier-to-noise ratio); however, the bandwidth and format tend to complicate the receiver design task.

Were a signal consisting

Video Carrier	
Channels	24
Adjacent channel spacing	40 MHz
Orthogonal channel spacing	20 MHz
Frequency band	3.7-4.2 MHz
Peak deviation	10.25 MHz
Max. video frequency	4.2 MHz
Pre-emphasis curve	CCIR 405-1
Audio Subcarrier	
Frequency	6.8 MHz
Peak deviation	75 kHz
Max. audio frequency	15 kHz
Pre-emphasis time const.	75 usec
Energy Dispersal	
Waveform	Triangular
Frequency	30 Hz
Peak deviation	750 kHz
Composite	
EIRP	+65 dBm

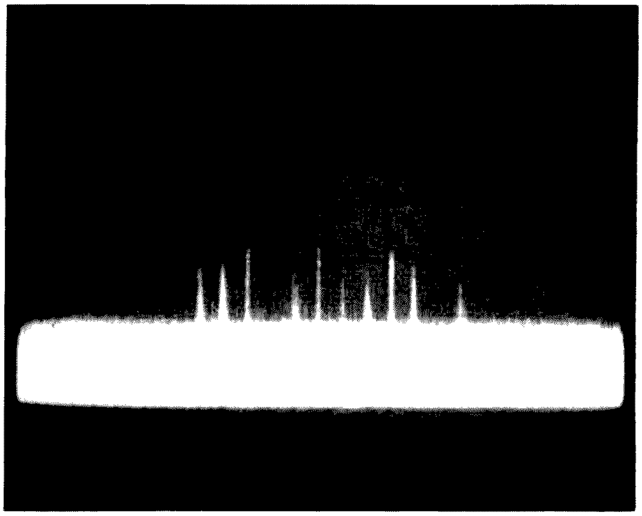

Fig. 1. Spectral display of a 4-GHz DOMSAT downlink recovered on a 4.7-meter antenna and amplified by a GaAs FET Low-Noise Amplifier (LNA). Horizontal deflection is 100 MHz/div, and vertical sensitivity is 10 dB/div. Eleven video carriers, along with their associated FM sidebands, are visible. Note that the fourth channel above the bottom of the band is vacant. Otherwise, channel spacing is 40 MHz and carrier-to-noise ratio appears to be on the order of 10 dB.

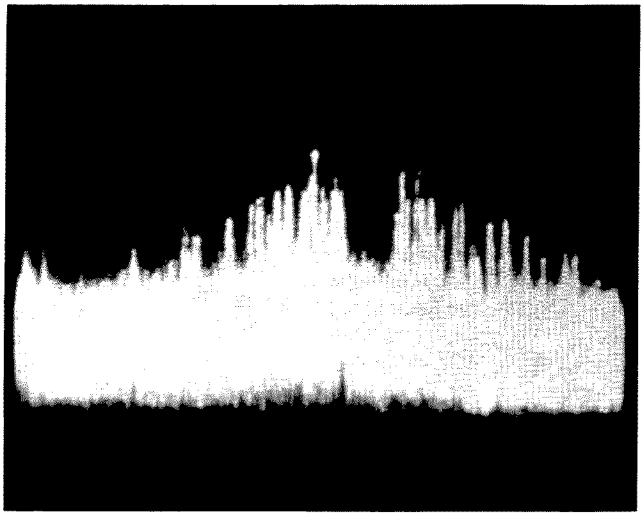

Fig. 2. Spectral display of a single wideband FM video channel after dual-downconversion to a 70-MHz second i-f. Horizontal deflection is 3 MHz/div. and vertical sensitivity is 10 dB/div. This is the composite FM signal from which video and audio are to be demodulated.

would involve merely heterodyning the selected channel in the 4-GHz transmission band against a stable microwave local oscillator (LO), and applying the VHF difference signal directly into the tuner of a conventional TV set. Unfortunately, with DOMSAT signals as they are currently formatted, such a downconversion process would merely spread unintelligible sidebands across six adjacent TV channels.[2] Thus, it becomes necessary to design a complete receiver, including heterodyne conversion stages, demodulators, and video and audio processing circuitry, to recover and display satellite TV.

Frequency Agility

It will be noted from Table 1 that the downlink band used by most North American DOMSATs is 500 MHz wide, and that for a given antenna polarization there will be present up to twelve video carriers, spaced 40 MHz apart (see Fig. 1). That these signals are of extremely low amplitude complicates the design of the Earth station's antenna[3] and low noise preamplifier,[4] but we will assume for the moment that an adequate signal-to-noise ratio exists at the input of the receiver to permit signal recovery. The problem at hand, then, is to select a particular 40-MHz wide channel from among 12 such signals in a 500-MHz wide band, while adequately attenuating the adjacent channels.

A Tuned Radio Frequency (TRF) approach, with detection occurring directly at the downlink frequency, would require readily-tunable bandpass filters of high Q (to accommodate the 1% or so channel bandwidth) and skirts steep enough to reject adjacent channels. Tuning requirements rule out both LC and resonant cavity filters, suggesting the use of Yttrium-Iron-Garnett (YIG) sphere resonators for channel selection.

Although YIG filters can readily be bias-tuned, their cost and the complexity of the required driving circuitry tend to rule them out for private terminal applications. Furthermore, it is far easier to tune a single oscillator than a bank of filters. This suggests heterodyne-downconverting a selected channel into a fixed intermediate frequency, at which demodulation may take place.

I-f Selection

The selection of intermediate frequencies for superheterodyne receivers involves careful attention to the required and realizable mixer bandwidths, image rejection criteria, demodulator circuit capabilities, and tuning constraints. These various considerations tend to be mutually exclusive, but it has been shown[5] that for narrowband systems, a reasonable compromise is achieved by selecting an intermediate frequency approximately one-tenth the frequency of the incoming signal. Although DOMSAT video hardly qualifies as a narrowband service, we can use the one-tenth rule of thumb to establish a starting point. For a 4-GHz input signal, this suggests a UHF i-f. However, the various demodulator circuits compatible with wideband FM video (quadrature detector, ratio detector, Foster-Seely discriminator, phase-locked loop and the like) are all most readily realized in the lower portion of the VHF spectrum. An obvious solution is to utilize dual downconversion, with first and second i-fs near 400 and 40 MHz, respectively.

In fact, numerous experimental DOMSAT video terminals have adopted the above frequency scheme, many employing UHF TV tuners for the second downconversion. The drawbacks to such an approach include the typical UHF tuner's restricted channel bandwidth, relatively high noise figure, and poor local oscillator stability. Nevertheless, when cost is the primary design constraint, these problems can be circumvented.

Not so readily resolved is the input filtering requirement which such a frequency scheme imposes. Assuming low-side first LO injection and top-channel reception, the first conver-

MX-4200 DOUBLE-BALANCED MIXER	
Input frequency	3.7–4.2 GHz
LO frequency	2.5–3.0 GHz
Intermediate frequency	1.2 GHz
Isolation	20 dB
Conversion loss	7 dB
LO-3000 VOLTAGE CONTROLLED OSC	
Output frequency	2.5–3 GHz
Output power	+7 dBm
Spurious rejection	20 dB
Tuning voltage range	3–10 V dc
Supply potential	+13.5 V dc
RF-1200 AMPLI-FILTER	
Center frequency	1.2 GHz
3-dB bandwidth	50 MHz
Gain	15 dB
Noise figure	2 dB
Supply potential	+13.5 V dc
LO-1270 LOCAL OSCILLATOR	
Output frequency	1270 MHz
Stability	±0.001%
Power out	+7 dBm
Spurious rejection	40 dB
Supply potential	+13.5 V dc
MA-1200 MIXER-AMPLIFIER	
Input frequency	1200 MHz
LO frequency	1270 MHz
Intermediate frequency	70 MHz
Conversion gain	20 dB
3-dB bandwidth	40 MHz
Supply potential	+13.5 V dc
Isolation	20 dB

Table 2. Typical parameters for conversion modules.

sion will generate an image frequency which falls a mere 300 MHz below the bottom edge of the downlink passband. An input filter capable of providing adequate passband flatness and minimal insertion loss over the 3.7- to 4.2-GHz band is unlikely to provide adequate image rejection if a 400-MHz first i-f is utilized. One may wish to raise the first i-f high enough to separate the image frequency band well away from the downlink passband, thus simplifying input filtering.

In fact, if the Low-Noise Amplifier (LNA) which precedes the receiver utilizes a waveguide input, then an image filter already exists. Rectangular waveguide is a high-pass transmission line. If low-side first LO injection is used and the first i-f is carefully selected, the LNA's waveguide input will itself reject the image frequency.

Most commercial LNAs utilize an EIA standard WR-229 waveguide input. This guide has a lower $TE_{1,0}$ cutoff frequency near 2.5 GHz. This cutoff frequency is about 1.2 GHz below the bottom edge of the receiver's required passband, so input losses will be minimal. But a first i-f of, say, 1.2 GHz, will place the image frequency as far *below* cutoff as the input passband is *above* cutoff. The image thus ends up quite far down the waveguide high-pass filter's skirts, and may effectively be ignored.

True, the fixed 1.2-GHz first i-f requires that the first LO be tunable, but we mentioned earlier that it's far easier to tune a single oscillator for channel selection than a bank of filters. And even at the top of the downlink passband, where the first LO must be tuned up to 3 GHz, the image at 1.8 GHz is sufficiently far below cutoff so that a 12-cm long input waveguide will afford on the order of 60 dB of image rejection.[6]

Another signpost pointing to the selection of 1.2 GHz as a first i-f is realizable amplifier Q. The 3-dB bandwidth of the i-f amplifier string must be greater than or equal to the 20-dB channel bandwidth in order to avoid unduly attenuating significant sidebands. Assuming a channel bandwidth of 40 MHz and an i-f of 1.2 GHz, this dictates an effective first i-f Q of 30. This value is readily realized with microstripline circuitry.

Despite the obvious economic advantages of the modified UHF TV tuner conversion scheme, it was decided to employ a 1.2-GHz first i-f in the Microcomm DOMSAT video receiver. But what of the second i-f—is it similarly constrained by the wide downlink passband? Actually not. With channel selection occurring in the first downconversion, the second i-f need only be wide enough to accommodate a single video channel. Downconverting the 1.2-GHz first i-f to any desired VHF frequency will allow ample second-conversion image rejection with simple i-f filtering while providing adequate bandwidth to pass the 40-MHz composite.

Since the communications industry has long utilized 70 MHz as a standard i-f for microwave links, it was decided to employ a 70-MHz second i-f in the DOMSAT video receiver. This makes it possible to utilize any of the readily available 70-MHz wideband FM i-f strips to demodulate the video information.

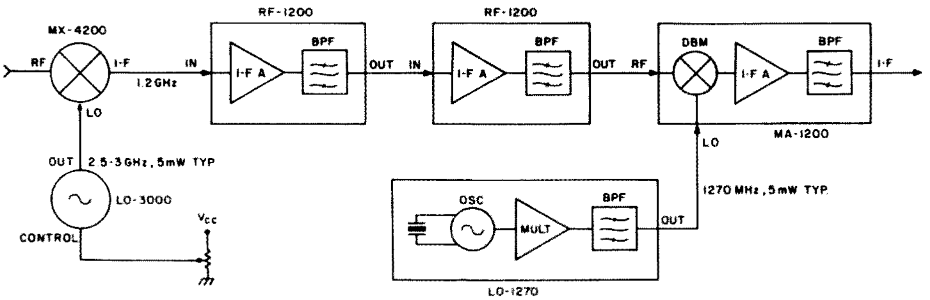

Fig. 3. Block diagram of the heterodyne downconversion portion of the DOMSAT video receiver. Shown at left is the 3.7- to 4.2-GHz input terminal from the LNA and feedline. The 70-MHz i-f output at right feeds the baseband demodulator and processing circuitry (see Fig. 7). The potentiometer shown at the lower left represents the resistive voltage divider which tunes the first LO for channel selection. Gain partitioning of the various blocks is discussed in the text.

Gain Distribution

Gain partitioning for the DOMSAT video receiver depends upon the available power from the satellite, the threshold sensitivity of the demodulator circuitry selected, and the gain of the receive antenna utilized. It has been shown that for the illumination contours typical of most North American DOMSATs, an optimum private-terminal antenna will exhibit on the order of +41-dBi gain.[7]

Given the EIRP and path loss numbers listed in Table 1, it appears that the signal level available to the LNA will be on the order of −90 dBm.

The input threshold for a typical phase-locked loop (PLL) integrated circuit operating as an FM demodulator at 70 MHz is on the order of −20 dBm. This suggests that between the antenna and the demodulator, roughly 70 dB of conversion gain is required.

There are three sources of gain available between the antenna and the PLL. These include the LNA and first and second i-f amplifiers. There are, similarly, three sources of loss in the system: the insertion loss of the transmission line which connects the LNA to the receiver, and the conversion loss of the first and second mixers. For a typical home installation, the feedline insertion loss may be on the order of 6 dB, and if double-balanced diode mixers are used for the two frequency conversions, it is safe to assume that the conversion loss of each will be on the order of 7 dB. This suggests that the overall gain of the LNA, first, and second i-f amplifiers will need to total 90 dB for adequate DOMSAT video reception.

In the interest of maximizing system stability and dynamic range, it is desirable to distribute the required 90 dB of gain uniformly between the rf and two i-f frequencies. A 30-dB gain LNA is clearly feasible at 4 GHz and would require three stages of GaAs FET amplification. This amount of LNA gain is sufficient to adequately mask the noise temperature contribution of the feedline and receiver, allowing the low-noise temperature of the FETs to predominate.[4] Similarly, it is practical to achieve the desired 30 dB of 1.2-GHz gain by cascading two stages of ion-implanted silicon bipolar transistor amplification. At 70 MHz, the required gain is readily available from thin-film wideband gain blocks produced by a number of different vendors.

A block diagram for the dual downconversion portion of the DOMSAT video receiver, partitioned in accordance with the foregoing discussion, is shown in Fig. 3.

Construction of Conversion Circuitry

During the initial system-development phase of any new product, it is common practice to build a number of different amplifier, mixer, filter, and oscillator circuits, each connectorized for coaxial input and output and with each circuit separately boxed and shielded. A modular developmental system provides the engineer with the flexibility of changing one or more circuits without having to disrupt the rest of the system. Microcomm's earlier efforts at modular receiver development have been documented previously.[8]

But modularization has advantages for a production system as well. If every function represented by a block in Fig. 3 is implemented in a separate, shielded module, then isolation between stages is maximized and the cross-talk and stability problems associated with stray rf coupling can be eliminated entirely. Further advantages are realized in the area of maintainability. Should a receiver fail, fault isolation by module sub-

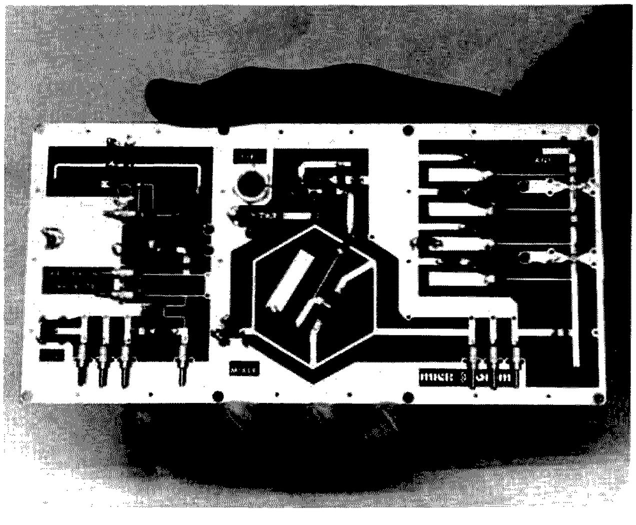

Fig. 4. Typical microstripline circuit module used for satellite video downconversion. Each module in the receive system is mounted in its own shielded enclosure, and all are interconnected via coaxial cable as discussed in the text.

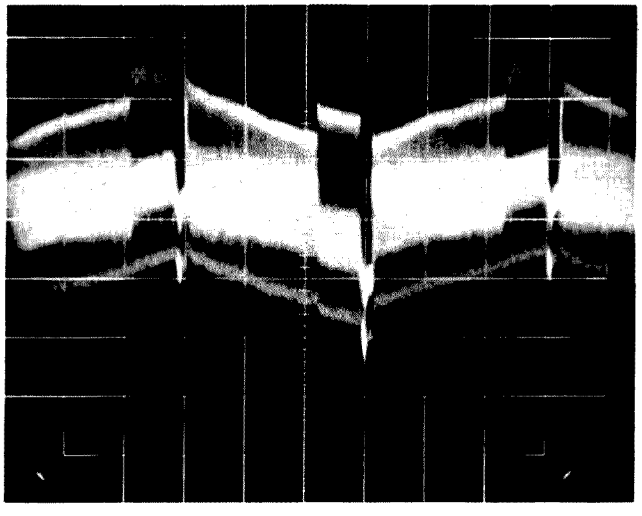

Fig. 5. Baseband output of the PLL demodulator. Presence of the energy dispersal waveform on the video composite is evident.

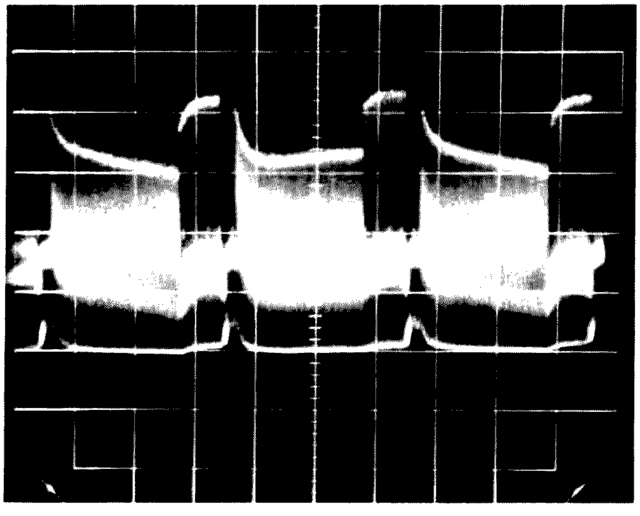

Fig. 6. The dc restorer is simply a diode clamp circuit which removes from the video waveform any vestiges of the energy dispersal waveform seen in Fig. 5.

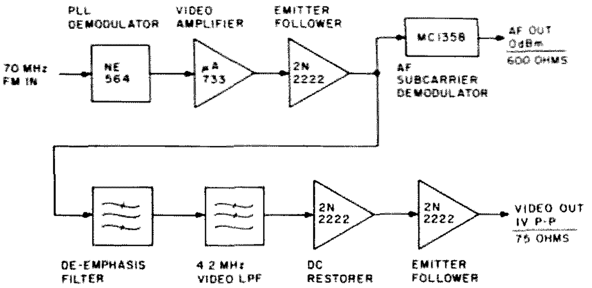

Fig. 7. Block diagram of the complete baseband processing portion of the DOMSAT video receiver. The above circuitry is driven by the output of the downconversion module set (see Fig. 3), and provides standard 1-volt video and 0-dBm audio outputs to an external modulator, studio monitor, or video tape deck.

stitution becomes a viable troubleshooting technique. And, of course, a modular system maximizes user flexibility by allowing customers to assemble from standard modules a custom system designed to meet their precise needs.

The specifications of the modules developed to implement Fig. 3 appear here as Table 2. Each of these modules employs microstripline construction, as shown in Fig. 4, to minimize component count and assure duplicability.[9]

Baseband Processing

Before the wideband FM composite shown in Fig. 2 can be displayed, several processing steps are necessary. The 70-MHz i-f signal will, of course, be demodulated first, and this may be accomplished readily by using a monolithic PLL in a standard circuit.[10] The output waveform from the PLL will contain both the video waveform and the modulated audio subcarrier, but superimposed on these will be found the 30-Hz triangular energy dispersal waveform added to all DOMSAT downlink signals as an interference reduction technique. This waveform is evident in the oscilloscope display in Fig. 5.

Prior to attempting to remove the energy dispersal waveform, it is desirable to amplify the rather feeble video level available from the PLL demodulator, and this may be accomplished using a single monolithic TV video-amplifier IC. Next, an emitter-follower permits splitting off the 6.8-MHz audio subcarrier for demodulation in a standard TV sound i-f microcircuit, whose associated circuitry is modified slightly for compatibility with the higher carrier frequency and peak deviation used on satellite audio.

After passing through a de-emphasis filter and passive video low-pass filter, the video waveform may finally be applied to a diode clamp circuit which will remove the energy dispersal waveform (see Fig. 6). An emitter-follower then establishes the desired 75-Ohm video output impedance to drive recording or display circuitry, as required.

A block diagram for a complete baseband processing subsystem is shown in Fig. 7. This circuit can be constructed on a single printed circuit board and incorporated into a complete DOMSAT video receiver by simply interfacing it to the downconversion circuitry shown in Fig. 3.

Fig. 8. The video output of the baseband unit, displayed on a TV set with the aid of the rf modulator in a video cassette recorder. Most DOMSAT viewers find the clarity and resolution of satellite video clearly superior to network video which is distributed by multiple terrestrial microwave hops.

Display Options

An ideal DOMSAT video receiver for the home Earth-station market would provide an intercarrier audio, vestigial sideband rf output for direct interface to the user's VHF TV receiver. Such an rf output may readily be realized by using any of the available video modulator microcircuits developed for the TV game and home computer industries. In fact, the video and audio levels available from the baseband unit shown here are entirely compatible with such modulators.

Unfortunately, incorporating an rf modulator in a commercial DOMSAT video receiver would subject the entire receiver to FCC type acceptance in the United States. As more than one home computer manufacturer has discovered, the type-acceptance procedure is burdensome in the extreme, with bureaucratic delays often precluding a timely market entry. In addition, the resolution and clarity of most of the available low-cost video modulators leave quite a bit to be desired, and rf modulation would tend to degrade overall video quality noticeably.

A possible solution would be to provide the user with simply a video and audio output from the DOMSAT receiver and allow him to display the receiver's output on a studio-quality TV monitor. However, few videophiles possess such a monitor, and the cost is prohibitive.

Fortunately, most videophiles do possess a videotape recorder (in fact, the owner of a home satellite Earth station would most likely find it impossible to function without one!) and the average video recorder contains an extremely high quality rf modulator. Allowing the user to interface his DOMSAT receiver to the TV via a video recorder provides an ideal solution to the type-acceptance dilemma. And those users who have no recorder are, of course, free to add an external rf modulator, any number of which are available in kit or assembled forms.

Equipment Availability

Once priced in the tens of thousands of dollars, DOMSAT video receivers are now being brought within the reach of the American consumer. The conversion modules shown in Fig. 3, for example, have, since late 1978, been available to the ex-

perimenter at $1000 complete, and to the OEM at significantly lower prices in production quantities.

It is expected that by the end of 1979, a complete, fully tunable DOMSAT video receiver, utilizing the above conversion modules and a baseband unit such as that blocked out in Fig. 7, will be available to the consumer for under $2000. This receiver will be fully packaged and assembled, including power supply, tuner, control circuitry, and inter-connecting cables. Such a receiver promises to make possible for the first time a complete, consumer-grade Earth station, including antenna and LNA, for under $4000. We can only begin to guess at the price breakthroughs which may follow! ■

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A Simple 2m/10m Crossband Repeater System

—work the world with an HT!

Bob Heil K9EID
PO Box 26
Marissa Il 62257

With the rules relaxation concerning the crossband repeater operation and the clearance of the Technician license holder to be retransmitted on an HF frequency (tnx to the OSCAR program), we have a terrific opportunity to use HF links on our two-meter repeater systems with not too much effort and one heck of a lot of fun. A whole new world can be opened up to those who really haven't gotten a taste of the HF bands as well as those of us who are out just to experiment and enjoy all the benefits from such a hookup.

MARC Does It!

The Marissa Amateur Radio Club, Inc., in southwestern Illinois, has a three-site, two-meter repeater which has three receivers, a quarter-kW transmitter, 50 voice-ID tapes, a time machine, and an open autopatch and gives a good 100-mile coverage on two meters with rubber duckies! The idea was generated when I listened to Carlos TI2CF with his ten-meter auxiliary link. The interface to do this with WD9GOE/RPT was begun. A Pace 1000M CB SSB rig was converted to 10 meters with the American Crystal Company kit. This worked out fine and gave us a good little 15-Watt rig tied to a TA 33 antenna. Next, we needed to build a COR (carrier operated relay) that would be activated by the Pace squelch, to key the two-meter transmitter. At the same time, a spare keying line had to be pulled off the two-meter repeater COR so that when the two-meter signal was received, it would key up both the two-meter repeater transmitter and the ten-meter transmitter. Simple. Really! (See Fig. 1.)

Not a Ten-Meter Repeater

One point that should be noticed is that this system is not a ten-meter repeater. That is to say that the ten-meter signals received are *not* retransmitted on another ten-meter frequency. The ten-meter signals are repeated *only* on two meters at the same time that the normal two-meter signals are repeated on two meters, so, in actuality, we have a simple ten-meter auxiliary link between two-meter and ten-meter receivers and transmitters.

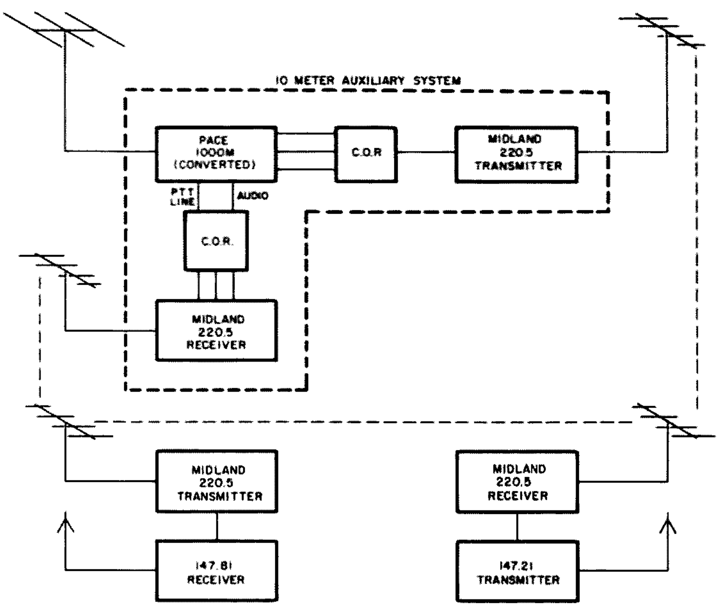

Fig. 1. Block diagram.

220 Link

The MARC group had a special problem that may not be relevant to most systems. This section may not really apply to your group, therefore, but it will show that this system is capable of a lot more, should your group want to carry it out further. The main receiver site for the 81/21 system is located 5 miles southwest of Marissa on a 250′ coal silo. The two-meter signals are relayed back to the 250-Watt transmitter, located in Marissa, over a 220-MHz link system using the Midland 13-509 equipment. The actual ten-meter link of WD9GOE/RPT is located at the home of K9EID. The

reason for this was twofold. The ten-meter system should be at the transmitter site, not at the receiver site, due to desense, etc., and the MARC group felt that very close tabs should be kept on the ten-meter link so that it was not abused. A Midland 13-509 transceiver was taken apart for link use, therefore (a great piece of gear for this service!), and used ahead of and behind the Pace 1000M so that all signals would pass from ten to 220 then to the two-meter repeater, and reverse. It sounds complicated, but it was very easy to do. Follow the block diagram and you can see how simple it really is.

If your group has a repeater system using cavities and duplexing, you can skip all the 220-link activities and wire the Pace straight through (see Fig. 4). One thought about the 220 link is that it also gives WD9GOE/RPT a 220-MHz link that 220 operators can get in and out of just as the ten meter operators are able to do, so we really got a lot of mileage from doing the extra link thing. It is not unusual to dial up the Marissa system and hear a QSO going on: one station operating on 147.81/21, another on 220.5, while another can be 1000 miles away talking to both of them on 29.590! That's communication! What is interesting is that some club members have only a 220 rig, some have only ten-meter equipment, and some have only two-meter equipment. All three of these can communicate very readily with no problem, and should you listen on any of the three frequencies, 99% of the time you would not be able to tell who was operating where or what mode they were operating. One thing that is interesting is that the SSB signals from ten meters come through the 220 and two-meter FM system, and you are hard-pressed to tell that that signal is not FM! Likewise on ten meters, it is *impossible* to detect that the SSB signal you are listening to is an actual FM signal except for one thing—the squelch tail! That sounds crazy on ten-meter SSB! (We recently modified the Motran receiver so that that blasted squelch tail is GONE!) The ten-meter link is no longer disturbed by the crashes!

Audio Coupling

The audio coupling has been done passively. An active limiter could be used here, but it was decided to try the passive route just for simplicity; so far, it has worked without any inherent problems. You perhaps will have to make minor adjustments of values to achieve linear audio response between the two outputs. Care also was taken at the audio inputs of both transmitters so that rf would not enter and cause undue problems. Bypass these audio leads with very small, .001 capacitors and, of course, use good shielded wire throughout.

COR Operation

The really good point about the Pace 1000M when used in this application is that it has a squelch circuit that works with the agc line and, therefore, will operate on SSB signals; this is something that most of the CB rigs will not do. Since the squelch does work on SSB signals, it makes it very simple to pull off a reference voltage, drive a simple COR, and use that to key up the two-meter transmitter. An interesting side effect of the Pace squelch is that since it does get activated via the agc line, a slight delay is noticed with the squelch, and that becomes our

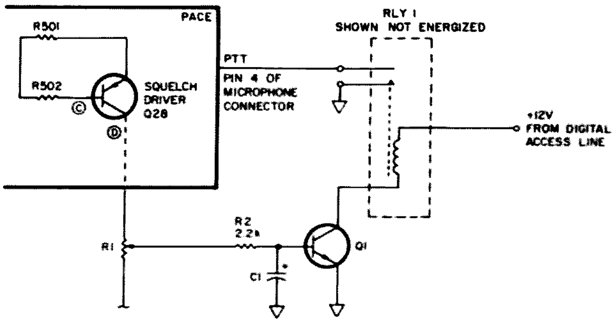

Fig. 2. COR for the ten-meter Pace.

2-second delay tail. It works well and was found to be adequate; delay circuits were not required to achieve the necessary hang time to allow things to switch over. (See Fig. 2.)

A worthwhile project for the two-meter repeater is a timer-reset beep. Without it, it is difficult for the two-meter operator to tell when the ten-meter signal dropped out (or turned the transmission over). With a reset timer "beep tone," the two-meter system is aware when the COR of the ten-meter receiver has been dropped. Because of the slight delay that the agc introduces, the timing is such that the COR does not drop out when the ten-meter SSB operator pauses for a breath between words. Pace certainly made things easy for us!

Choose Your Mode

As you can see quite easily, you can select the frequency and mode the ten-meter link will operate on simply by adjusting the Pace to those requirements. The MARC group at Marissa has chosen USB on 29.590. After spending much time and effort in checking with groups such as the 10-10 club, etc., 590 seemed out of everyone's way and has worked out well. The unit has, on occasion, been used on ten-meter AM further up the band. It would be an easy task to remote this procedure should you desire. With the great increase of CB conversion to ten-meter 29.6 FM, it might even work out for your group to use this mode if you have lots of ten-meter FM activity.

One of the interesting facets of the SSB mode is the absolute clarity when listening on two-meter FM. At first, one might ask, "How do you tune the ten-meter receiver?" The answer is that the repeater *never* is adjusted. It transceives (hopefully!) on the exact same frequency. The two-meter FM signals are patched to the Pace microphone input and are, of course, transmitted on ten-meter upper sideband. The ten-meter operator simply will tune in this USB signal as he normally would and, when it is his turn, merely transmits on the same frequency which the Pace receives and patches back through the two-meter FM transmitter. Easy.

CB-to-Ten Conversion

The first thing that you will have to do is get the Pace, or similar rig, working where you want it on ten meters. MARC used the American Crystal (American Crystal Supply, PO Box 638, W. Yarmouth MA 02673) conversion, and it

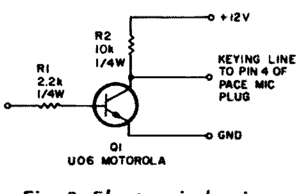

Fig. 3. Electronic keying.

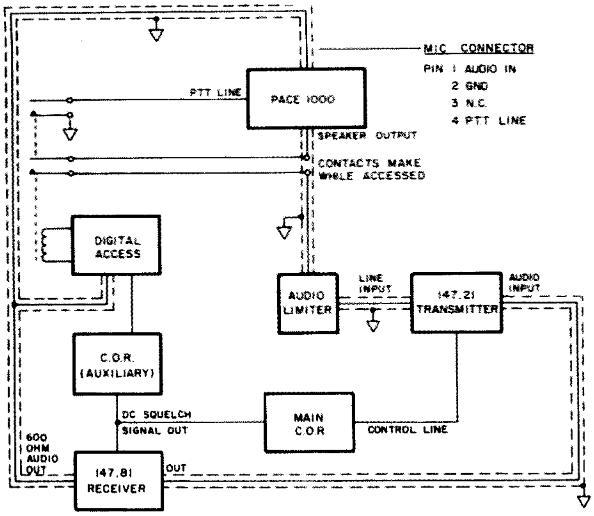

Fig. 4. Audio patching access control.

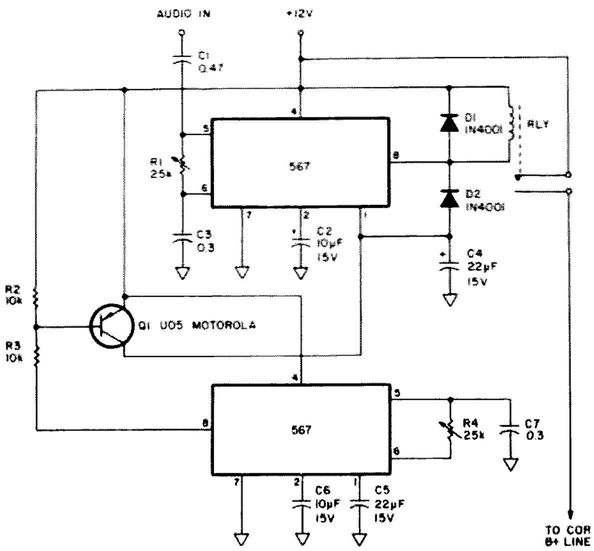

Fig. 5. Digital access.

took less than one hour to make the conversion and get the ten-meter rig on frequency.

A few modifications are available in the conversion kit that can be left out—mainly, the frequency expansion switches that allow a full one-megacycle coverage. By selecting the correct set of crystals in the kit, the Pace can be put on the frequency you have selected without the addition of the switches and cabling. American Crystal also recommends a modification that allows the "clarifier" to move the transmitter as well as the receiver. As long as you check the two frequencies very carefully and do not plan to move the ten-meter frequency, this modification also can be left out.

The COR pick-off point is taken from Q28. Fig. 2 shows the very simple, but very effective, COR circuit used to key up the two-meter transmitter. Spare contacts on this relay can be used for various other applications which may suit your particular needs. This one connection is the *only* connection that has to be made inside the Pace. Everything else is done from the speaker jack and microphone jack. Should you desire local audio from the Pace, you may want to install a switch (or wire the speaker jack permanently) to keep the speaker operational with a plug inserted into the speaker jack. Normally, the speaker wire is disconnected when a jack is plugged in. Since we will pull the ten-meter audio from this jack, you will not have any local speaker audio unless you make this change.

Two-Meter COR

The Pace will need only a ground to transmit for the PTT circuit, which will be tapped off at the microphone front-panel plug. If you do not have any spare contacts on your two-meter COR, parallel another relay across the main COR and away you go. You also could use electronic switching here to save you the problems of installing a separate relay. Look over this auxiliary circuit in Fig. 3. Fig. 4 shows the actual audio patching in and out of the two-meter repeater. It is very important to use good shielded cable with proper rf bypassing to keep the audio lines free of any stray rf that may occur when installing the additional equipment.

Access Equipment

Access to the ten-meter link can be accomplished in many ways. The simplest method is to use a telephone line with proper equipment to allow a control operator (or operators) to dial up the proper codes to complete the access link in the two COR circuits. (See Fig. 4.)

With digital circuitry today, it is very simple to come up with an easy access system for the ten-meter link. The only thing that the access equipment has to do is connect the 12-volt dc line to the COR circuits. With the 12 volts removed, power can be left on the Pace continuously, and even though there may be signals received on the ten-meter frequency, the COR will not bring up the two-meter system, or vice versa. By allowing the access equipment to connect the 12 volts to the COR, the ten-meter link then becomes active. Fig. 5 will give you a simple digital access to the system. We really don't need to go into great detail here because almost all of the repeater systems have some kind of access control for other functions and it should be easy to tie in the ten-meter access to this existing logic.

The only problem that your group may encounter, should you use ten-meter access, is that there is no really good foolproof access through ten meters. The MARC ten-meter group feels that the *only* access should be on two meters; a great many problems are eliminated while a tighter control can be kept on the system.

An Alternate Control System

Carlos TI2CF has an Icom 701 linked to a Spectrum two-meter repeater via a regular phone patch system, like the Data Signal RAP 200. This system controls the audio of the 701 just as it would the telephone line. To use this system, a member of the group accesses just as he would if it were a phone patch, only when this occurs, the ten-meter link will come up. When the two-meter station transmits, the patch circuitry keys the PTT line of the ten-meter transmitter. When the two-meter station listens, the ten-meter receiver audio is patched to the two-meter transmitter. The only problem with this system is that the two-meter transmitter would be keyed up con-

stantly (as it would when any patch logic is accessed). Should someone access the ten-meter link and *not* bring it down, the two-meter repeater stays on until someone brings it down. This system does allow the two-meter operator to switch the ten-meter link audio by simply pushing his or her mic PTT button. The ten-meter station received would not control any relays or controls. The system would work just like a phone patch but, of course, without the phone lines and actually substituting a ten-meter (or 20-, or 40-meter!) transceiver for the phone lines.

This system has some advantages but also needs additional equipment that groups may not have, nor could round up the finances to obtain. It also has some disadvantages for control, so your group will have to select the method that best suits its needs.

The Marissa system at WD9GOE/R has been in use since March, and many excellent contacts have been made by many members of the group as well as by dozens of interested newcomers that the system has attracted. It becomes very exciting to work Venezuela from southern Illinois on a Tempo S-1 HT with the rubber ducky! It is also very exciting to foreign stations when they discover what they are working! The system has brought the entire St. Louis area to its feet, and, again, attention to amateur radio is gained through simple technology, some imagination, and a few hours of hard work. This is only the beginning. Let's all get to work and see where we can go from here. It's all for amateur radio! ■

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Audio Booster for Mil-Surplus Receivers

—a must for headphone haters

One of my biggest pet peeves with military surplus radio equipment is the low audio output of some sets. And that is the one big problem with the R-648/ARR-41 radio receiver that I converted recently. (See "Another Surplus Treasure," *73 Magazine*, November, 1978.) This receiver worked fine with headphones, but not when the output transformer was changed for a speaker. If you have done much work at all with surplus radio equipment, you know what I am talking about!

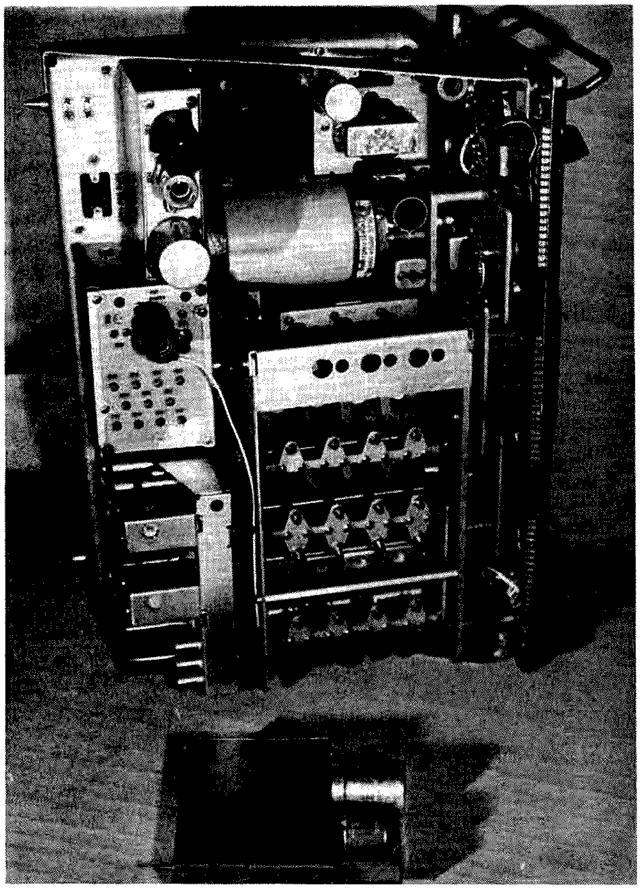

Photo A. Plug-in audio amp with rig.

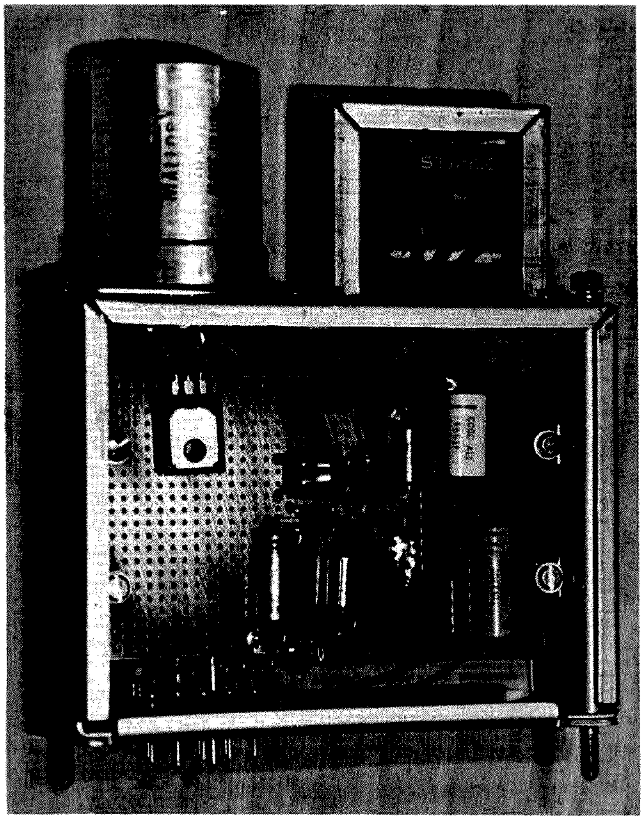

Photo B. Interior view of amplifier.

After studying the schematic of the audio stages, I saw that the best route would be to change the 5686 output tube to something heftier—like a 6AQ5. You could do it but for one

thing: Mounting the tube could create a height problem with the case. Also, you would upset the filament string in this series string set. So that was out.

The next best thing turned out to be a whole new audio amplifier, built from the ground up. This turned out to be a fairly easy job; an IC "building block" amplifier was pressed into service. It was possible to mount all parts in the module case, too, and the whole thing makes up a neat plug-in package. Oh yes, there is plenty of volume with a speaker now!

If you are working with other surplus sets and need an audio boost, this amplifier may do it for you. It is cheap to build, takes little room, produces little heat and creates a heck of a lot of volume. You are welcome to try it in your own unit; in this article, however, I will concentrate on the R-648 receiver conversion.

Before getting started with the actual wiring, let's take a look at what is being modified in the R-648. If you check out Fig. 1, you will see a simplified diagram of the receiver's audio section. Basically, you have two stages of gain (5814) and a stage of power (5686). The 5686 tube is the bottleneck here. The tube just won't draw enough plate current for any real power output, and is a poor choice for an audio output, especially since it sits there and draws 300 mA at 6.3 volts. It's a better heater-dropping resistor than output tube!

Note particularly the cathode connection of the first audio stage. Resistor R1305 is in series with the tube cathode and a pot on the front panel. This is the volume control. It is unique in that no audio signals pass down it, preventing hum pickup, yet making shielded cable from the volume control unnecessary. This is called a "dc volume control" and is used widely in IC-generation TV sets today. It is important to us because we are going to use it in our modification.

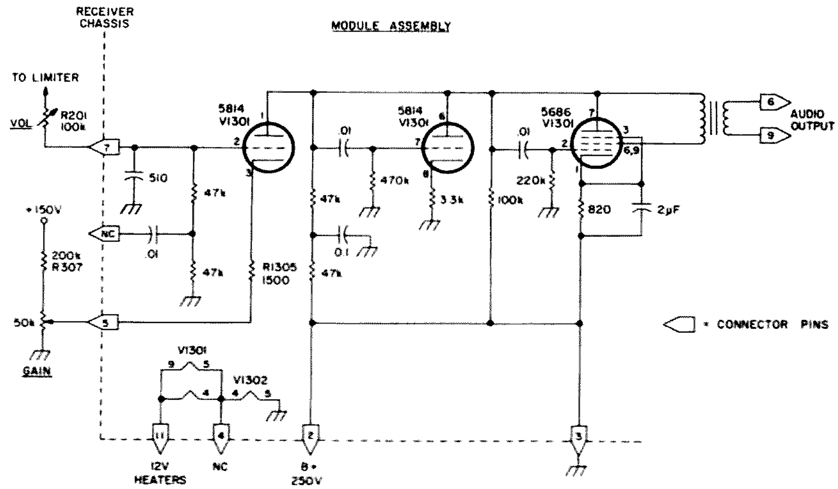

Fig. 1. Existing audio section of R-648.

The schematic shows what goes in place of the two tubes: two low-cost ICs. One IC you are probably familiar with—the National LM-380. This is the 2½-Watt power amplifier job. It is a natural for this job. The other one is a little less known, and that's too bad, because it is very useful. This IC is the Motorola MFC-6040 or Motorola HEPC6009. It is an electronic attenuator. It attenuates a signal when either a resistor to ground or voltage is applied to a control pin. There is no gain added, just attenuation. A simple 12-volt power supply rounds out the modification.

Construction is easy. I would suggest, however, that if your R-648 still has the tube filaments wired for 24 volts, leave the tube filaments in the audio module wired up. This will make sure that the other tubes get the proper voltages. One good advantage, besides the fact you eliminate several power resistors, is that the tubes can be bad. Just the filaments have to be good.

The photos and the schematic tell the construction story pretty well. I must add that I rewired the filaments in my receiver for 6.3 volts, so I was able to mount all parts in the schematic on the original module. This made a neat package. If you leave in the tubes, as required for the old 24-volt filament string, you will have to mount the power transformer elsewhere. I might add, at this point, that I tried a half-wave rectifier and filter directly from the 24-volt filament supply, but I had to supply a huge amount of filtering, and I had to drop the voltage to IC3 (voltage regulator) because it exceeded the chip's ratings. In the long run, a separate transformer for the audio amp power supply takes up less space, reduces construction frus-

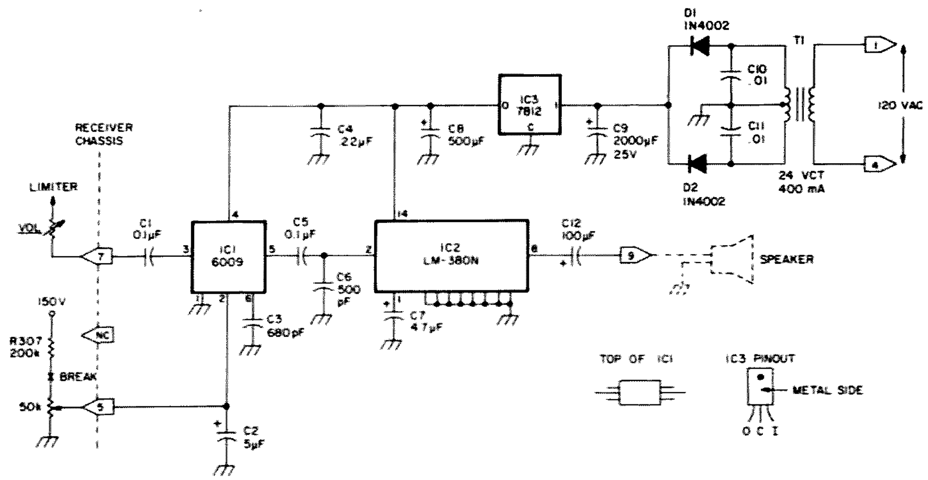

Fig. 2. Schematic diagram.

Parts List

C1, C5—0.1-uF disc or mylar® caps
C2, C7—4.7- or 5-uF, 16-volt electrolytic caps
C3—680-pF disc cap
C4—0.22-uF mylar cap
C6—500- or 470-pF disc cap
C8—500-uF, 16-volt electrolytic cap
C9—2000-uF, 25-volt electrolytic cap
C10, C11—0.01-uF disc caps
C12—100-uF, 16-volt electrolytic cap
D1, D2—1N4002 rectifier diodes
IC1—Motorola HEPC6009 or MFC-6040 attenuator IC
IC2—National LM380N power amp IC
IC3—7812 voltage regulator; 12 volts at 1 Amp
T1—24 volt c-t, 400-mA power transformer

tration, and possibly is cheaper.

I started construction by removing all components from the audio module, save the connector. Inside, I mounted a piece of copperclad "ground plane" perfboard, which serves as shielding and a heat sink for IC2. You don't have to duplicate this method of construction—copperclad perfboard is rather expensive—but at the least you must solder some kind of heat sink to the *grounded* leads of IC2. Two pieces of shim brass cut to size will do fine.

IC3 does not have to be heat-sinked, as its power dissipation is very low. You can see this IC in my unit mounted upside down under the filter capacitor.

The rest of the construction is noncritical and needs little comment. You might want to shield the input lead around C1 to the connector to cut hum pickup, though. In my unit, the 120 volts ac for T1 went to pins 1 and 4 of the connector. If you must leave the tubes in, you will have a wire connected to pin 4. This wire is not used inside the set, so cut it off inside the module and use pins 1 and 4 to carry the 12 volts from the added power supply to the audio circuitry. (Mount T1, IC3, etc., on the receiver chassis.)

After you have rewired the module, you will have to make a few additions on the main chassis. In my case, I ran 120 volts ac to pins 1 and 4 of the audio module chassis socket. If you kept the tubes in as ballast resistors, you will have to build the 12-volt power supply externally, and feed in the regulated voltage through the proper pins. After that is done, you must make one more change. Resistor R307 on the front panel must be disconnected or the attenuator IC will receive B+ through the *gain* control. This should be very easy. Unlatch the front panel and look at the rear section of the gain control. In my receiver, there was a yellow wire tied to the CW or far left-hand lug on the control. I cut it and I was home free.

After these modifications were complete, the receiver worked fine, and with room-filling volume! I haven't tried this modification on other surplus sets, but it should work if the proper power-supply voltages are available. And, oh yes! This conversion has other benefits, too. Besides a dramatic increase in volume, and less heat, the dc volume control can be switched and used as part of a squelch or noise blanker scheme. Or, how about a Selcal system? ■

Reader Service—see page 259

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Working with FETs

—part II: experiments with gain and supply voltage

In part I of this article, I began a discussion of audio amplifiers which use the FET, the transistor that thinks it's a tube. Let's continue by examining more of the functions these devices can be made to perform.

The triode FET small-signal voltage amplifiers are probably the all-time easiest circuits for a tube person to work with. This is one place where your tube-thinking will fit right in almost without change, and yet you will be working with solid state.

The circuits are straightforward, easy to duplicate, and the testing is nothing out of the ordinary. For basics, as with some of the other articles in this solid-state series, a microphone, audio signal generator, VOM, and scope are what you need.

It will help if you have a good junk box of small parts or a resistance sub box. Part of the fun on this one is watching what really happens when you play around with the values.

Here goes. Fig. 1 shows a basic triode tube voltage-amplifier stage. Notice that there is no cathode resistor. This stage would be a common first stage for a mike amplifier in an SSB rig. There are other uses for such a stage, too, but the important thing to note is the absence of the cathode resistor.

In theory, it looks as though the stage is running without any grid bias. There is a tiny smidgen, however; it is caused by "contact potential." The stage is able to get away with it because the input signal is assumed to be so small that the stage is still operating on a linear portion of its tube curve. The amplified signal is sent to the next stage, which is very similar but usually has the cathode resistor.

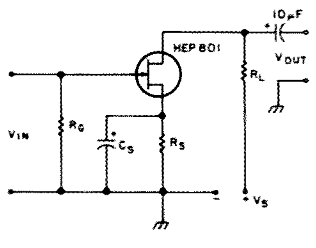
Our tube stage has a few other points about it. It is high impedance. (A tube is voltage-operated, that is, high impedance.) Notice that the grid resistor is 1 megohm. The load resistance of such a stage is often in the 100k to 220k range. A high signal output voltage is developed across the output resistance, but this is at very low power. The current may be on the order of a few mils or so.

Fig. 2 shows the same amplifier with an FET as the triode. This test circuit uses the Motorola HEP801. This is an "N" channel FET. That means it is roughly the same as the NPN bipolar transistor, as far as bias polarity goes. In fact, you hook up the voltage the same as for the tube; you just use less of it and only one supply.

The specs say a maximum of 20 volts between any of the elements. The maximum drain current is 15 mA. That's not much in the way of power, but it's not meant for power. While it can go to 20 volts at the drain, this series is geared to 12 volts, so we have some built-in safety margin.

There is one other mechanical oddity with the 801 which should be mentioned. There is a fourth pin which connects to the case. This is for shielding. For test use you can ignore it. If you want to be fancy, ground it or connect it to the source pin. You will do this anyway if you use it in an IC matrix board as I did.

Here's where the fun starts. Usually with solid state you have to fuss about the parts' values. This is the gizmo that thinks it's a tube. Let it think that. Use the same 1-meg resistor at the gate, since this is not critical at all. As with a tube circuit,



	R_G	R_S	R_L	C_S	V_S	V_{IN}	V_{OUT}	GAIN	Db
A	1M	NONE	2.2K	NONE	12VDC	1.5 P-P	6V P-P	4	12
B	1M	2.2K	15K	NONE	12 VDC	<1.5P-P	6V P-P	4.6	13.2
C	1M	2.2K	15K	10μF	12VDC	0.4 P-P	6V P-P	15	23.5
D	1M	2.2K	15K	10μF	20VDC	0.2 P-P	6V P-P	30	29.5

Table 1. Circuit performance test results.

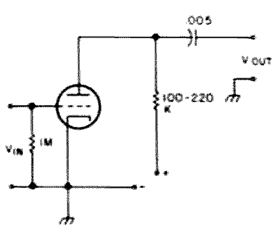


Fig. 1. Triode tube voltage amplifier stage.

250k on up would be common, and the circuit will work with much more and much less.

The next thing to fuss with is the drain load resistor. Use your substitution box and click your way down. With the mike input, at some point you will begin to get it to work. Then watch the scope and prune for best results. You might put your VOM in the drain circuit to watch the current; it's educational. The circuit should only draw a few mils. By the time you start to draw much current, you can see the performance fall off on the scope.

The drain resistance is not that critical, and a wide range of values wi]l work. This is a wide-range circuit. When it was tested above and below 12 volts, it worked from 5-20 volts. It might work at even less, although my supply would go down only to 5.

If you work at it, you may be able to get clipping with the mike, but here is a nice time to try adding an audio signal of some sort, and it would be nice if it was adjustable—or you can add a standard tube-type volume control as in Fig. 3. Just keep the input signal to less than 20 volts p-p.

I started with the theory that the operation would be quite similar to the tube version, but there was quite a surprise when I started comparing the data. With the simple circuit, your only variable is the load resistor. This gets adjusted for most output voltage. This may not be clipped. Once you get the most output, adjust the input signal until the output is undistorted. That will be your best value. Check a few resistance values on either side to make sure, though.

With my HEP801, this worked out to a 2.2k-Ohm

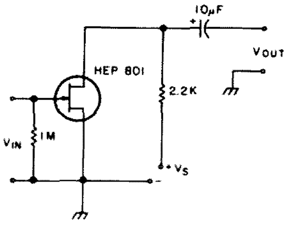


Fig. 2. FET triode circuit.

load resistance at a 12-volt source voltage. It gave a 6-volt p-p output. Then I added the source resistor. I had to go back and readjust the drain load. The values are not critical, but I settled on a source value of 2.2k and a drain value of 15k (Fig. 4).

This also got me an output of about 6 volts p-p. I had hoped for a clearer parallel to tube operation, but I don't really see it on the scope. With the tube, a cathode resistor would allow for more input voltage swing before distortion, but I really saw little difference between the two FET circuits. The scope values were about the same. The input distortion point was about the same, and I could get the same general output. So much for theory.

The oddest effect was when I added the bypass capacitor (Fig. 5). With a tube, this would have increased the bias and the output. It did increase the output to about 10 volts p-p, but it was clipped. All I could get was about 6 volts peak-to-peak from the circuit, but the resistor-capacitor circuit had more gain. What it did was lower the input distortion point. In other words, I could not have as high an input signal,

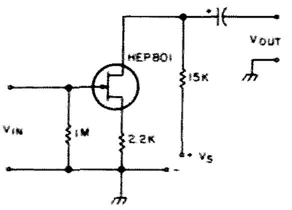


Fig. 4. Source resistor added.

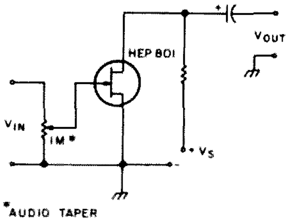


Fig. 3. FET volume-control circuit.

but the circuit would give me the same output with less input.

Rough scope measurements placed it at over 9 dB gain over the other two circuits. Thus, it is far more sensitive, but easier to overload. I used a 10-uF capacitor, but a higher value would be better, something from 20 to 100 uF.

The statistics of these circuits are somewhat alarming. They don't behave quite the way I would have expected. Table 1 shows a chart of various operating conditions. The first three have an operating voltage of 12 volts at the source; the last is 20 volts at the source. For this test, the input voltage was adjusted for an output of 6 volts peak-to-peak, and then the input voltage was measured p-p.

The output was divided by the input and the gain figured and converted into dB. In each case, the circuit was optimized for output in each configuration, with the circuit values shown being chosen. The no-resistor circuit would take a higher input, but needed a high input to get the 6 volts out. Its gain was

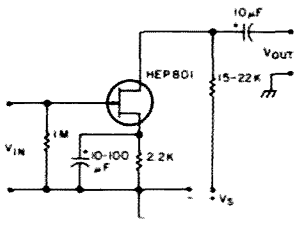


Fig. 5. Highest sensitivity and gain circuit.

only four.

The unbypassed resistor circuit was only slightly better. The bypassed resistor circuit not only had the best sensitivity to a weak signal, but also had much better gain. When the voltage was raised, the output voltage could have been more, but even holding to our present value, the actual gain of the circuit increased even at the lower levels. I was surprised at the difference in gain figures between the no-resistor and bypassed-resistor circuits. The other tests, such as for total output and distortion from overload, did not show up such a wide difference in actual circuit performance.

The low-gain high-input circuits would be the choice where you had gain to spare and needed high input capability. For most uses, you will probably want the bypassed circuit so you get some actual gain in signal and the ability to be sensitive. It was also unexpected that the gain of the circuit would increase with the increase in voltage to it. It was not just a matter of more possible output; the circuit worked better at the higher voltage when it was optimized for it. Still, I would have to recommend staying at the 12-volt or so level so as not to throw away your safety margin.

In actual fact, these circuits are not really optimum circuits as far as gain goes. They are useful when you want the FET capabilities, but other transistors can perform the gain function better.

These rough tests may not show the whole story. After all, it was a high-level input signal I was using, but these were intended to be rough-and-ready circuits to work with. There might be reason to use the source resistor even if the

capacitor was not required. This would not be the highest gain, but would be the most stable. Besides being the best as far as input overload, you also have the stabilizing effect of the extra resistor. It will prevent any problem with the drain circuit trying to draw too much current. It's unlikely, but it will give protection. It also may help stabilize the stage and even out operating variations as a tube does—but it just doesn't show on the scope.

I chose the 801 because it is commonly available. There are plenty of other audio FETs which should work with these circuits, and you may want to, or have to, prune values for best results. The same techniques will work with any FET. You should keep in mind that there is a built-in brick wall. After a certain point, you cannot have any more output voltage. In theory, you would run out of supply voltage to provide output, but you don't even get the full supply voltage swing, anyway. Past a certain point you are going to clip the peaks off because there is no additional voltage available to become output voltage swing.

The fact is, a lot of what you think ought to be available voltage just isn't there. Your output voltage swing is only what you have at the drain itself. These circuits are centered on 12-volt source voltage. That's at the power input, not what's at the FET drain. Even though the current is slight, the voltage measured at the drain terminal was just about 5.5 volts dc. That's all you are going to get as output voltage swing; even though the source may be more, it's what's at the FET that counts.

This brings up an interesting question. If that's all the voltage there is at the FET and all the voltage available for output swing, why not increase the source voltage?

Good question. When it was done, setting it to 20, the circuit worked even better, but the FET drain voltage was still only about 12 volts, which means an output voltage swing of even less than that.

What about increasing the source voltage until the drain voltage as measured reaches 20 volts, the maximum allowable?

Here, you face several design decisions. As a practical matter, if you wanted to try it, you would start with this circuit and increase the source voltage while measuring the drain voltage and current. When it reached the desired value, you would probably want to go back and try some different values at the load resistor. You would have to get a new best value for the higher voltage. This would mean some resetting of the resistor and the voltage, back and forth. You would arrive at the best values for your 20-volt drain voltage, though, if you use the method described here. It is likely that you would get increased performance, too, but there are drawbacks.

The first is the higher source voltage. You would need somewhere around forty volts. This series was geared to 12, since most equipment these days wants to use batteries if possible.

It also might be mentioned that my supply goes up only to 20 volts. This test would have been outside of the given specifications for the articles. There also is the matter of safety. Since the 20-volt maximum would be met by the higher source voltage, what effect would this have when you really started pushing out a 20-volt peak-to-peak audio signal? You would be running close to the ratings, which is not the best way to design.

Still, if the test setup is available and you are willing to risk a bargain FET or so, go ahead and try it. The basic monitoring procedure should tell you what is going on, and the test will give you an even more complete picture of the full capability of the FET. As to applying it in a circuit, that would depend on how you were going to power the final circuit.

Trouble with small-voltage amplifiers accounts for a great deal of the distortion problem in equipment. Input overload is common. Depending upon the type of amplifier, it may be biased to accept a certain input level and start to clip a peak because the bias is wrong for a higher level. That's why you find some circuits designed to handle a high-level input, even though it is intended for a lower-level use.

Musical instrument amps often have that feature. A guitar might work fine, but one with a built-in preamp would distort if the amplifier input circuit couldn't handle it. After that, it's a question of your output voltage swing. You may have lots of gain, but how much can you use before you get up to all the output voltage you can have and start clipping?

If you are looking for distortion, you can see these effects with your scope in a circuit. If you are building, you can build to take care of some of them.

Still, without even trying, we have opened the door to further developments of this simple circuit. They are easy to implement and have their own place in practical usage. We'll discuss them in part III of this article. ■

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Build this $50 Mini-Counter

—three-IC design goes to 135 MHz

Sooner or later, anyone who does much work with communications equipment discovers the need for an accurate frequency counter. Let's face it, crowded communications channels make knowing your frequency more important than ever. This is where this counter project comes in.

Would you like to have a counter that measures frequency up to 135 MHz and beyond—one that is pocket-portable with battery power to make accurate measurements simple anywhere? Of course you would! The Model 304 Communications Counter has these features and much, much more: a low price tag of about $50, easy, one- or two-evening construction, and a superior sensitivity from 4-mV rms at 27 MHz to 12-mV rms at 135 MHz with input protection.

The 304's battery drain is low enough (130 mA) that you get long hours of operation on a set of charged nicads. You get a frequency range of below 1 MHz to over 135 MHz, covering ham, CB, commercial, radio control, and TV frequencies. And, best of all, you can measure the frequency to within 100 Hertz of what the transmitter is putting out. If you are in a hurry, you can select a reading to within 1 kHz, and get five readings per second versus one reading per 2 seconds on the 100 Hz range. Accuracy can be up to ± 0.002% ±1 count if the counter is calibrated on a frequency standard. Now that you know what this counter can do, go out and look at units selling from twice to three times as much as this one. One wonders why no one has thought of this design before.

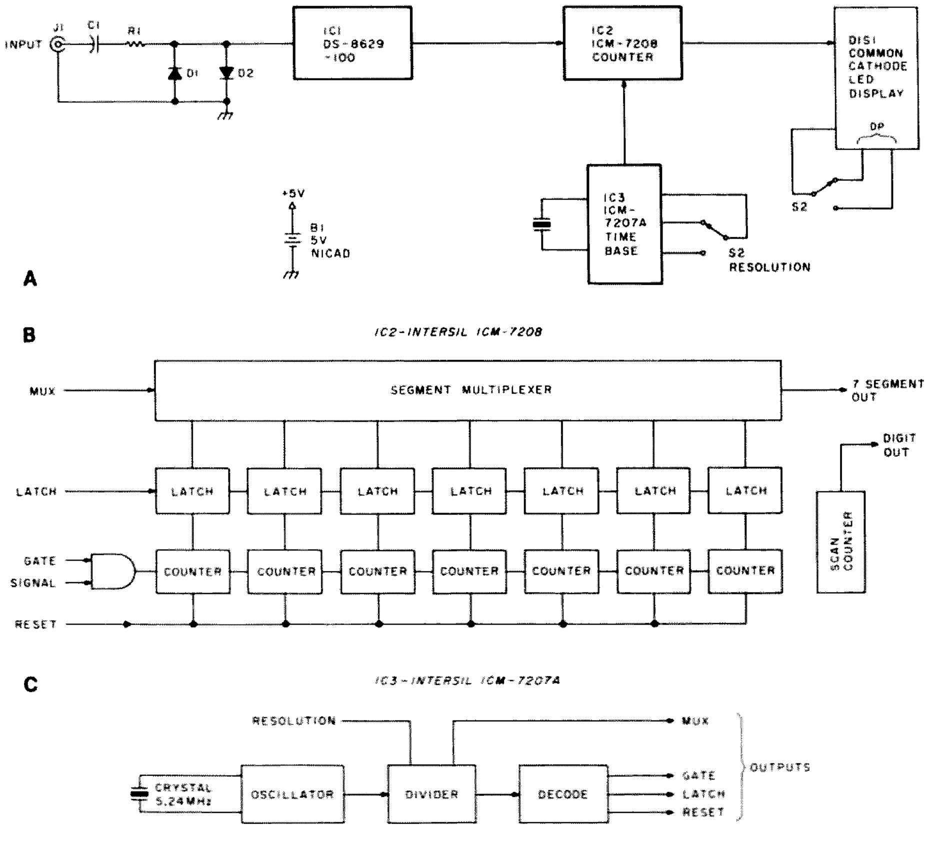
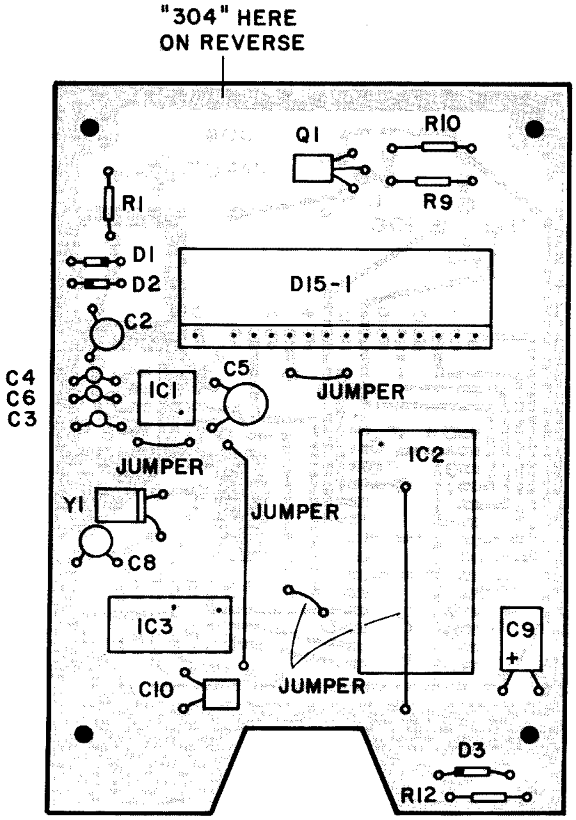


Fig. 1. (a) Block diagram of the model 304 counter. It features a 6-digit display, a 135-MHz counting range, and only three ICs. Power is supplied by a 5-volt nicad battery pack. Switch S2 selects either 1-kHz or 100-Hz resolution of the input signal. (b) Inside the ICM-7208 (IC2) counter array. (c) Inside the ICM-7207A timebase controller. An input connected to the divider section controls the gate time, and thus the resolution of the signal being counted by IC2.

Construction of this project will be a pleasant surprise because it is very

Fig. 2. Component side of the board. Be sure to get all jumpers installed before the sockets go in.



easy. Thanks to a clever PC board layout, this project uses only a single-sided PC board, making duplication from the pages of this magazine a snap. There are only six wire jumpers in the board—for those of you who hate to install jumpers. There are sockets for all ICs and a minimum number of components. Since there are only three ICs and one transistor, your construction time for the board should be about four hours of casual work. Add another evening for the cabinet work and you are all set.

The parts in this counter should be easy to get. The two main CMOS chips have been on the market for nearly three years, and the prescaler chip has been used for well over one year. The rest of the parts are not too critical. All parts are available from the surplus houses. To assist you, however, I am including addresses of typical suppliers of the key parts, plus the addresses of the manufacturers who make the ICs. If necessary, you can write for a local dealer's name and address.

How It Works

This counter project is based on three ICs: One amplifies and divides the signal by 100, another counts it up and displays 7 digits of information, and the third generates precise timing signals to control the second chip. Check Fig. 1 for details as you read.

Input signals applied to J1 first encounter a protection network composed of C1 (which blocks dc), R1 (which limits input current) and D1-D2 (which limits input signal). The purpose of this network is to protect the counter from "real world" overloads such as an accidental dose of excessive dc voltage, 120 volts ac, and excessive rf signal. This keeps IC1, the preamp/prescaler chip, safe.

Next, the protected signal goes to IC1. Although this IC was designed by National Semiconductor for synthesized FM stereo radios, it works great in a counter. It has a preamp stage for high gain which has sensitivity of up to 4 mV at 27 MHz, then a series of ECL (Emitter Coupled Logic) and low-power Schottky TTL dividers. It divides the input signal by 100, so 100 MHz in equals 1 MHz out. This is necessary because the counter-display chip to be described won't count a TTL signal much beyond 2 MHz.

The divided signal enters IC2, a CMOS/LSI chip that counts it and displays the results on an LED display. Fig. 1 shows a general overview of this chip. The signal from IC1 passes through seven decade counters. They count up the signal. After it is counted, the data is passed on to the display via the latches (one per decade counter), through the multiplexing circuitry, and on to the display. Actually, the multiplexing circuitry consists of a big data selector at the output of the latches, squeezing 7 digits (at least 4 lines each) into a single set of 7-segment lines. The latches hold the signal while the decade counters are reset to zero and count up the signal again. The latches are then opened allowing the new reading to pass through to the display. This prevents the rapidly changing decade-counter outputs from reaching the display and causing a blur of numbers. The sequence in which the count-latch-dis-

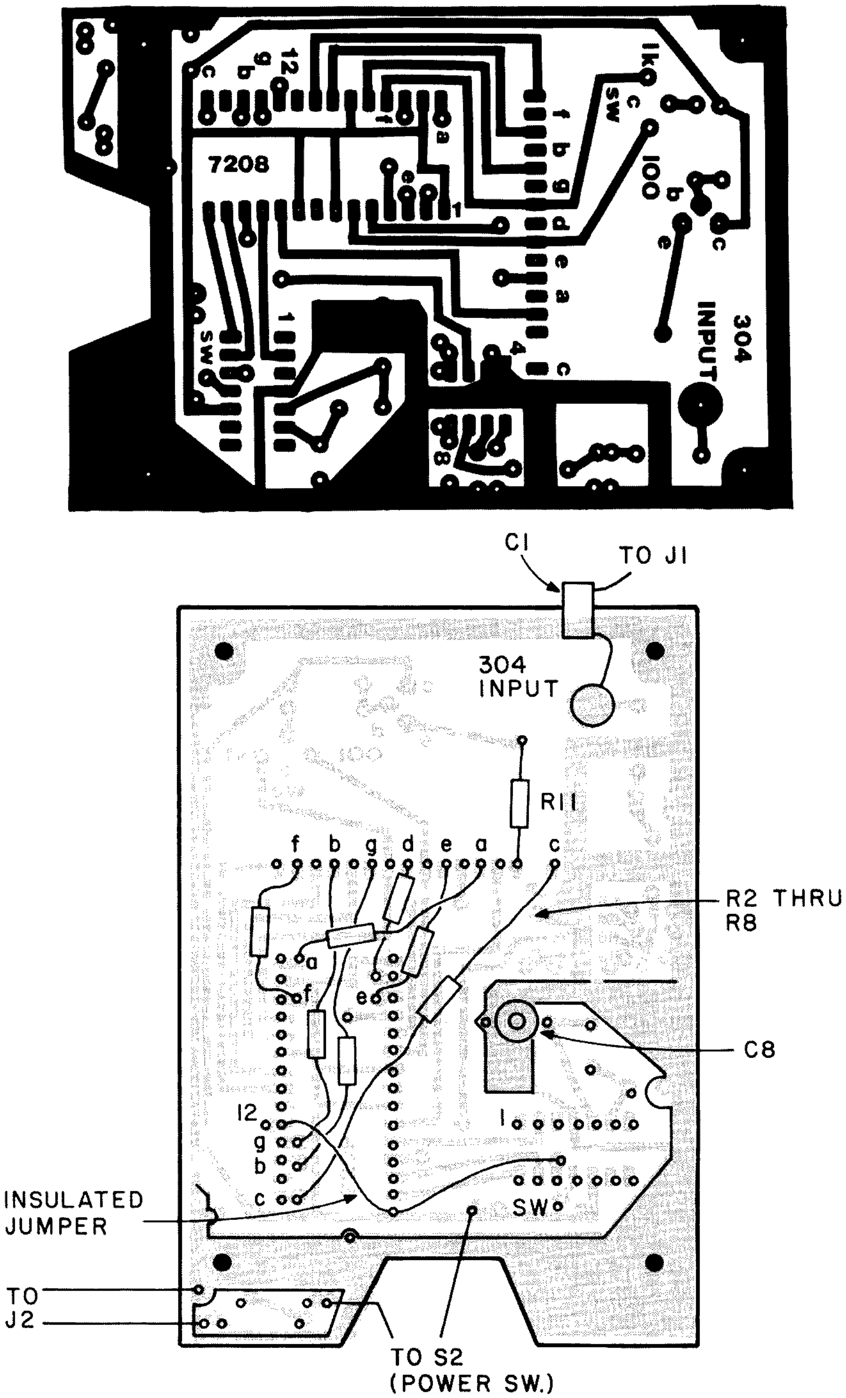


Fig. 3. Foil side of the board. Take your time and install those resistors correctly!

play-reset cycles occur is determined by the third IC.

The third IC generates the key signals necessary for IC2 to count the input signal properly. Fig. 1 shows a block diagram of this chip. A 5.24-MHz crystal connected to IC3 is the source of the proper frequency. It drives a Pierce-type oscillator inside the chip, which has the advantage of very high stability. (The circuit isn't much like the old 6AG7 tube Pierce oscillators of days gone by, but it accomplishes the same result.) The output drives a divider chain composed mostly of binary devices, and then the output drives a series of gates generating the precisely-timed gate, latch, and reset pulses needed by IC2. Also, an input connected to the divider chain controls its length—or number of stages—and selects a 1-second gate time or a 100-ms gate time. An output from IC3's divider chain also carries the multiplex signal for IC2. This signal determines when a digit will be scanned by IC2's multiplexer, and is just as important as the other signals.

Construction Guide

The first step is to round up the parts. If you are lucky, you can probably scrounge most of them from your junk box, but more likely you will have to buy at least the ICs. All of them have been available to the industry for nearly three years, and they are starting to pop up in the ads.

The LED display is commonly used in low-cost calculators, and can be almost any such unit; the pinouts have been pretty much standardized by various manufacturers. We have used National NSB-188, Litronix DL-94 displays, and others with success. The HP unit specified is recommended because of its superior appearance, but its $12 price tag may drive you to scrounging a junk calculator instead. Order any parts you need, plus the crystal. If my own experience is any indicator, you should order the crystal first. They are custom made, and take time to get.

The next step is to obtain or make the PC board. Luckily, this one is a single-sided type, and can be made at home using the G-C "Lift It" kit, or the newer printed circuit transfer films such as PCP type A, which is carried by Tri-Tek, Inc. (See distributor list for address.) It might be wise to silver-plate the finished board to improve high frequency performance, but that is up to you. While the improvement will be slight, the appearance will be considerably better. Drill all holes with a number 64 drill, and then drill out the four corner holes with a 1/8" drill. Now let's start the wiring.

You should install the jumpers and IC sockets before doing anything else. Refer to Fig. 2, which shows

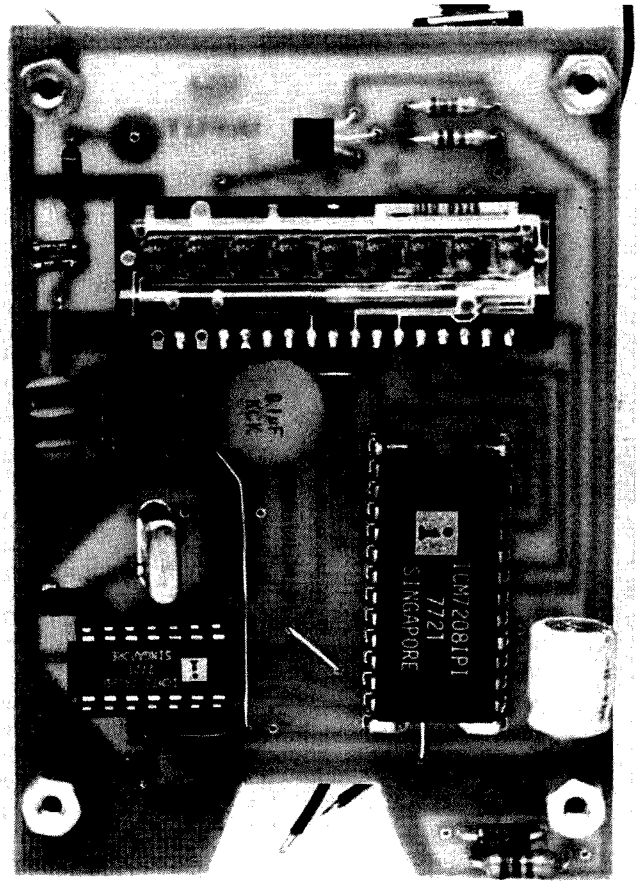


Fig. 4. Completed component side of the circuit board. Your finished board will look like this.

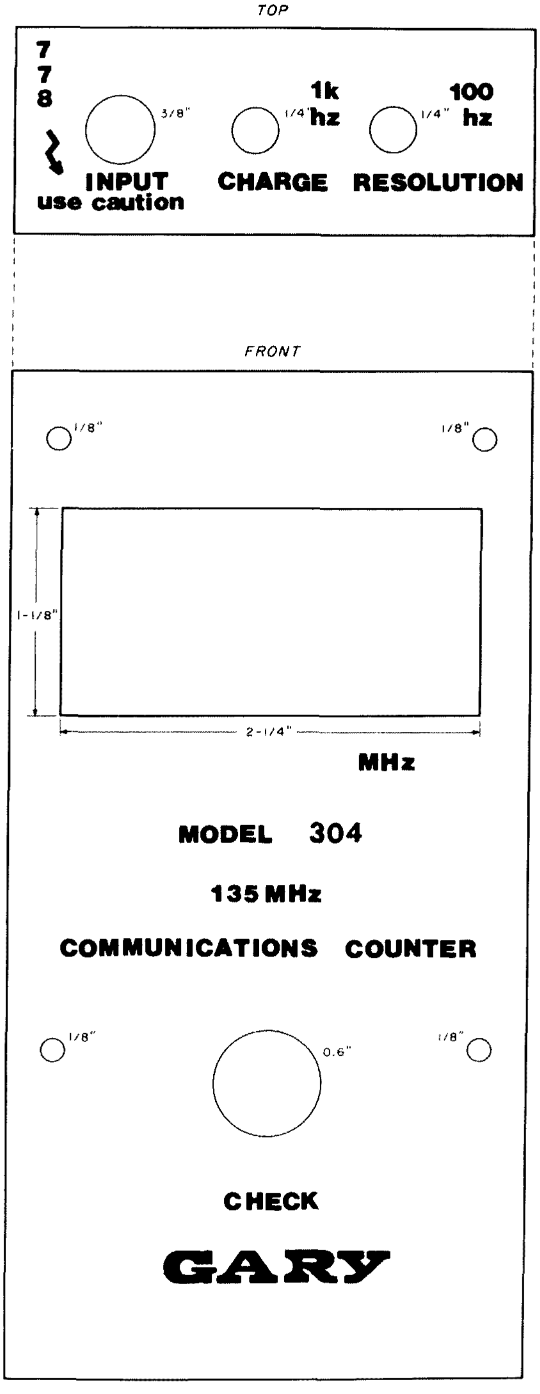


Fig. 5. Cabinet drilling template.

the component side of the board. Cut up three 1" pieces of no. 28 solid wire or resistor leads. Then cut two 2" pieces of wire. Install one 2" wire between the two holes near the right center of the board, as shown in Fig. 2. Install the other 2" jumper between the two holes near the left center of the board. Install a 1" jumper near the bottom of the board at the cutout. Move up to the center of the board, and install the remaining two 1" jumpers. Be sure to get the jumper nearest the left center of the board in the proper holes. An 8-pin IC installs next to it. When done, check to be sure all connections are soldered. Also, trim away the PC board at the bottom to form the trapezoid-shaped cutout, if you haven't already done so.

Next, install the 8-pin low-profile IC socket in the top left corner, next to that small jumper. Move down from it and install a 14-pin low-profile socket near the bottom edge. Finally, install the 28-pin socket next to the right edge of the board. I recommend the use of low profile sockets because they make later installation in the cabinet easier. Molex® pins will suffice, however. Check for solder bridges, fix, and flip the board over. Cut a 1¾" piece of insulated hookup wire, strip, and solder one end to pin 12 on the 14-pin socket, and the other end to pin 19 on the 28-pin socket. This wire shows up on Fig. 3. (Note that there is a "1" to identify pin 1 on each socket.)

The next step is to install the eight segment resistors on the foil side of the board. About ¼" of each resistor lead appears on the other side of the board for mounting the display, so don't trim the leads off from the row of wires in the center of the board. Start with the A segment resistor, R2. Lay the resistor against the board between the A on the socket (28-pin) and the A pad in the center of the board. Pass the resistor end through the A pad, so that the lead comes through the hole in the center of the board. Remember that this is for the display, so don't trim it. Solder to the pad. Bend the resistor body so that the other lead won't touch any other foil but the A pad on the 28-pin socket.

This process is identical for the other resistors, and

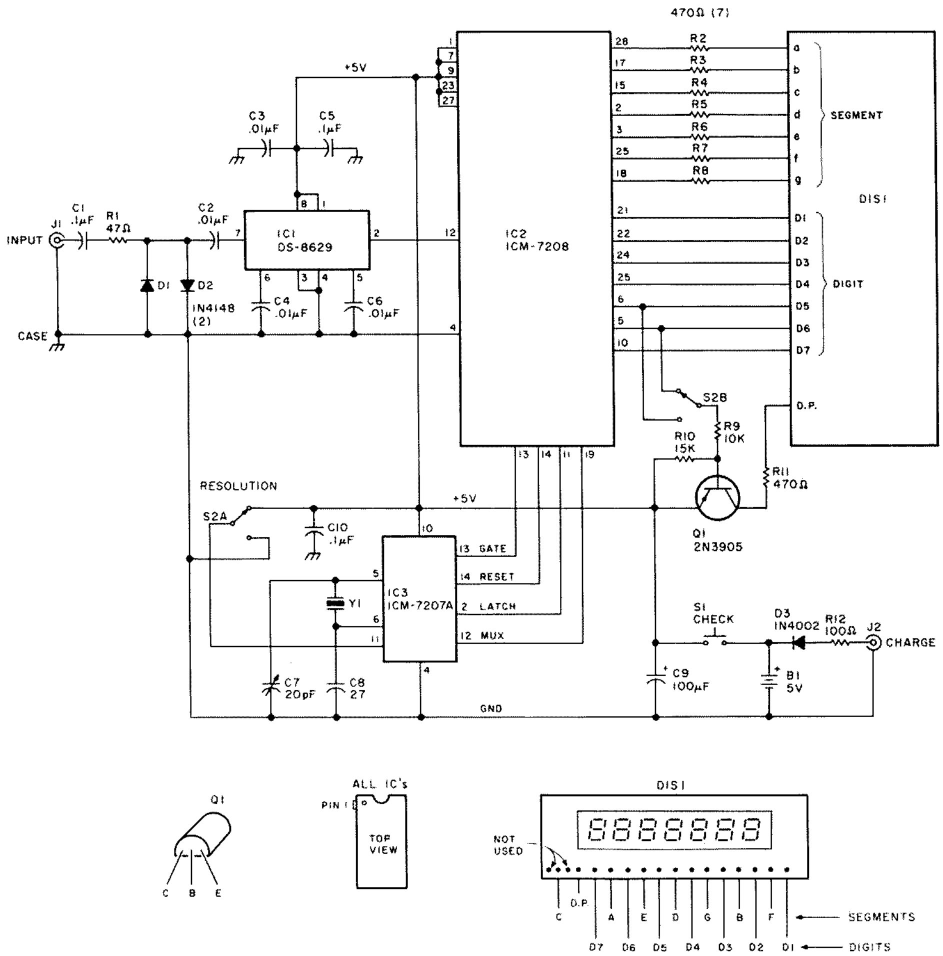


Fig. 6. Schematic diagram of the complete model 304 counter. All parts except the batteries and jacks and switch mount directly on a PC board.

is shown in Fig. 3. Repeat with installation of the D segment resistor. Position it over the A resistor you just installed, and bend the leads so they go from the D in the center of the board to pin 2 on the big IC socket. Note that there isn't a D next to pin 2 on the 28-pin socket. (There wasn't room for it.) Continue by installing the E segment resistor in the same manner, leaving at least ¼" of lead sticking through the center of the board to mount the display. Continue with the F, G, B, and one end of the C resistors. Attach a piece of bare wire to the other end of the C resistor, slip a piece of insulating tubing over it, and solder the wire to the C pad on the big IC socket. Pick up another 470-Ohm resistor and bend the leads so that one end goes to the pad just below "Input" on the board, and to the display. Cut the end flush with the board where the lead comes through near "Input," but not the one coming through the center of the board. That concludes the resistor installation for the display.

Continue by cutting up seven 1" wires for use as jumpers. These jumpers tie the digit leads from IC2 to the cathodes on the display. Heavy wire, just large enough to fit the display holes, might work better here, but the wire size you use is up to you. Bend one end of each wire into a small right angle, so that the wire looks like the letter L. Pass a wire through the foil side of the board, and place the short arm against the foil pad. Solder carefully. Put a wire in each pad that doesn't have a resistor. Use patience and care to prevent the wires from touching the adjacent resistored pads. This concludes the hardest part of the project.

Turn the board over to the component side and very carefully clip the 15 wires down to about ¼" above the board. Place the display over the wires, being sure to leave the hole on the the far *left* side of the display open. All holes on the *right* side must be used. Do not leave a hole open here or the counter won't read right. Press the display down flush against the board, and solder quickly. Use a minimum of heat to avoid loosening the wires soldered to the counter PC board. Clip off the excess wire.

The rest of the wiring needs no comment; refer to Fig. 4 for details. Install resistors R9 and R10 at the top of the board and R1 along the left side. Move to the bottom right and install R12. Now you have installed all resistors.

The semiconductors go in next. Install Q1 at the top center of the board, as shown in Fig. 4. For your convenience, the E, B, and C were marked on the reverse side of the board. Move over to the top left side of the board and install D1/D2 in the spaces near R1. Note that the bands on these diodes point in opposite directions. Move to the bottom right corner of the board, and install D3. That completes the semiconductor installation. The IC installation will follow later.

Now let's install the capacitors on the front of the board. Refer to Fig. 4, then turn to the top left side of the board. Install C2-C3-C4-C6 as close as possible to the board. Jump over the 8-pin socket and install C5 as close as possible to the board. Bend it flush with the board before soldering. Move down the left side next to the 14-pin socket and install C8 near it. Then jump over the socket and install C10 as shown. Bend it flush with the board before soldering. Skip over to the bottom right side of the board and install C9. Be sure the negative terminal faces the outside edge of the board. That completes capacitor installation on the front of the board.

While you are working with the front, dig out Y1 and install it next to C8. Also, bend the crystal over against the board edge before soldering. The photo shows it standing up, but this is not normal practice.

Flip the board over to the foil side so that you can install the remaining ca-

pacitors. Install C1, standing on end, at the input pad. Leave the other end free. Install C7 in the spot near the center of the board. Note that on most trimmers there are three leads. The two closest together go to the heavy ground foil on this counter, while the third goes to the crystal and IC3. That completes capacitor installation.

Next, the switch and mounting hardware are installed. Attach six 3" wires to the terminals of S2. Then wire up this switch as shown in the schematic and Fig. 4, cutting the wires to size as you go along. Install four spacers in the corners with 4-40 hardware and lockwashers. Note that the spacers are on the front side.

That just about wraps things up on the module. Finish by installing the ICs. Be careful about pin 1 orientation. Remember, pin 1 is identified on the PC board if you get confused. Then cut two 1" pieces of hookup wire, strip both ends, and install at the bottom of the board near the cutout. See Fig. 3. Also, cut a 5" piece of the same wire and attach near the end in the bottom left corner of the board. That completes the module assembly. It can be tested by applying 5-volts dc to the wire off the bottom center of the board.

Now you get to work the case. Fig. 5 shows a drilling template for the front of the box. Drill out the box and nibble the display hole. Clean up the box, label it with press-on transfers, and spray it with clear acrylic spray to preserve the finish.

Complete the assembly by installing the module in the box and wiring it up. First, install J1 and J2 in the top of the box. Then slip the module into the box and secure it to the front with screws and lockwashers. Mount S2 on the top of the box, too. Snap in S1 and wire it up. Install the battery pack and wire it up to the other side of S2 and ground. Finish up the job by wiring up J2 and C1 to J1. Don't close up the box until you finish calibration. Charge up the batteries and you are all set!

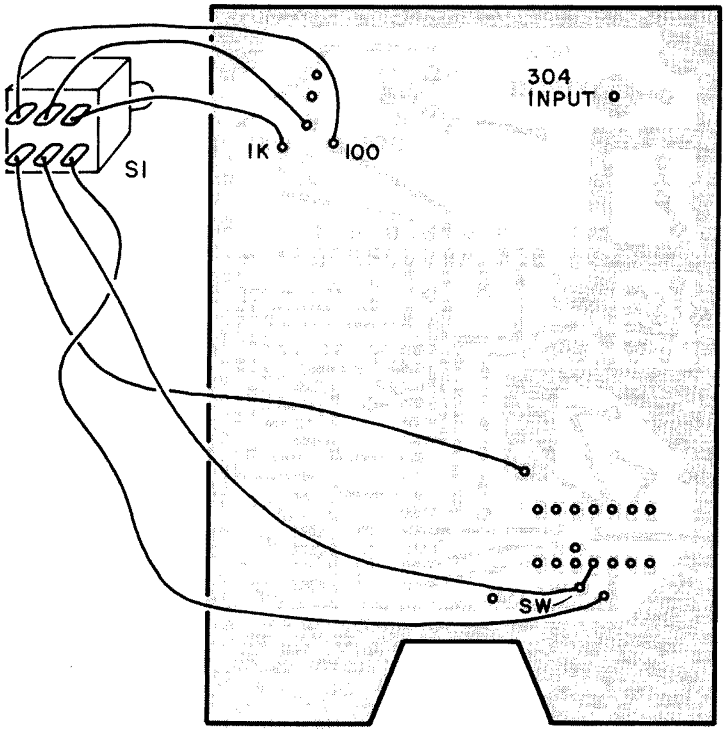


Fig. 7. Rear view of PC board showing switch wiring.

Calibration and Operation

There are several ways to calibrate your counter, with the simplest being to measure a known frequency. This is how I calibrated the model 304 counter. Connect a signal of 50 mV or so at 10 MHz from a fre-

Supplier List

Item	Factory	Distributor
IC1-National DS-8629	National Semiconductor 2900 Semiconductor Dr. Santa Clara CA 95051	Tri-Tek, Inc. 7808 North 27th Ave. Phoenix AZ 85021 (602)-995-9352
IC2-IC3 Intersil ICM-7208IPI and ICM-7207AIPD. Note: These parts come as a set	Intersil, Inc. 10900 Tantau Ave. Santa Clara CA 95014	Poly Paks, Inc. PO Box 942 S. Lynnfield MA 01940 Stock #92CU4079 (617)-245-3828
Y1—5.24288 MHz crystal	JAN Crystals 2400 Crystal Dr. Ft. Meyers FL 33901 (813)-936-2397	JAN Crystals
DIS1—H-P display	Hewlett-Packard, Inc. Optoelectronics Div. 1501 Page Mill Rd. Palo Alto CA 94304	Poly Paks, Inc.
C7—20 pF trimmer cap	Sprague, Erie, etc.	Tri-Tek, Inc. Stock# CAP9308
Case—LMB-CR-531	Heeger, Inc. 725 Ceres St. Los Angeles CA 90021	

Note on the "Factory" column: These people should be contacted *only* for a local distributor; only JAN Crystals will sell small quantities of parts to individual users.

quency standard to J1. Your standard should be accurate to at least ± 0.001%; ±0.0005% or better would be highly desirable. Press the check button and set the resolution switch to 100 Hz. You will get a reading close to 10 MHz. Adjust trimmer C7 until you get a reading of exactly 10.000 MHz. That completes calibration with a standard. If you don't have access to a frequency standard, a transmitter will do as well. You should have a high-quality counter to measure the transmitter. A CB set will do. Attach a piece of coathanger wire about 12″ long to J1. Then key the transmitter after you set the resolution switch to the 100-Hz position. Key the transmitter in brief steps and do not modulate it. A walkie-talkie is ideal for this since little power is necessary. Adjust C7 until the counter reads the exact transmitter frequency when the counter is held near the antenna. That completes calibration of the counter. Close up the counter case and secure it with screws.

Operation is a snap with this counter. Simply connect low-level signals to be measured to J1 and press S1. You then read the frequency off the display. The resolution switch, S2, is designed to offer you two time bases, and, thus, two different gate times. Use the 0.1-second position where you want a speedy display of frequency, and use the 1-second position where you want greater accuracy. This will allow you to read up to the last 1 kHz position on the display with S2 set to 0.1 second, and read to the last 100 Hz position with S2 set to 1 second. As you can see, each has advantages.

A few tips on using this counter: You might want to fabricate a 12″ whip antenna out of a male BNC connector and a piece of coathanger wire. Epoxy the wire inside the plug. With this setup, you should be able to measure a 100-mW CB walkie-talkie at least 15 feet away. If you performance-select IC1, this counter will cover the 2 meter ham band. Finally, whenever you measure a transmitter or signal generator, be sure to operate it in the unmodulated mode, or SSB units in the CW mode. This will give you maximum accuracy in your measurements. ■

Model 304 Counter Specifications

1. Accuracy: Adjustable to up to ±0.0002% or better, short term. Also ±1 count error on all measurements.
2. Frequency Range: From below 1 MHz to over 135 MHz.
3. Gate Times: Switched 1 second or 0.1 second. Display correspondingly updated 2 seconds or 0.2 seconds respectively.
4. Input: About 500 Ohms at low signal levels (below 0.5 volt).
5. Power requirements: 5 V dc at 130 mA, no signal. Power supplied by nicad batteries.
6. Resolution: 100 Hz and 1 kHz of the measured frequency.
7. Sensitivity: Typical rms sine wave sensitivity for stable count is 55 mV at 1 MHz, 4 mV at 27 MHz, 5 mV at 50 MHz and 12 mV at 135 MHz.
8. Special Features: Hand-held portable unit. Diode-protected input, easy construction, long battery life, etc.
9. Display: 0.105″ LED calculator-type with 7 digits.

PC Boards

The PC board (stock #STGM-279) for this project is available for $5.60 (drilled) or $4.00 (undrilled) from O. C. Stafford Electronic Development, 427 South Benbow Rd., Greensboro NC 27401. Add $1.00 for shipping.

Parts List

B1—4 "AA" Nicad batteries in square holder
C1—0.1-uF, 200-volt Mylar capacitor
C2, C3, C4, C6—0.01-uF, 50-volt disc capacitors
C5, C10—0.1-uF, 25-volt disc capacitors
C7—6-to-20-pF trimmer
C8—27-pF mica capacitor
C9—100-uF, 6.3-volt electrolytic
D1, D2—1N4148 diodes
D3—1N4002 rectifier diode
IC1—National DS-8629N VHF prescaler
IC2—Intersil ICM-7208IPI counter chip*
IC3—Intersil ICM-7207AIPD timebase controller chip*
J1—BNC connector, UG-1094, Amphenol 31-221
J2—RCA jack
Q1—2N3905 PNP silicon transistor

Resistors: All resistors ¼-Watt film except for R12.

R1—47-Ohm resistor
R2 through R8, R11—470-Ohm resistors
R9—10k resistor
R10—15k resistor
R12—100-Ohm, ½-Watt resistor
S1—SPST Push-button switch
S2—DPDT miniature toggle switch
DIS-1—Hewlett-Packard 5082-7441 9-digit LED display, "Industry Standard" calculator LED display, Poly Paks 92CU2954, or similar.
Y1—5.24288 MHz crystal in HC-18/U holder with wire leads. Loading capacitance is 12 pF, accuracy is ±0.005% at room temperature.
Misc.—9-volt ac/dc battery charger with RCA plug, PC board, Bezel, 3/8″ spacers (4 each), LMB CR-531 case, 4-40 screws, wire, etc.

*Available from Poly Paks as a set. Stock #92CU4079.

✓ Reader Service—see page 259

A Versatile, Variable Active Filter

—dc switching and 8-pole response make this one a winner on RTTY or CW

Eric J. Grabowski WA8HEB
30312 Arnold Road
Willowick OH 44094

Recently, my interest in RTTY operation was rekindled. The thought of using the existing tube-type terminal unit, however, was not a pleasant one. A rework of the terminal unit seemed appropriate.

A good place to start was replacing the bulky LC filters with active filters. Although many active filter circuits have been described in previous articles, none was exactly what I needed. Consequently, the circuit presented here was developed. The application is not limited to RTTY; with some value changes it can be used for CW reception or other uses where it is desired to pass a single frequency while rejecting all others.

Design Goals

After some initial brainstorming, the following list of objectives was prepared:

1. Ultimate selectivity should be less than 100 Hertz, but some intermediate choices should be available.
2. Minimize power consumption. Single supply operation. Operation consistent over a wide range of supply voltage.
3. Some type of dc-switching technique should be used for selectivity selection to simplify wiring and provide for future control by microprocessor.
4. Capability to bypass the filter altogether.

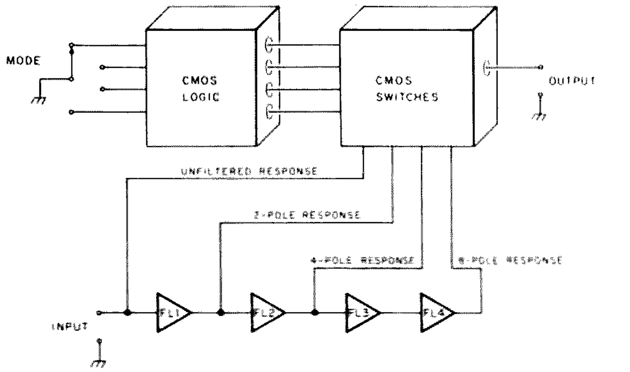
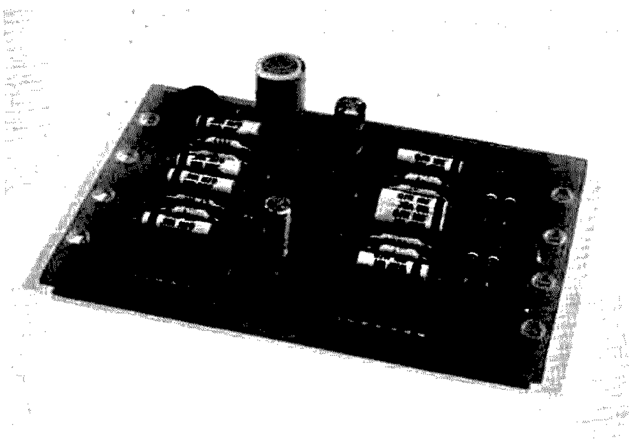


Fig. 1. Block diagram illustrating the concept of dc switching. Wires to the remote mounted switch carry dc levels only. Stray currents induced into these wires will not degrade the filter performance.

Center Frequency	R1—R4	R5—R8	R9—R12	Comment
2975 Hz	220k	430k	6.8k	RTTY Space (850 Hz shift)
2295 Hz	270k	560k	9.1k	RTTY Space (170 Hz shift)
2125 Hz	300k	620k	10k	RTTY Mark
750 Hz	820k	1.8 Meg	27k	CW

Table 1. Active filter resistor values.



Active filter.

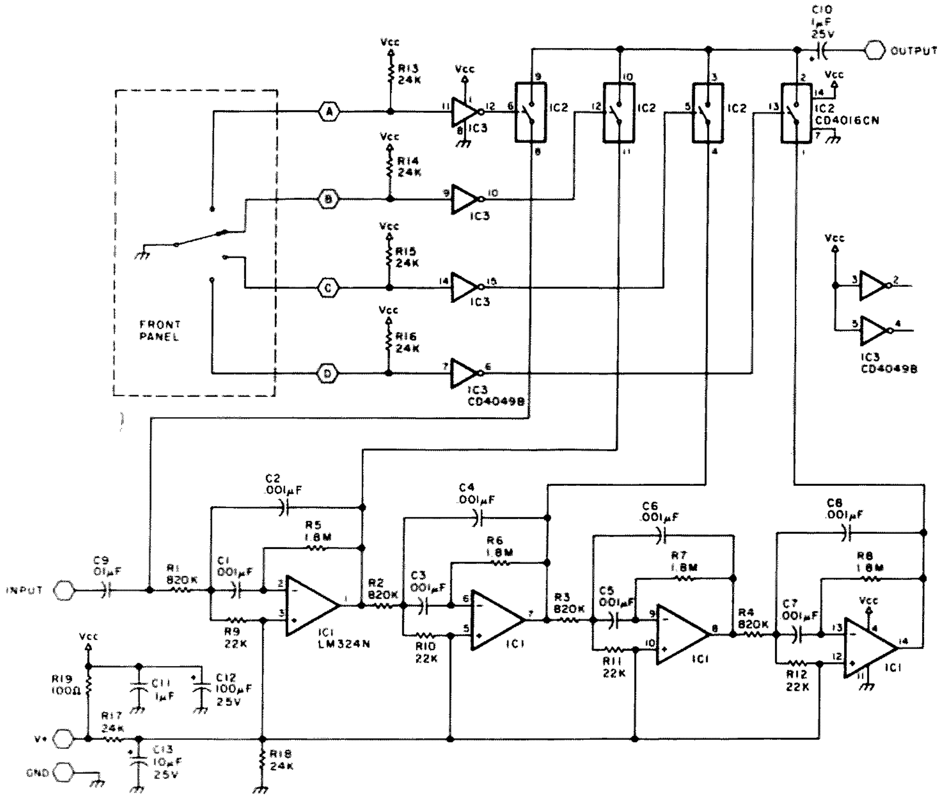


Fig. 2. Schematic of the active bandpass filter using dc switching for bandwidth selection. See table for values of frequency determining components.

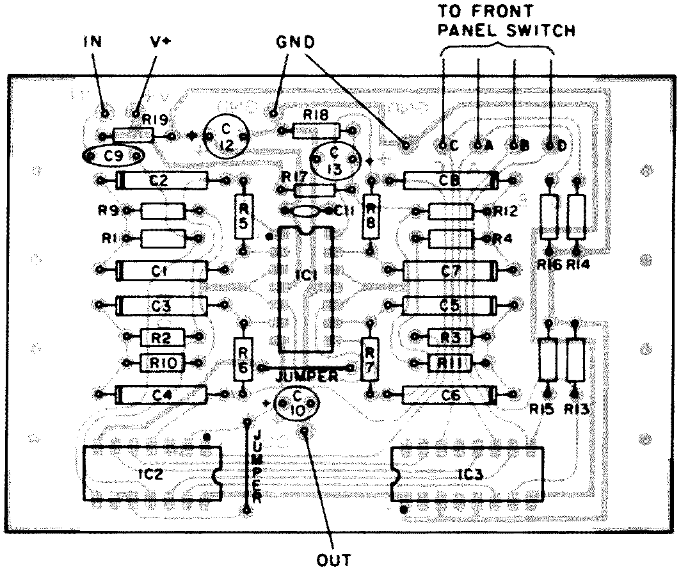


Fig. 3. Component placement drawing. A dot is placed near pin 1 of all integrated circuits for identification.

Filter Circuit

The LM324 quad operational amplifier was selected for the filter circuit. Each of the op amps is configured as a two-pole active filter and cascaded in a daisy chain fashion. Each stage has a Q of about 4, unity ac gain, and a center frequency determined by the R and C values chosen. The outputs of all op amps except the third are applied to the switching circuitry. The decision not to use the third output was arrived at experimentally, and experience has proved this to be a wise choice.

Table 1 identifies the values of resistors used for the RTTY mark and space frequencies. Values are also shown for a CW filter centered at about 750 Hertz. (C1 – C8 = 0.001uF)

For best results, the frequency-determining capacitors should be a high-stability type. Cornell-Dubilier series WMF is a good choice, and they are readily available.

If you want to use the filter on some other frequency, the R and C values will have to be calculated from formulas. Since there are more standard resistor values than capacitor values to choose from, it is usually more convenient to arbitrarily select a capacitor value and then use the nearest standard value resistors.

Dc Switching Circuit

Two complementary MOS integrated circuits comprise the dc switching circuit. A CD4049 hex inverter is used to drive the control inputs of the CD4016 quad analog switch.

A pull-up resistor normally holds each hex inverter input at the positive supply voltage. This forces the inverter output and the associated control input to ground potential. As long as the control input is grounded, the switch appears open. A four-position rotary switch is used to select which switch is closed by grounding the appropriate pull-up resistor.

Since there are only four switches in the IC package, and the unfiltered input uses one of them, one of the filter outputs had to be sacrificed. The output of the third filter seemed to be the least useful; consequently, it was deleted

Construction

The circuit was built on a printed circuit board 3-5/8 by 2-1/2 inches from the artwork shown. For those of you unable to roll your own, arrangements have

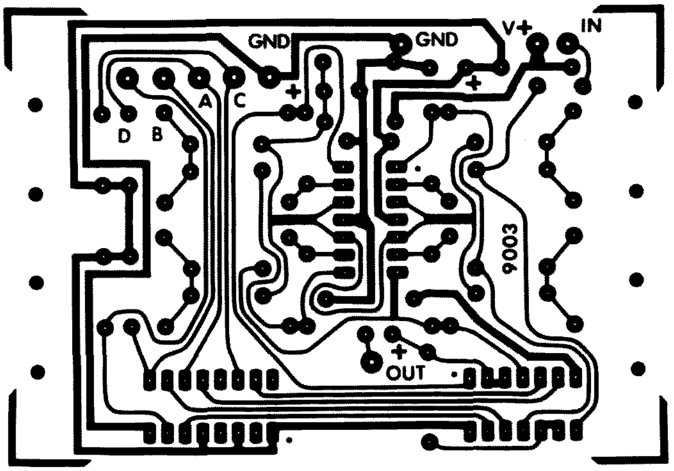


Fig. 4. Actual size artwork of the foil side of the printed circuit board.

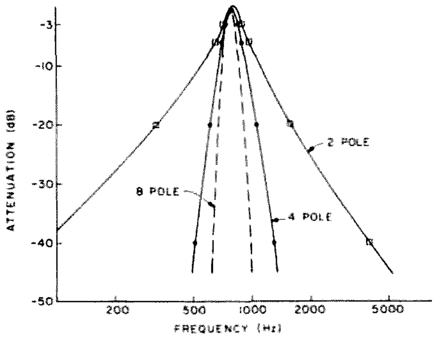


Fig 5. Graph of the response at the various outputs of the active filter. This filter has a center frequency of 800 Hertz and was used as a CW filter.

been made with Firstron Electronics, P.O. Box 151, Streetsboro OH 44240 to supply etched and drilled boards. The cost is $4.00.

Assembly should proceed quickly by following the component location drawing. The usual precautions should be observed when handling the CMOS integrated circuits to prevent damage by static charges. Capacitors shown with polarity are either dipped tantalum or vertical electrolytic types.

When the assembly phase is over, double-check the polarity of polarized capacitors and make sure there are no solder bridges across adjacent foils.

Operation

The dc power supply voltage is not critical. Any voltage between 3 and 15 volts will suffice. With power applied, check the voltage on pin 3 of the LM324. It should be very close to half of the supply voltage. If it is not, the output waveform will be clipped, causing distortion.

Both the input and output of the filter are ac-coupled, so there is no need to worry about disturbing the bias voltages of the preceeding and succeeding stages of the equipment the filter is used with. In order to maintain a linear response though, the level of the input signal must be less than the dc supply voltage. For example, if a 12-volt supply is used, the peak-to-peak input voltage must be less than 12 volts.

For RTTY operation, two circuit boards are required. One for the mark frequency and another for the space frequency. If desired, a ganged rotary switch can be used to select the bandwidths of both channels simultaneously.

Conclusion

The graph illustrates the

Loc	Code	Key	Comments				
					42	STO	
0	43	RCL	Find R1		06	06	R3
	04	04			91	R/S	Find R2
	55	÷		30	53	(	
	53	(			43	RCL	
	02	02			05	05	
5	65	X			65	X	
	89	π			43	RCL	
	65	×		35	06	06	
	43	RCL			54	)	
	01	01			55	÷	
10	65	X			53	(	
	43	RCL			04	04	
	02	02		40	65	X	
	65	X			43	RCL	
	43	RCL			04	04	
15	03	03			33	X²	
	54	)			65	X	
	95	=		45	43	RCL	
	42	STO			05	05	
	05	05	R1		75	—	
20	91	R/S	Find R3		43	RCL	
	65	X			06	06	
	02	02		50	54	)	
	65	X			95	=	
	43	RCL			42	STO	
25	02	02			07	07	R2
	95	=			91	R/S	END

Fig. 6. TI-58/59 program coding for determining the frequency dependent components.

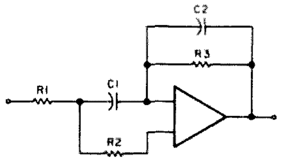


Fig. 7. Program description. Given center frequency (f), gain (A), desired Q (Q), and capacitance (C1), find values for R1, then R3, then R2. Equations: $C1 = C2$; $R1 = Q/2\pi fAC1$; $R3 = 2AR1$; and $R2 = R1R3/4Q^2R1 - R3$.

Step	Procedure	Enter	Press	Display
0	Initialize			
1	Load program			
2	Enter center freq in Hertz	f	STO 01	f
3	Enter gain in units	A	STO 02	A
4	Enter capacitor value in uF	C1	STO 03	C1
5	Enter value for Q in units	Q	STO 04	Q
6	Find R1; STO-05		RST R/S	R1 megohms
7	Find R3; STO-06		R/S	R3 megohms
8	Find R2; STO-07		R/S	R2 megohms

Fig. 8. User instructions.

0	Not used
1	f
2	A
3	C1
4	Q
5	R1
6	R3
7	R2

Fig. 9. Data registers.

bandwidths obtained and the selectivity achieved. Ultimate bandwidth is about 80 Hertz, which satisfied the design goal. All the other goals were met as well. Current draw is about 2 milliamperes. Since all audio signals are contained on the board, long, unshielded hookup wire can be used between the board and the switch without degrading the performance.■

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Variable Tuning for WEFAX Receivers

—why be rockbound?

In recent years, literally thousands of radio amateurs have discovered the thrill of recovering weather facsimile (WEFAX) images from orbiting satellites. Their efforts and accomplishments have been well-documented in numerous articles—some are listed below as references nos. 1-9—and in at least one excellent book.[10]

Until recently, the majority of weather satellites transmitted VHF-FM images in the 137-MHz region, and enterprising hams have employed their characteristic ingenuity to recover these signals at minimum expense. Receivers which have been successfully modified for WEFAX reception include various Motorola and GE high-band commercial receiver strips, police scanners from Bearcat, Regency, Realistic, and others, monitor receivers such as those sold by Vanguard, Heathkit, Hamtronics, VHF Engineering, and others, and a limitless variety of 2 meter FM receivers.

One characteristic which all of the above receivers share is the lack of tuning flexibility. These are fixed-tuned, crystal-controlled (or "channelized") receivers which, when crystalled and tweaked for WEFAX reception, allow no fine-tuning adjustments. In satellite work, however, manual tuning often spells the difference between marginal and exceptional images (see the accompanying photographs). The purpose of this article, then, is to outline a method of adding frequency tuning to VHF-FM receivers used for weather satellite work.

A weather satellite image received with the incoming signal at the edge of the receiver's passband (some 15 kHz off the frequency).

Why a Tunable Receiver?

Consider an NOAA (National Oceanic and Atmospheric Administration) satellite orbiting the Earth at 900 miles and transmitting weather pictures at 137.5 MHz. As the satellite appears on the horizon, races overhead, and then drops off beyond the opposite horizon, its frequency, as received on the ground, is forever changing. This characteristic Doppler shift, which is well known to anyone who's ever listened to the 2-meter downlink signal from OSCAR VII (Mode B), may amount to several kHz during an overhead pass.

One way to keep the satellite's signal within the receiver's passband is to widen the receiver's i-f bandwidth by the amount of anticipated Doppler shift. But the signal-to-noise ratio (SNR) of the recovered signal is in part a function of the i-f bandwidth. That is, widening the passband response of the receiver admits additional noise, which degrades signal quality.

A costly, though effective, alternative is to keep the receiver narrow, but add an automatic frequency control (afc) loop. The receiver will then lock on to the incoming signal and track it across the spectrum—that is, assuming the receiver is able to acquire the signal in the first place. One disadvantage to afc is that if the receiver loses the signal momentarily due to fading, interference, or whatever, it may be unable to reacquire the signal quickly enough. While searching for a signal to lock on, the system may lose a substantial portion of the transmission.

If an operator is present during reception, manual tuning overcomes the above problem. An operator's search-and-acquire time is minimal (just notice how quickly the pileup materializes when a rare DX station shows up on frequency!), and the operator need only tune to keep the discriminator meter centered once the satellite is acquired.

Consider now the case of receiving signals from

the new generation of geostationary weather satellites.[11,12] Here the satellites are in an eastward orbit above the equator, completing one orbit every 24 hours. Thus, to an observer on the ground, the satellite appears to hover motionless in space. This orbit not only minimizes tracking difficulties, but also eliminates relative motion between the satellite and the observer, thus eliminating the Doppler shift problem.[13]

On-frequency reception of the new geostationary satellites (the United States' GOES E and GOES W, Japan's GMS, and the European Space Agency's METEOSAT) presents other difficulties, however. These satellites transmit WEFAX in the microwave spectrum, at 1,691 MHz. Since image format and modulation characteristics are similar to the transmissions from the earlier, polar-orbiting VHF satellites, reception of these new birds is generally accomplished by placing a heterodyne downconverter in front of an existing VHF satellite receiver.[14,15] And it is in the downconversion process that frequency problems crop up.

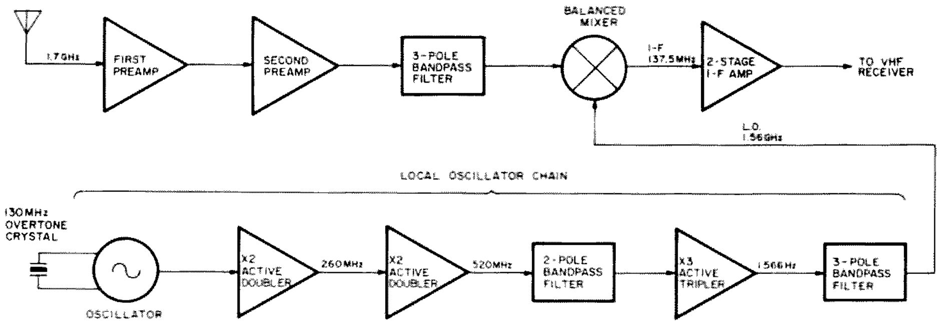


Fig. 1. Block diagram of the Microcomm Model RX-1691 integral WEFAX downconverter. The oscillator/multiplier string is typical of modern microwave receivers. For more information on this downconverter, send an SASE to Microcomm, 14908 Sandy Lane, San Jose CA 95124.

Converter Calibration

A crystal-controlled converter for reception of the microwave WEFAX transmissions might employ a local oscillator in the 1.5-GHz region, derived by multiplying up a stable crystal oscillator in the 130-MHz region (see Fig. 1).[17] A high quality overtone crystal will exhibit a room-temperature tolerance on the order of ±0.001%, which is about five times better than the average ham-rig crystal. This sounds like high precision, but when applied to the 1.5-GHz LO injection frequency, represents a calibration ambiguity of 15 kHz! Since the typical bandwidth of a VHF-FM receiver used as a weather satellite i-f would be on the order of 30 kHz, you can see that even a relatively well-calibrated crystal can easily result in the received signal being on the very edge of the receiver's passband.

Unless the converter's crystal oscillator is installed in a thermostatically-controlled oven, however, the problem doesn't stop there. Over the temperature range of −10° C to +60° C, the thermal tolerance of even a high-grade crystal will be on the order of ±0.002%. Applied to the 1.5-GHz LO frequency required to downconvert microwave WEFAX to VHF, the frequency drift over temperature may be as much as 30 kHz, placing the received signal completely out of the receiver's passband.

Obviously, keeping the receiver "on frequency" with respect to the satellite is going to require some kind of tuning, either to the downconverter's LO or the VHF receiver. I maintain that the appropriate place to introduce tuning is in the VHF receiver. To understand why, it's first necessary to know a little about phase noise.

Phase Noise

An unavoidable characteristic of any crystal oscillator, no matter how well engineered or fabricated, is that it will always exhibit some degree of instability. This is evidenced by incidental

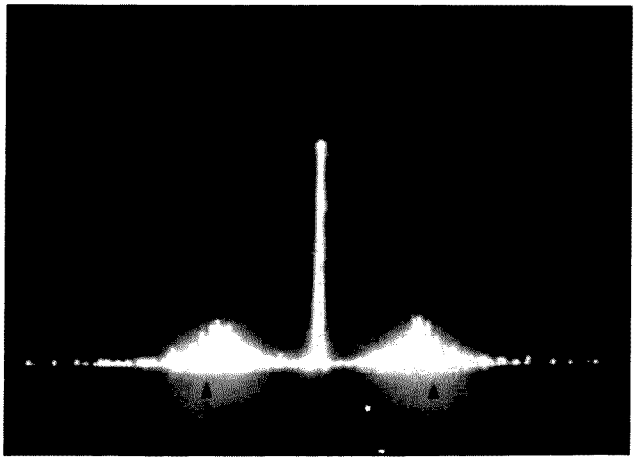


Fig. 2. A spectrum analyzer photo of a microwave local oscillator exhibiting excessive phase noise sidebands. This incidental FM results from excessive pulling of the crystal's frequency of oscillation, as discussed in the text.

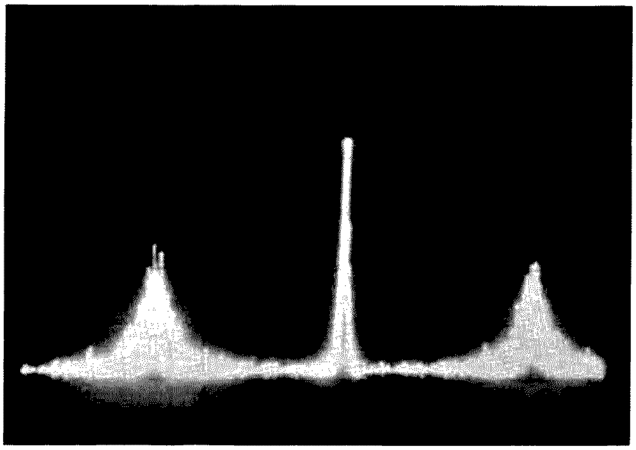
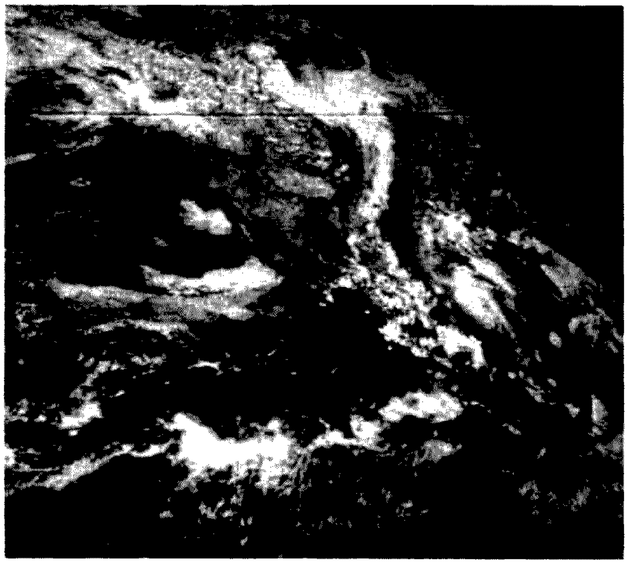


Fig. 3. This is the same LO chain shown in Fig. 2, after having been multiplied in an active doubler stage. Note that both sideband amplitude and deviation are increased, as discussed in the text.



A weather satellite image received with the signal centered in the receiver's passband. All other conditions were identical to those prevailing in the photo where the signal was some 15 kHz off frequency.

FM sidebands visible above and below the primary output frequency, when viewed on a spectrum analyzer (see Fig. 2). In achieving reception which is reasonably free from spurious responses, it is desirable to keep these sidebands (also known as phase noise) to a minimum.

Unfortunately, any time an oscillator's output is multiplied to a higher frequency (such as occurs in the microwave downconverter of Fig. 1), both the amplitude and the bandwidth of phase noise will tend to increase. As illustrated by Fig. 3, phase noise bandwidth increases because, as a signal is multiplied in frequency, the spacing between sidebands is multiplied by the same amount. The increase in phase noise amplitude with multiplication relates to multipliers being nonlinear (generally class C) devices. Think of a multiplier as an amplifier being driven into saturation. The primary signal will be gain-compressed to a greater degree than its sidebands (which, after all, started out at a lower level). Thus, the sidebands emerge from the multiplier nearer in amplitude to their carrier than they were going in.

Since both phase noise and its increase with multiplication are unavoidable, it is apparent that one objective of receiver design should be to minimize incidental FM on local oscillators to the greatest possible extent.

Which Oscillator to Tune?

Any crystal-controlled oscillator can be made to vary somewhat in frequency by placing a small reactance (either capacitive or inductive) either in series with or in parallel with the crystal. The circuit configuration used, amount of tuning achieved, and reactance values chosen are a function of several variables which are, as the textbooks say, beyond the scope of this course. The technique of varying or "warping" the crystal's resonant frequency by the addition of an external reactance, however, is used in most commercial variable crystal oscillators (vxo's) and CB "sliders." The only problem which this technique presents is that "rubbering" a crystal's operating frequency *always* degrades its stability somewhat, and this instability shows up as incidental FM, or phase noise.

Fig. 4. is a simplified block diagram of a microwave downconverter (such as that shown in Fig. 1), operating into a typical VHF-FM receiver. It illustrates the frequency schemes used in the various conversions. You will notice that there are three separate crystal-controlled oscillators involved. Vxoing any one of the three will result in varying the frequency response of the receiver, but which oscillator should be tuned?

Since tuning any oscillator introduces instability, and since instability compounds when frequency is multiplied, it should be evident that we can rule out vxoing the microwave local oscillator chain. This is unfortunate, because the high-order multiplication scheme used would have made it very easy to achieve a considerable amount of frequency flexibility, were phase noise not a factor. That is, the x12 multiplication of the 130-MHz crystal oscillator would have made it possible to achieve ±24 kHz of tuning range just by pulling the crystal up or down 2 kHz. Lest you be tempted to pull the 130-MHz crystal, even this small amount, look again at Fig. 2, which is a spectrum-analyzer photo of the instability which will result.

In the interest of minimizing phase noise sidebands, it always is best to let oscillators driving multiplier chains oscillate where they want to, and do your tuning downstream. Since the output of the 10-MHz oscillator is not multiplied at all, one might be tempted to make it variable, in order to tune the receiver shown in Fig. 4. However, notice that the last conversion stage occurs *after* the 10.7-MHz bandpass filter which sets

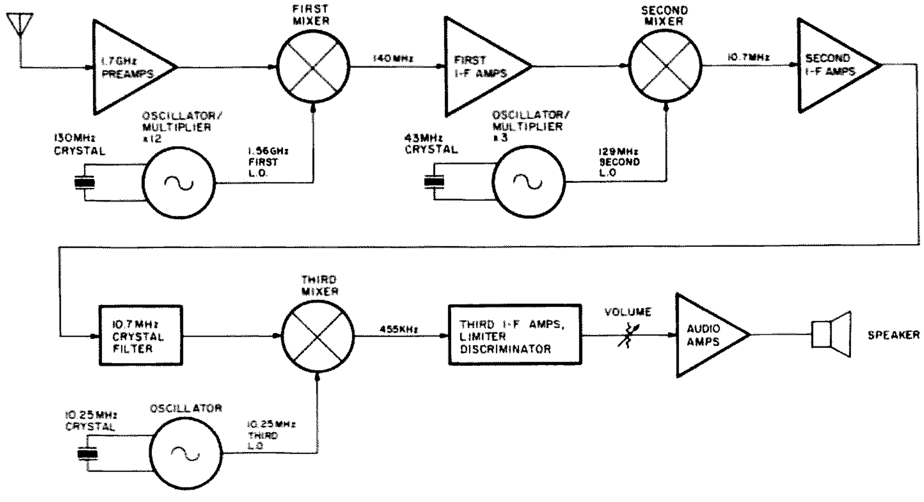


Fig. 4. A simplified block diagram of the microwave receiving system.

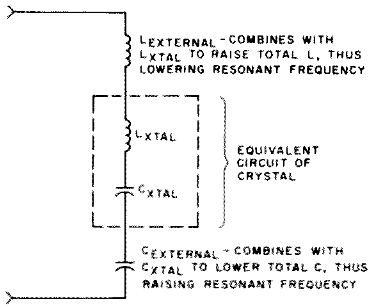
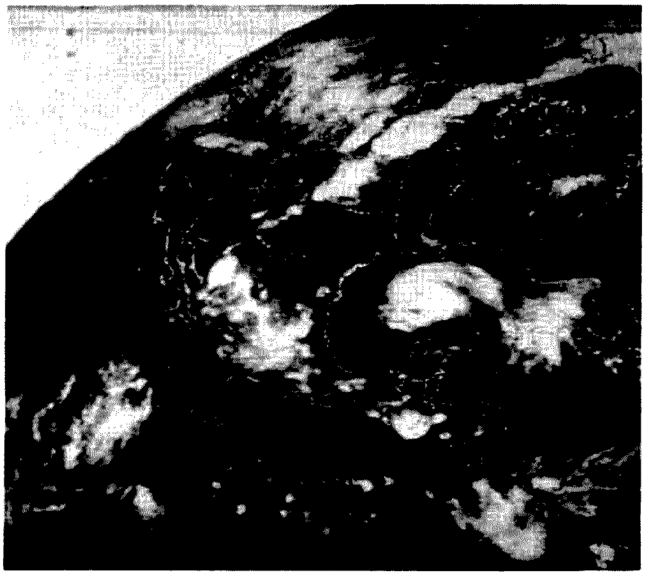


Fig. 5. Varying the operating frequency of a series-mode crystal.



This is a weather satellite image taken with the signal centered in the receiver's passband. Notice the slight blur at the top, caused by tuning the receiver during reception.

the receiver's overall response. Since it does little good to do your tuning downstream from the major selectivity portion of the receiver, this leaves only the 42-MHz crystal in the second conversion as a likely candidate for achieving frequency agility.

It is true that the output of the 42-MHz crystal is multiplied to 126 MHz, and true that that multiplication will tend to aggravate the phase noise problem, but a times-three multiplication is less horrendous than a times-twelve jump, as far as instability is concerned. My experience indicates that it's possible to pull the frequency of oscillation of the 42-MHz crystal as much as ±10 kHz (yielding ±30 kHz of overall tuning range) with no ill effects.

Vxo Circuit Description

I said before that reactances can be added in series or in parallel with a crystal, and that they can be capacitive or inductive to achieve tuning. In the case of a crystal operating in its series-resonant mode, the addition of series-inductance will tend to lower the operating frequency, while series-capacitance will tend to raise it. This is illustrated in Fig. 5. Series-inductance will combine with the equivalent inductance of the crystal itself, lowering the resonant frequency. On the other hand, a capacitor in series with the crystal's equivalent capacitance will *decrease* the overall capacitance, raising the resonant frequency. Where both series inductance and capacitance are used, one effect or the other will predominate, depending on which reactance is of the greater magnitude. If the added inductive and capacitive reactances are equal, they will cancel each other (resonate), and the crystal will oscillate on its original frequency.

Fig. 6 is a schematic diagram of the oscillator section of a Vanguard receiver, which is typical of many of the receivers mentioned in the introduction. The crystals are third-overtone units in the vicinity of 42 MHz, operating in their series mode. Notice the 5-to-30-pF trimmer capacitor, shunted by a 10-pF fixed capacitor, in series with each crystal. These capacitors are used for "netting" or zeroing the receive frequency, and provide a total tuning range of about 2 kHz, upward. To make the receiver come out on frequency, the manufacturer specifies crystals cut for 1 kHz lower than the expected frequency.

Since the 2-kHz total tuning range (±1 kHz) is hardly sufficient to compensate for Doppler shift or thermal drift, it is necessary to significantly increase the tuning range of this circuit. In my WEFAX receiver, I wanted to be able to tune 137.5 MHz ±30 kHz (a total tuning range of 60 kHz). Since the output of the 42-MHz oscillator is tripled to 126 MHz, it was necessary to make the oscillator tune a total of 20 kHz. I found, however, that no matter how small I made the series capacitance, the circuit dropped out of oscillation before it reached 20 kHz of frequency change. Similarly, a series inductor raised the frequency of oscillation, but the circuit died before a 20-kHz change had been achieved.

I was able, however, to make the oscillator move either up or down about 10 kHz by applying about 300 Ohms of inductive or capacitive reactance in series with the crystal. It thus became clear that my vxo circuit was going to have to incorporate both inductance and capacitance to achieve the desired tuning range.

The values which I ultimately selected are shown in Fig. 7. This circuit gave me the desired 60 kHz of total receiver tuning range, but for reasons which I do not fully under-

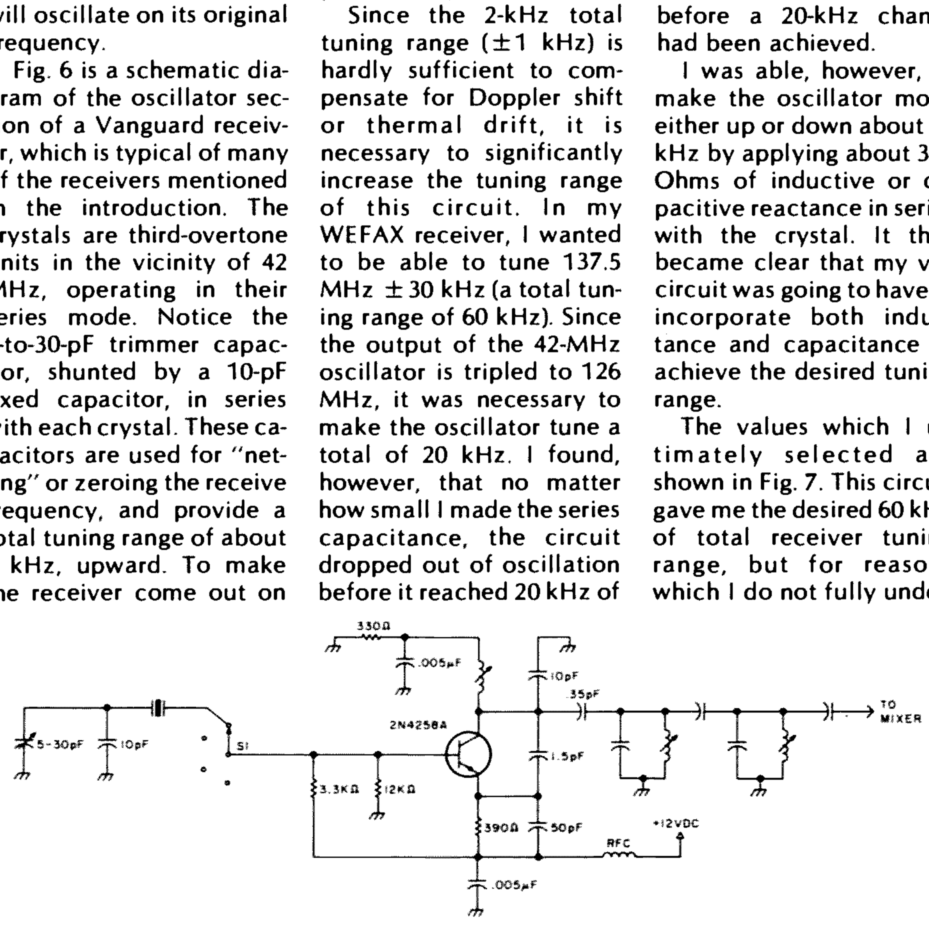
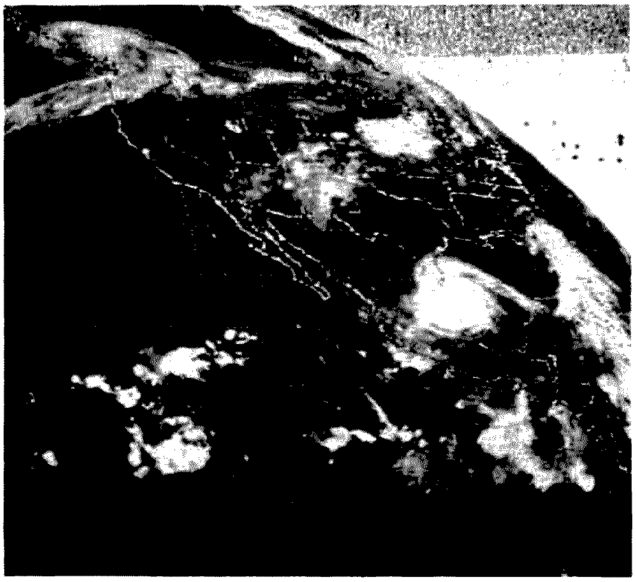


Fig. 6. VHF local oscillator section of the Vanguard FMR-250-11 and FMR-150A FM receivers.



The blur at the top of this picture is a dramatic indication of the effects of tuning. At the start of the transmissions, the receiver was not tuned on the incoming signal. The noise disappears abruptly when the receiver is tuned. This is especially evident in the grey-to-white transition at the upper right.

stand, the tuning range of the crystal was "skewed" downward somewhat. (I suspect this may have been due in part to the crystal's holder capacitance, which I overlooked in my simplistic analysis in Fig. 6.) By purchasing a crystal cut to receive 25 kHz high in the band, this circuit gave me accurate center-frequency calibration, and plus-and-minus 30-kHz tuning.

Since this vxo circuit worked for a Vanguard receiver, I later tried it in a Drake 2 meter transceiver. With a single crystal for 146.55-MHz reception, I am now able to tune the three popular simplex frequencies of 146.49, .52, and .55.

Modification Procedures

The following procedure applies specifically to the Vanguard Model FMR-250-11 receiver. Of all low-cost receivers, this is perhaps the one most widely used for weather satellite work. The procedure will no doubt be similar for other receivers, although the layout will differ. Those readers modifying Vanguard receivers will be aided by the accompanying photographs.

(1) Remove crystal selector switch S1. (This assumes that single-channel plus-and-minus-tuning performance will be acceptable.)

(2) Remove all twelve "netting" capacitors (5-to-30-pF trimmers) and all twelve 10-pF ceramic disc capacitors located adjacent to the crystal sockets.

(3) Cut away the front of the printed circuit board behind S1 to accommodate the tuning capacitor. Note that two power traces at the very front of the circuit board are eliminated in the process.

(4) Using insulated stranded wire, reconnect the power by jumpering around the traces just cut. Leave the wires long enough to be routed around the tuning capacitor, well behind the front panel.

(5) Install the 3-to-30-pF tuning capacitor in the hole formerly occupied by S1.

(6) Wire from the base of the oscillator transistor directly to one of the remaining crystal sockets. Install the two miniature rf chokes between the other pin of the crystal socket and the stator of the tuning capacitor. (See Fig. 7.)

(7) Order a 42.275-MHz third-overtone crystal in an HC-25 package, specifying series resonance and ±.003% tolerance. Plug in the crystal, and enjoy 137.5 MHz (±30 kHz) tuning!

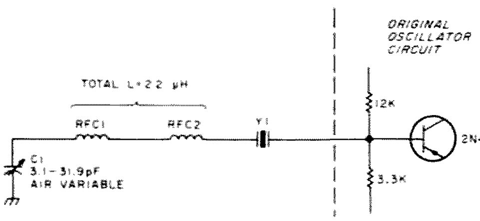


Fig. 7. Vxo circuit for the Vanguard VHF-FM receivers. An added component: Y_1 = 42.275-MHz series-resonant, .003% tolerance, third-overtone crystal, with HC-25 holder (Sentry scanner crystal, cut for 137.525 MHz reception). C1 = E. F. Johnson 1-60-130 air-variable capacitor, 3.1 to 31.9 pF. Rfc_1 = 1.2-uH miniature inductor; rfc_2 = 1.0-uH miniature inductor.

Acknowledgment

Amateurs helping me to evaluate the requirement for tuning flexibility on weather satellite receivers included Ralph Taggart WB8DQT, Dale Hauck W6YFT, John Prigg WA7JIO, and Bob Schloeman WA7MOV. Each of us approached the problem in a different way.

Ralph designed his own VHF-FM receiver from the ground up, with a design which included frequency tuning. Although his circuit employs a tuning varactor diode, it's not too different from mine. He is currently producing the receiver commercially, and from all indications, it should significantly benefit weather satellite enthusiasts.[16]

Dale first tried tuning the microwave LO chain, suffering the very phase noise problems I mentioned earlier. He has since ordered one of Ralph's tunable receivers.

John ordered a synthesizer to go with his existing VHF receiver. The synthesizer gives him fixed-tuned coverage in 5-kHz steps, which is adequate for keeping the received signal rather close to the center of the receiver's passband.

Bob has been using ice cubes, blankets, and lots of luck to try to keep the temperature constant on his microwave downconverter! Though this is certainly the least costly solution of the temperature stability problem, he admits that it does have its weaknesses. By the time this appears in print, the chances are that he will have modified his Vanguard receiver for variable tuning. ■

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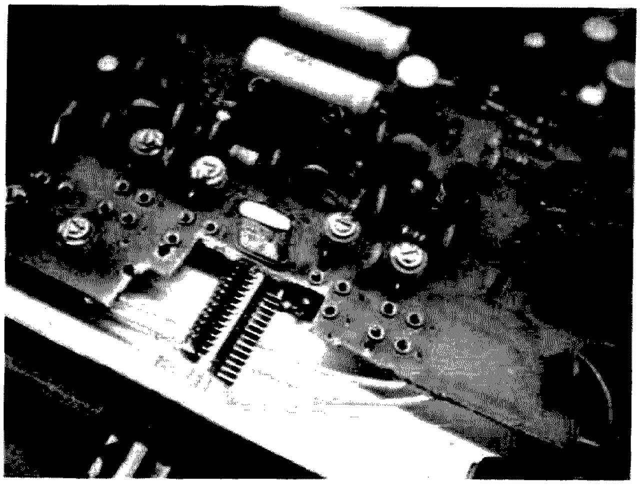
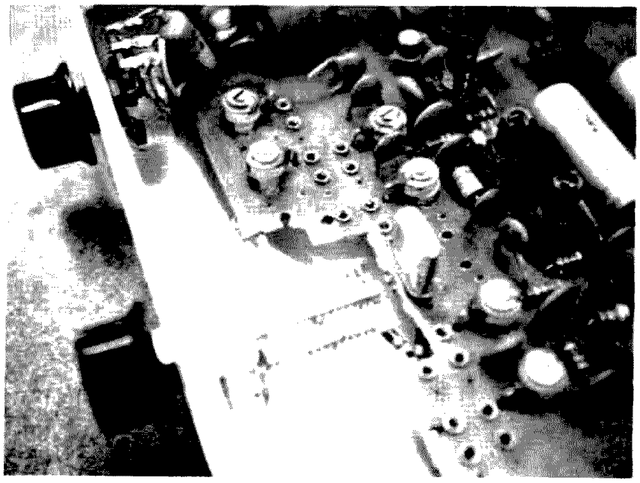
7. Ralph Taggart WB8DQT, "A

These two pictures show the component side of the modified Vanguard receiver. Note the surgery mercilessly performed on the PC board, to allow for the mounting of the tuning capacitor. The rf chokes are visible behind and below the air-variable capacitor.

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16. Model GR1-IF; available from Metsat Products, Box 142, Mason MI 48854.

17. Model RX-1691; available from Microcomm, 14908 Sandy Lane, San Jose CA 95124.

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Ham Radio Marriage Manual

—a YL and her understanding spouse

My reason for writing this article is the tone of surprise or, in some cases, absolute amazement in the voices of my contacts when they learn that I am married to a non-ham.

Not only is the OM not a ham, he doesn't seem to have any desire to be. Since a ham ticket has to be earned at the expense of the individual who wants it, I can not and will not try to push him. He returns this respect by not trying to force on me the—to me, questionable—joys of fishing. The result is that we view each other's hobbies with a kind of head-shaking fascination.

Upon learning that Roger is not a ham, my contacts always ask the obvious question: "How in the world did *you* ever get interested in radio?" The answer usually goes something like this.

There has been a streak of ham in me for years—more years, in fact, than I care to count. It tickles me to remember back to my first year in high school, when my mother and the guidance counselor had to threaten me to get me to take my first speech course. I have silently thanked both of them many, many times since. That first involvement with speech led to what developed into a real love—communicating with people. By the time I finished high school, I was hooked, and it came as no great surprise to my parents that I chose to major in Radio and Television Communication Arts. It was my intention, at that time, to make broadcasting history and revolutionize the communications industry.

Before I finished college, however, and certainly before I had time to gift the broadcast industry with my presence, I married my high school sweetheart. In the years that followed, we traveled around the country at the request of Uncle Sam. Roger was in the Army at the time, and when Uncle Sam invited, it was not an invitation that one could refuse. Of course, our beautiful daughter, who is now nine years old, came along. I never lost my love of people and the enjoyment of exchanging ideas and thoughts.

In 1971, I met Marie WB5OKV, who later became my "Elmira." She was not a ham, but her OM, at the time, was. A few years after we became friends, she began studying for her license. By this time, we were close friends, and I wanted to help her if I could. About the only way I could help was to read her the questions from the license manual. I had no idea what I was reading, but after a while managed to be able to gather whether or not she was right. Most of the time, she would know if she was right or not when I would say, "It says here . . ." At any rate, she told me it was a help to her—maybe she was just being nice.

At this point, I still had not been bitten by the bug. Naturally, after getting her ticket, that's all she talked about. She suggested that I might enjoy ham radio and offered to help me study. At first, of course, I thought I'd never be able to understand all that theory and the code, but after a few months, it finally dawned on me that an amateur radio license was my passage to anywhere I wanted to go. With the cost of living index going up faster than my weight (a phenomenon in itself) and no end to inflation in sight, the only way I could ever see all the places I wanted was through the eyes of the people living there.

So I took Marie up on her offer of help, borrowed her study material, and set out upon what would become a long journey.

I told Roger what I wanted to do, and he said he thought it was a fine idea. The code was the worst thing I had ever tried in my whole life, and theory was about as clear as mud. After a while I became very discouraged, which I have learned since is quite natural. All of you who have ever been in that position will remember. First, you think to yourself, it's not that important, anyway. After all, you've gotten this far in life without it. Right? Then we all realize that we do want it, and the deep-down want-to takes over again and we decide that we will get it no matter how long it takes.

After weeks of study, worry, code practice, sweat, and tears, I took the Novice test, administered

by none other than my Elmira, of course. I felt that I had passed, but was nonetheless amazed and overjoyed a few weeks later when the license came in the mail. Marie understood my excitement, and Roger was happy that I was happy.

After that, I studied with a new dedication for that coveted General ticket. During this time, Roger was patient and tried to be cooperative, but he simply didn't understand how important it had become to me. Marie gave me great moral support, listened to my code, and went over theory points with me whenever I asked her to.

In spite of where my mind was, the usual domestic chores had to be kept up with. So, in order to keep pace with both, I would prop the license manual in the window above the sink while doing dishes, and I listened to a tape recording of me asking theory questions while I ironed. There was a list of formulas on the wall above the washing machine, and Roger's patience was really put to the test the first morning he looked in the bathroom mirror and found himself looking at a block diagram of a receiver.

Finally, the big day in February of 1977 was drawing near. I was going to go to San Antonio for the test since the FCC did not come to Laredo. Plans were made for Marie to help watch my daughter while I made the overnight trip. Test time was 8 am, and I knew better than to think I could get up at 3 am, drive 150 miles, and still have an even chance of passing. So I went the evening before and spent a restless, almost sleepless, night. Every time I closed my eyes, I saw swr rushing at me, and when I tried to run, I kept falling over the formula for inductive reactance. Ultimately, I was taken prisoner by an army of capacitors in series.

The next morning, bleary-eyed and battle-weary, I went to the test. The next couple of hours are a blur in my memory, but I left the examination room clutching a form, signed by the examiner, saying that I had passed the required elements for a General license. Believe me, the tires of my car did not touch pavement all the way back to Laredo!

When I pulled up in Marie's driveway, she was seated in front of her radio. (Her shack was in the garage.) Her blank stare of questioning anticipation was transformed into a smile that went from ear to ear when I gave the thumbs-up signal. I still wonder what her neighbors thought as we yelled at the top of our lungs and jumped around like kids on Christmas morning.

Roger was pleased for me and a few weeks later made me a gift of a 2 meter rig for my car. By this time, he had realized that I was serious and was not surprised that for the next many weeks my every spare moment was spent in Marie's shack listening to and, at her gracious invitation, talking to, her friends on the air. These people became my friends, too, and helped me locate a used Swan 500C that was in good shape at a reasonable price.

Of course, even a reasonable price presented a problem for me. Since the household budget was strained to the breaking point, the $300 I needed sounded like the national debt. The only answer was a part-time job. That was no easy task, either, since I had not worked in years. I was able to find one, however, and being aware of my dilemma, the ham from whom I bought Charlie (the name I gave the rig) offered to let me use it while I paid him for it. Heaven doesn't have a corner on the angel market!

We put up my 40/80 meter doublet well in advance of Charlie's arrival, and I spent the rest of the waiting period fixing up the closet of the guest room, which was to be my ham shack. I had decided that the garage was too hot in the summer and too cold in the winter. Besides that, the closet location would allow me to close the door and keep the rig out of sight of small children who might come to visit.

On the evening of October 3, 1977, Marie and I met Charlie at the bus station and rushed home to get him on the air. Ever since then, amateur radio has been a big part of my life and has brought me many, many hours of pleasure.

Thanks to amateur radio, I have met and made friends with some fantastic people. I've spent hour upon hour listening to other people, sometimes not even breaking in. One can learn a lot just by listening (and about theory, too). Even though I may not have anything to contribute to that particular QSO, I still find it interesting to hear others exchange ideas. I have felt the thrill of talking to people in some of those places I may never see and have known the warmth of helping people find out about loved ones.

Do you have any idea how large a child's eyes can get when he talks to Santa Claus on the radio? (Thanks, J.R.) Some of the people I've met on the air I have had the pleasure of eyeballing and some I have not, and there are others whom I have met that I will never see again because they have become silent keys. I will always cherish their memory.

To me, there is a very real sense of accomplishment in being a ham. Everyone needs to feel the satisfaction that comes from achieving, regardless of age. For me, amateur radio has offered me an avenue of accomplishment, achievement, and pure enjoyment that I have not found anywhere else. I have only regret—and that is that I did not find it sooner.

When I came home after finally passing my Advanced test (suffice it to say that I did not pass it the first time I took it), Roger asked me if I was finished yet. He isn't usually given to such foolish questions!

The bottom line to all this is that if you want a ham ticket, hang in there. For some, the code and theory come more easily than for others. But there is one thing true of every ham in the world—none of them was born with a knowledge of electronic theory, and I assure you that not one of them ever said his first word in CW. We all had to learn it. When I first began studying, I thought ac was the brand name for a spark plug, dc was where the President lived, and CQ was duty that the OM used to pull in the Army!

Don't be dissuaded if you're living in a home without a ham. When you do get your ticket, you will be able to count yourself special because you had more obstacles than most. In any case, don't be scared off by thinking amateur radio is no place for a woman. There are hundreds of us girls on the air. Of course, there are a few guys around who still think that amateur radio is a man's world, but they are few and far between. Ninety-nine point nine percent of the time you'll be welcomed with open arms, as I was. ■

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Photo A. The 10-meter square vee supporting a nine-year-old helper.

Want an electronically rotatable array, but can't afford the vertical height required for a sloper system[1] or a perverted double vee?[2] Don't have an extra acre or two for a good radial system on your phased verticals? Maybe the DJB Square Vee is for you.

Here's an antenna only a quarter-wavelength high, supported by a single mast, that doesn't depend on a good ground system for efficient radiation. It is electronically rotatable, doesn't require an antenna tuner, doesn't require retuning as the pattern is rotated, and has both high- and low-angle lobes useful for both local and DX work. This is an antenna that could be tacked to the side of an apartment house or, on the high frequencies, easily could be made collapsible for portable or field day operation. Interested? Read on!

Design

The heart of the system is the 3/8-wavelength dipole.[3] A diagram of this dipole, which is 25% shorter than a normal half-wave antenna, is shown in Fig. 1.

The dipole is formed from two $3\lambda/8$ sections of 300-Ohm twinlead. The first section is connected to the second with a 1.5-inch-long piece of twinlead, twisted as shown. The ends of the dipole are at a voltage maximum and must be separated by cutting the ½-inch space shown in Fig. 1. The feedline, a $\lambda/4$ coaxial matching section discussed later, is attached directly to the antenna feedpoint.

The $3\lambda/8$ dipole has not been used widely in the past by amateurs. In part,

this is due to its odd radiation resistance (about 200 Ohms) and to its physical complexity. The square vee takes advantage of both of these apparent drawbacks.

In the square vee, two 3λ/8 dipoles, each bent in the shape of a vee, are mounted vertically with the feedpoints spaced a quarter-wavelength apart. For high frequencies, the antenna can be mounted on a wooden cross, as shown in the schematic of Fig. 2. At lower frequencies, a mast can be used for vertical support with guy wires pulling the feedpoints apart.[2]

The two dipoles are connected in parallel at the phasing control box, which is located in the station operating room. This device is used to adjust the relative rf phase between the dipoles by changing the length of their feedlines. The pattern control box, therefore, allows the pattern of the antenna to be rotated in the same manner as an array of phased verticals.[4,5]

Construction

An example of a ten-meter square vee supported by a wooden cross is shown in Photo A. Each crosspiece is cut slightly longer than a quarter wavelength. The two pieces are joined at the center, and the feedpoints of the two dipoles are connected near the ends of the horizontal crosspiece, as shown in Fig. 2.

Of course, it doesn't really matter whether you use a cross-type support or a simple mast with guy wires. Remember, though, for *all* types of vertical directional arrays, use a nonconducting support such as a wooden mast. A metal mast in the plane of the radiating elements can strongly influence the electrical behavior of the antenna, and may result in disappointing performance. The square vee has a real advantage over the sloper array or the perverted vee in this regard, as it requires only a quarter-wavelength mast rather than a half wavelength or so. On 40 meters, this means the difference between a 34-foot mast, required for the square vee, and the 50- or 60-foot masts required for the other systems.

Using 300-Ohm twinlead makes construction of the 3λ/8 dipole simple. Two sections of 300-Ohm twinlead are cut to 3λ/8. The wires, but not the insulation, are cut at the centers to form the interconnections, as shown in Fig 1. A 1.5-inch piece of twinlead is used to connect the first section to the second. Be certain to separate the wires at the ends of the dipole, and leave about half an inch of space between the ends of the wires (see Fig. 1).

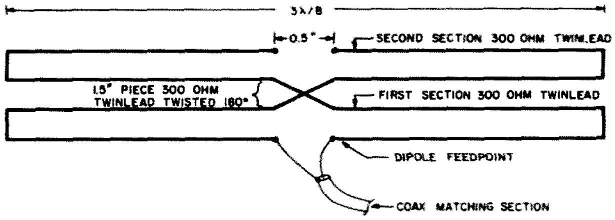

Fig. 1. Schematic drawing of the 3/8-wavelength dipole.

For each dipole, the first section of twinlead is mounted on one side of the horizontal crosspiece, and the second section is mounted on the other side. The 1.5-inch connection at the center (see Fig. 1) feeds through the horizontal support as shown in Photo B. This method of mounting keeps the wires of the dipole properly spaced. The ends of the twinlead can then be attached to the top and bottom of the vertical mast. I used small wire brads tacked through the center of the twinlead near the end. Before the ends are permanently attached, however, it is best to secure them temporarily with tape and check the antenna tuning.

Tuning

For maximum performance, it's very important that the two dipoles be electrically equivalent. Beg, borrow, steal, or perhaps even buy a grid-dip meter or similar instrument and trim the lengths of the dipoles to resonance at the desired frequency. I found that the length had to be slightly shorter than three-fourths of the length predicted by the traditional formula $L(\lambda/2) = 468/f$ (MHz), where $L(\lambda/2)$ is the length of a half wave in feet. Two factors probably accounted for this. First,

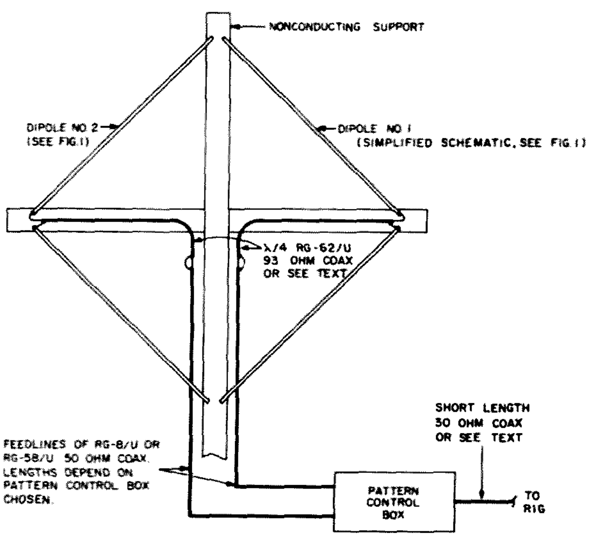

Fig. 2. The square vee antenna supported by a mast and crosspiece. The pattern control box is located inside the operating room near the station.

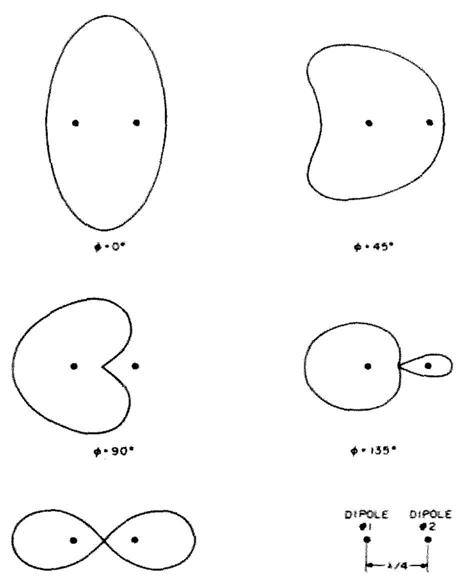

Fig. 3. Antenna radiation patterns in the horizontal plane for two vertical dipoles spaced a quarter wavelength apart.

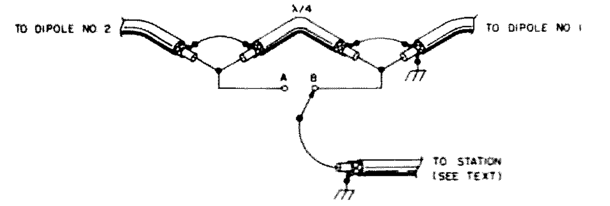

Fig. 4(a). Circuit of the pattern control box for phasing steps of 180°.

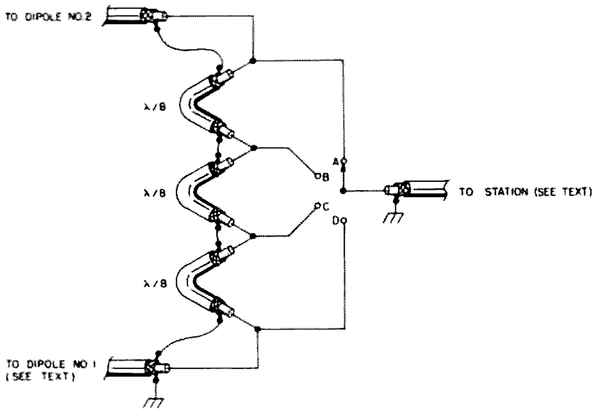

Fig. 4(b). Circuit of the pattern control box for phasing steps of 90°.

the formula doesn't include the one-inch interconnection between the two twinlead portions of the dipole, Fig. 1, and, second, the formula is good for a linear dipole and not a dipole in the shape of a vee. You probably won't go too far wrong if you cut the dipole length 1% shorter than that given by the standard formula; that is, use $L(3\lambda/8) = 347.5/f$ (MHz).

Antenna Matching

The radiation resistance of a linear 3/8λ dipole, measured high above a perfect ground, is about 225 Ohms.[3] In the configuration shown here, I found the radiation resistance to be closer to 175 Ohms. The radiation resistance of the antenna was lowered both by its vee shape and by its proximity to surrounding objects. It's very important that the swr on each dipole feedline be as close to unity as possible. If it's not, the load on the transmitter will change as the pattern is rotated, and the transmitter will have to be retuned for every direction. What's more, a mismatch here will probably require a matching network between the transmitter and the antenna for proper operation.

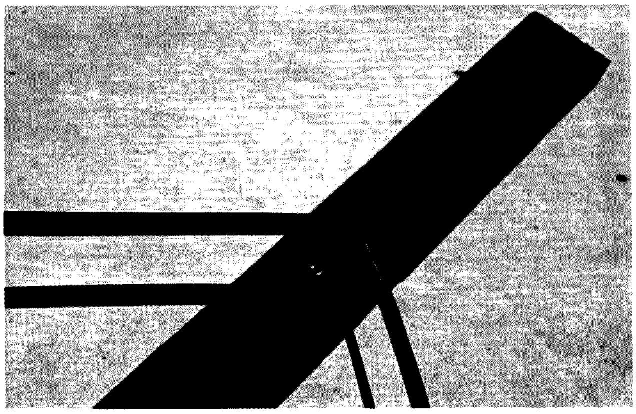

Photo B. Closeup of the dipole feedpoint near the end of the crosspiece. The coaxial line feeds through the wooden crosspiece to connect to the dipole.

A quarter-wave matching section of 93-Ohm coax, such as RG-62/U, makes a good match between the 175-Ohm antenna resistance and 50-Ohm coax feedline. We calculate this from the formula $Z_1 = Z_o^2/Z_r = (93)^2/175 = 49.4$ Ohms,[6] where Z_o is the impedance of the quarter-wave matching section, Z_r is the radiation resistance of the antenna, and Z_1 is the impedance at the feedpoint of the quarter-wave matching line.

Instead of the quarter-wave coaxial matching network shown in Fig. 2, a 4:1 balun transformer (Amidon Associates kit) could also be used.[7] The balanced, high impedance side of the balun would be connected to the antenna feedpoint, and the low impedance side to the 50-Ohm coax feedline. This should work especially well in installations where the radiation resistance of the dipoles appears closer to 200 Ohms than to 175 Ohms.

Phase Control

The 50-Ohm feedlines, RG-8/U or RG-58/U, run down the vertical mast into the operating room, and connect to the pattern control box. The pattern control box selects the relative rf phasing between the two dipoles and allows the directivity of the antenna to be changed. Fig. 3 shows the horizontal antenna patterns that can be expected from two dipoles a quarter wavelength apart, as θ, the rf phase angle between them, is changed. Of course, the shape of these patterns depends upon the incident angle of the incoming radiation, and the expected performance is modified further by the vee shape of the individual dipoles.

	Switch Position	Phase Shift
Equal Length Feedlines	A	+90°
	B	−90°
Feedline #1 90° Longer Than Feedline #2	A	180°
	B	0°

Table 1. Phase shift between dipoles #1 and #2 as a function of switch position for the pattern control box of Fig. 4(a).

Fig. 4(a) shows an elementary switching network that can be used to select between the 0° and 180° patterns, or between the +90° and −90° patterns. (The −90° pattern is the reverse of the +90° pattern.) For the 0° and 180° patterns, the feedline of dipole #1 must be a quarter wavelength, or 90°, longer than that of dipole #2. For the ±90° patterns, the feedlines must be equal length. Table 1 shows phase shift versus switch position for the difficult feedline lengths.

In calculating the electrical length of the feedlines, be sure to measure the physical length very carefully, and include the effect of the velocity factor for the coax you use. The velocity factor for solid dielectric 50-Ohm line is 0.66, and the velocity factor for foam dielectric line is 0.80.

The circuit diagram for a more versatile switching network is shown in Fig. 4(b). This network allows the antenna phasing to be switched in 90° increments, and requires that the feedline for dipole #1 be one eighth of a wavelength, or 45°, longer than the feedline of dipole #2. The phase shift (as a function of switch position) for this circuit is given in Table 2.

If desired, a more complex network employing an

eight-position switch could be used to select antenna patterns at 45° intervals. This would require that the feedline of dipole #1 be 22.5° longer than that of dipole #2, and would require one sixteenth of a wavelength of coax (22.5°) between each switch position.

Station Matching

If the dipoles have been carefully matched to the line, the termination impedance at the end of each feedline will be very close to 50 Ohms. When the two dipoles are connected in parallel at the pattern control box, the feedpoint impedance at that point will be 25 Ohms. There probably are a number of ways to match this 25-Ohm resistive load to your transmitter. If the output circuit is capable of matching a 25-Ohm resistive load, you can couple it directly to the pattern control box through a *short* (compared to a quarter wavelength) piece of 50-Ohm coax. Or, you can connect the pattern control box and the transmitter with a half-wavelength of 50-Ohm coax. The latter solution is better at the high frequencies; even though the swr on the line is about two, its short length prevents significant losses.

The technique I used was to connect a quarter wavelength of 73-Ohm RG-59/U from the pattern control box to the transmitter through a balun step-down network. The quarter-wavelength of 73-Ohm line transforms the 25-Ohm feedpoint at the pattern control box into a 213-Ohm load. We see this from the equation used previously, $Z_1 = Z_0^2/Z_r = (73)^2/25 = 213$ Ohms. At the transmitter end of the quarter wavelength, I used a 4:1 balun with the low impedance side connected to the transmitter to transform this in- to a 53-Ohm resistive load. This is a little bit more trouble, but provides an excellent match to pi networks designed to operate on 50- to 75-Ohm resistive loads.

Performance

I built my first square vee for the 10-meter band and used the pattern switching arrangement shown in Fig. 4(b), i.e., phasing steps of 90°. I mounted it on the roof approximately 20 feet off the ground, underneath a 40-meter inverted vee. The antenna required only minor retuning of the transmitter as the pattern was rotated, and I found that with about 100-Watts output, I could work almost anyone I could hear. A large number of European, East Asian, and Oceanic stations were contacted on both SSB and CW with a call-per-contact ratio for DX of about 80%. In other words, it works.

The big advantage of the antenna, however, lies in its directional performance. A large number of tests were performed on both receiving and transmitting, and it was found that the front-to-side ratio between the 0° and 180° phasing positions was about four S-units. As the patterns are not symmetric, the front-to-side ratio between the 180° and 0° patterns is different—and this was found to be about two S-units. The front-to-back ratio between the +90° and −90°phasing positions also was found to be about two S-units.

As an example of the directional performance, let me describe an actual contact with this antenna. With the 0° phasing pattern, I had maximum gain to the northeast, and was listening to a W8 station at S6. In between pauses, I heard a weak station, at about S3, calling CQ. Rotating the pattern to 180° phasing knocked the W8 down to S2 and brought in the other station at S5. It was an RAØ, and one call to him made the contact. Play with this for a couple of hours and you'll never go back to an omnidirectional antenna.

Switch Position	Phase Shift
A	180°
B	90°
C	0°
D	−90°

Table 2. Phase shift between dipoles #1 and #2 as a function of switch position for the pattern control box of Fig. 4(b).

Summary

Here's an electronically rotatable antenna that's 44% smaller in area than a single quad loop, stands only a quarter-wavelength high, and doesn't require retuning as the pattern is rotated. Of course, this antenna won't outperform a full-sized yagi/tower combination on the high frequencies, or an array of phased verticals with an extensive ground system in an open field on the low frequencies. And, like all electronically rotatable arrays, the shape of the pattern changes with the direction chosen. But at moderate heights, and with no special ground preparation at all, it appears to do a first-class job.■

References

1. *The ARRL Antenna Book*, 1974, p. 200.
2. Massa, A. J., "The Perverted Double Vee Antenna," *73*, June, 1978, p. 66.
3. Kraus, J. D., *Antennas*, McGraw-Hill, New York, 1950, p. 417.
4. Desjardins, B., "Phased Verticals for Easy DX," *73*, June, 1978, p. 82.
5. Swank, J., "Novice Guide to Phased Verticals—Part 1," *73*, June, 1978, p. 136.
6. *The ARRL Radio Amateur's Handbook*, 1976, p. 576.
7. Amidon Associates, 12033 Otsego Street, North Hollywood CA 91607.

which might be covered on the exam. I have heard them saying they arose at 5 am to practice their code. This is nonsense.

The best asset to bring to your FCC examination is a relaxed mind. The best way to assure this is to go to bed early the night before and to do nothing of a technical nature upon awakening. No code practice, no last-minute peek into a textbook, no checking out of cram slips. Instead, have a relaxing shower, a good breakfast, a look at the morning newspaper—anything but ham radio. In this way, you arrive at the examination site with a mind that is capable of leisurely comprehending the code that will be sent to you.

The Written Exam

Let's say that you've taken the code examination, you've been told that you passed, and now you can take your written examination. This is all there is between you and your higher class license. What tips can I offer to help you pass this portion of the exam?

Here are a number of things to keep in mind as you prepare for—and take—the written examination. Follow them and your success is virtually guaranteed.

1. Know your stuff. Very few people get through the exam if they don't know the material. You should get the necessary textbooks and study the material. Become as expert as you can with the technical side, operating procedures, and regulations.

2. Get as much practice as possible working on multiple-choice questions. Most textbooks offer sample questions and answers to give you experience in answering FCC-type questions. Study as many of these questions as possible *after* you've studied the material. Don't use the questions as a method of studying; use them to help you check on your understanding of the material studied.

If you've done steps 1 and 2, you're ready for all those that follow.

3. You now arrive at the FCC office. If you follow the advice given above for passing the CW portion of the exam, you'll be refreshed and relaxed. This condition is as important for passing the theory portion as it is for the CW portion. No last-minute cramming, no peeking into the text to look up that formula one more time, no carrying of sheaves of paper to refresh your memory at the very last minute. Shut off the studying before supper the night before. Let your mind relax.

4. Bring a calculator. This saves mental wear and tear and helps ensure correct answers to mathematical problems.

5. When you are entering the examination room, you will be given the printed test, the answer sheet, and a blank piece of paper for calculations and scribbles. As you sit down, take out the two pencils you've brought along, and for the moment put aside the test booklet and answer sheet. Now, while your mind is still relaxed, write on the piece of paper every formula you feel you may have to use. Write down every item that may be a little shaky in your mind. As long as these formulas and items come from your mind, everything is perfectly proper and legal. Why do this? Because your mind is relaxed and it's easier to recall, say, what the formula is for capacitors in parallel than it is to recall the formula when faced with an actual question. That's how the mind works. Ohm's Law can take on some interesting variations in the mind of a ham who is wading feverishly through an exam.

6. Once you've put on paper all your necessary formulas, open up the test booklet and see what the number of the first question is. Why do this, you ask? Don't all tests start with number 1? Not at the FCC, they don't! This test may start with 1, but it may start with 51, or 101. As soon as you see which number it starts with, take the answer sheet and mark the corresponding number with your pencil. This is where you start to answer questions on the sheet. Basic, you say? Obvious, you think? Yes, but we don't know how many aspiring hams (who knew their theory cold) failed the FCC exam because they gave beautiful answers to questions 51 through 100 in the spaces on the answer sheet marked 1 through 50. In short: Answer the question asked in the booklet at the exact spot on the answer sheet where the answer will be graded.

7. You're now ready to attack the first question. Here's the technique to follow: Read the first part of the question, the part before the multiple choices, but *do not* look at the five answers offered. See if you can mentally determine what the correct answer is before looking at the five choices. For example, if the question says, "The 'Q' signal for 'I am being interfered with' is . . . ," your mind should pause and mentally seek the correct answer—QRM. Once thought, write it down on the sheet of scrap paper. If you don't do this, you are now faced with a confusing array of Q signals from which you must make a choice: QRS, QSK, QRQ, QRM, and QNX. In the pressure of an examination, you might make the wrong choice when faced with this selection. So, for each question, don't look at the answers first. Mentally determine what the correct answer should be, write it down on your scrap paper, and then check the answers supplied to see if your answer matches one of the exam's answers.

8. Having picked out the right answer, indicate it on the answer sheet, and be sure that you put the answer in the right spot (a, b, c, d, or e) and at the right answer number. Don't put a "b" answer in the "c" slot, and don't answer number 73 in the space for number 74. Be alert.

9. Continue this process with each question. At some point, you'll come across a question which you can't answer in your mind. Now what do you do? At this point, look at the "a" answer *only*. Does it seem to be the right one? If so, write "a" on the scrap sheet. And then go on to b, c, d, and e, seeing if a "better" answer appears. If it doesn't, write "a" on the answer sheet in the appropriate spot. If another answer appears that seems to be just as correct, you have to make a judgment as to which is more correct. Once you've done this, write the answer in the appropriate spot. Continue on through the exam.

10. Let's say you come across a question that you can't answer. You review the five answers and none seems appropriate. At this point, write the number of the question on your scrap sheet and go on to the next question. Don't fret. Don't worry. The FCC gives you quite a margin for error in the exam. One question doesn't make much difference. The main thing is to keep your mind at ease, relaxed, and happy. Go on to the next question and let your subconscious mind take over. While your conscious mind is scanning the next question, your subconscious mind will be poring over the question you just passed. At some mo-

ment, the answer just might pop out.

11. Continue with this procedure. Answer the questions you're able to answer. Pass the questions you want to do something about later, after noting their numbers on the scrap sheet. If your mind suddenly gives you the answer to a skipped question, stop in your tracks and return to the question. Immediately write down the correct answer in the appropriate spot.

12. When you have gone through the list of questions the first time, return to the ones you could not answer. Read each question carefully and see if you see something which you didn't see the first time. Many times, a second reading of the question gives you a new slant on what is being asked or on what is being offered as an answer. See if you can pick out the correct answer for each skipped question.

13. If you cannot pick out one answer of the five offered, try to *eliminate* the incorrect answers in an effort to reduce your choices to two or three. When you have done this, pick the best-looking answer and write this on the answer sheet. Having made your decision, go on to the next question.

14. When all else fails, *guess*. Leave no question unanswered. You get no credit for an unanswered question. You may be lucky and guess the correct response.

15. After you have answered every question and have written the answers on the sheet, go back and check each answer on the sheet. Be sure it agrees with the answer you feel is correct. If the answer to 63 is "b", be sure "b" is indicated after 63 on the answer sheet. In the pressure of an examination, most people will incorrectly list one or two answers. By reviewing each answer, you can just about guarantee yourself one or two "extra" points which may be critical in passing the exam.

16. To reduce the tension, consider taking the code on your first visit to the FCC office and the written examination on your second visit. In this way, you can concentrate your mental energy on the task at hand: copying the code at the necessary speed or choosing the proper number of correct answers to questions on theory and regulations. (This splitting of parts of the test is more easily accomplished in cities where the examinations are held weekly or monthly.)

There are only three reasons why anyone will fail an FCC examination:

1. *Lack of preparation*. If you haven't studied your material and if you can't copy code at the required speed (or a little higher), don't waste your time taking the exam. Miracles are not commonplace these days.

2. *Poor testmanship*. Unfortunately, a number of people who do know their stuff and who can copy code at the required speed will fail an FCC examination. This article is designed for this group. By following the principles outlined, any upgrading candidate should find his or her chances of success improved immeasurably.

3. *Nerves*. If you prepare sufficiently and do what this article suggests, you may be pleasantly surprised to find that your "nerves" have disappeared.

Good luck on your next exam! ■

✓ Reader Service—see page 259

Muffin Fan Mania!

—a compendium of knowledge about electromechanical air movers

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The increasing price and rarity of vacuum tubes and other components in your ham rig make it imperative that it run as cool as possible. Have you ever wondered when those poor, hot components in the rig will finally melt into oblivion? The heat generated by the power-handling parts of the transmitter should be directed well away from the rig, preventing a possibly expensive episode in radio self-annihilation. Fortunately, there's an easy way to alleviate the woes of an overheated goodie in your station.

An electromechanical air mover, commonly called a fan, can be employed to keep things cool when thermal overload becomes imminent. In fact, the electronics industry is utilizing these gems in a variety of configurations more and more frequently as component densities escalate and enclosures shrink. One estimate puts the number of miniature air movers at the all-time high of 80-million dollars worth just last year.[1] With all this expensive hot air blowing around, there must be some good reasons for you to consider installing an auxiliary cooling device in your station.

There are indeed several good reasons for helping your rig stay cool: Components and tubes last much longer, frequency stability is improved with less thermal expansion of coils and coil forms, and smoked capacitors and resistors due to simple overheating just don't occur.

The fans I'll be discussing in this article are the so-called tubeaxial fans, normally known as Muffin™ fans (EG & G Rotron trademark). These things usually

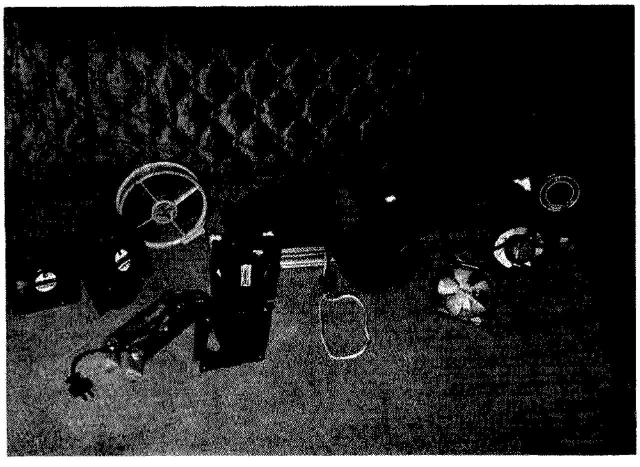

Photo A. A typical collection of fans available at flea markets for under $10. Visible are Pamotors, a Feather, Centaur, Caravel, and Boxer fans.

Photo B. A couple of fine-running Pamotor fans from Germany.

have square or circular housings with an "inside-out" motor—the shaft part of the motor is the fan hub with the moving blades attached. They're by far the most popular and useful fans available to the radio amateur.

Almost all ham rigs today have a well-designed natural air ventilation system called "convection cooling." This simply means that the warm components in the rig heat up the air nearby, causing it to rise and draw cool air in from the bottom of the case. This works great, but the idea (and cooling effect) is tremendously enhanced by placing a fan in the right spot on or by the rig. The result is a much cooler running operation.

Trademark Name	Cfm	Comments	Price
Sentinel	100	Stainless steel ball bearings	$25.00
Centaur CT3A2	100	Sleeve bearings, 15 Watts	16.90
Mark IV Muffin	100	Very popular	12.05
Whisper	65	Super quiet, 6 Watts	12.05
Sprite	35	3½"-square, 11 Watts	14.95
Spartan	110	Military, stainless steel BB	45.50
Feather	270	SS BB	36.85
Saucer	280	SS BB	70.40
Caravel	575	BB	29.70
Tarzan	350	BB	46.65

Table 1. EG & G Rotron fans, with 1970 prices.

Choosing a Fan

I've compiled a list of the most common fans you'll find at a swapfest or surplus store in Table 1. These are the Rotron trademark names, listing the amount of air moved (in cubic feet per minute, or cfm), and some very dated 1970 prices so that you can get an idea of their original market value. Other fine fans are made by Pamotor, of West Germany, and the Boxer fan from IMC Magnetics. Be sure to inspect your purchase for dented or bent blades, and also spin the blades a bit to make sure they turn very freely.

Let me emphasize at the outset that you don't need much in the way of cfm to cool an already well-designed rig. The important operating factor to consider is the noise generated by the mechanical beast. The key to quiet success is a slow motor speed. For example, I put a little 50-cfm Pamotor 4800A (very quiet) on top of a normally frying-hot 17-tube Polycomm 2-meter rig, and the transceiver ran ice-cool thereafter.

So, pick a fan which doesn't take much power (therefore, it will be running slower) and which doesn't have more than about 75 cfm or so of cooling power. However, flea markets and surplus stores often don't have fans which meet such stringent requirements. If you do get a fast, noisy fan, there are easy ways to slow it down, as I'll mention later.

By the way, 220-V fans are ideal for ham applications—they run beautifully on 120 V, retaining 60% of their original air-moving power with only 20% of their original noise, and they're cheaper, too. Surplus companies often offer these at reduced prices because they were not originally specified for the 120-V line. Best buys here are the 220-V Feather, Saucer, and Sentinel, or equivalents.

Mounting a Muffin

The easiest way to determine what part of your rig gets hottest is simply to turn it on, let it warm up, and feel the top of the case for hot spots. Obviously, the area on top of the finals will be warmer than the rest of the radio, so that should be your priority target. If there are other heat-producing components in the rig, you can place the fan so it pulls the most air past the finals and gets the rest of the rig with somewhat reduced air-flow. A larger-diameter fan, properly slowed and quieted, is better for application in all-tube transmitters, while smaller fans do nicely in "all solid-state except the finals" rigs.

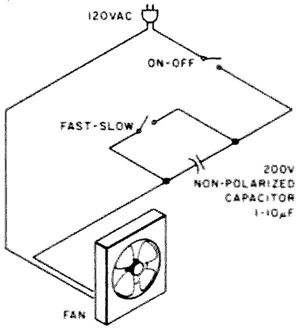

Fig. 1. Schematic of method to slow down a fan with a series non-polarized capacitor, 1 to 10 uF, at 200 WV minimum.

I don't recommend putting fans on receivers. They aren't necessary in a decent rig because there just isn't enough heat generated by its low-power components to warrant auxiliary cooling. If you want to cut down heat in an old-

Photo C. This Muffin fan sits over the finals and is mechanically damped by four felt feet.

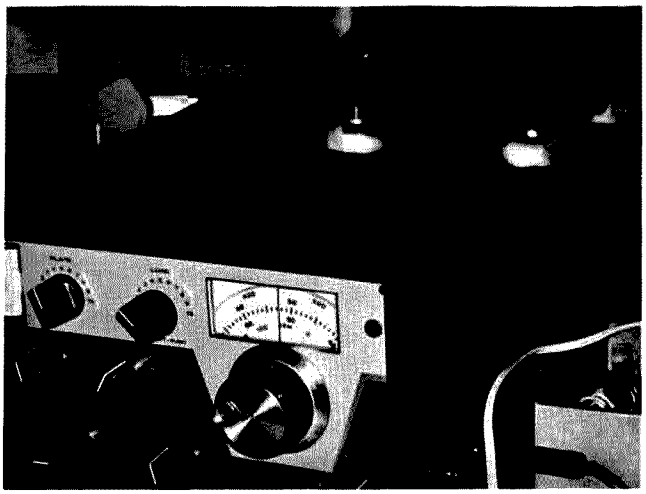

Photo D. A friend's setup with the fan bouncing merrily on four pads of foam rubber.

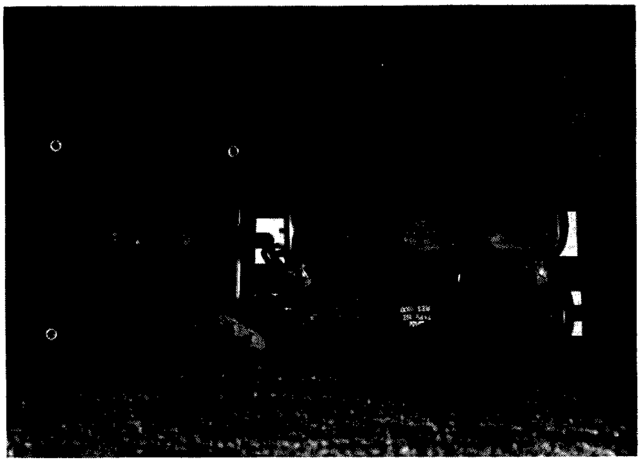

Photo E. The unclassy method of slowing down a fast, noisy fan, with power resistors. These two units need to be mounted in a well-insulated box, or be replaced by a much more elegant capacitor.

er tube-receiver, replace the rectifier tube with its solid-state equivalent (with suitable dropping resistors), and put in an LM-380 audio IC instead of those push-pull 6V6s.

When you mount the fan on your transmitter or transceiver, it's always best to place it on top of the rig so that it aids the natural tendency of hot air to move up and out. Don't try to blow air through the rig—just pull the hot stuff up and away. This makes it imperative that you keep the radio elevated on its mounting feet (don't take them off to save space), and that the area beneath the rig is kept as dust-free as possible. A too-powerful fan will suck dust and debris into your transmitter's innards, and a mild airflow is really all you need to keep the radio cool and clean.

You can kill potential mechanical vibration problems by sticking some foam rubber tape or thick felt under the fan. There's no need for an airtight connection between fan and case; just put something between them as a mechanical damper. The Pamotor I use has four felt pads glued to its underside, one in each corner, which work fine.

Quieting All That Coolness

As I mentioned above, the number one requirement for your fan is that it run quietly. In fact, plenty of air will circulate at the minimum noise level when the fan is running just a little faster than the rpms necessary to keep it going. How do you accomplish this with an ordinary Muffin?

There are two ways. First, you can put a 350-Ohm power resistor in series with the fan, experimenting with the values until it runs the way you like. This, however, generates heat—an advantage only if you have a cold basement shack and need a footwarmer! You should be very careful to thoroughly insulate the resistor from the outside world lest a shock hazard be created. Put it in a bakelite box with vent holes—and no, you don't need another fan to cool the resistor.

The second way is slightly more elegant, generating no heat. Simply put a 1-to-10-uF (again, experimenting with the values) non-polarized capacitor in series with the fan. Those old Pyranol non-polarized metal-cased capacitors clunking around in your junk box will work fine; you need at least a 200-V rating here. Don't use electrolytics—they aren't made for pure ac work. If you like to play with numbers and simple math, it's an easy matter to calculate how much capacitance you'll want. You need to know Ohm's law, the formula for capacitive reactance, how much power your fan draws, and how much voltage you want it to run on. For me, however, it's easier to slap in a few microfarads and see how fast she goes.

Fig. 1 shows a simple schematic of the fan and capacitor; I've added a switch across the capacitor so that you can zoom to full speed when you want to cool yourself off after a hot day's work at the rig. Again, be sure to put the capacitor and switches in a well-insulated box so that there's no chance of a shock. Be careful when you're experimenting with values—there's 120 V floating around on your connections.

Of course, if you have a 220-V fan, chances are it'll run slow and quiet by simply plugging it into 120 V. Just add some felt or foam padding to its mount, plop it on top of the rig, and be amazed how coolly the station runs.

The accompanying photos show evidence of a friend's mania for collecting these wonderful fans. Oddly, he never replaces tubes or other components in his well-used equipment. You'll have the same fantastic results when you simply and easily cool off the overheated parts in your own rig. ■

References

1. *Electronic Buyer's News*, February 27, 1978, pp. 26ff.

Other articles on the topic of Muffin fans have appeared in *Ham Radio*, November, 1972, and *CQ Magazine*, May, 1966.

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Are Repeaters Ripping Us Off?

—some thoughts about open access to scarce frequencies

Something has always bothered me about repeaters. It's never been anything like hatred or even a serious gripe. I've only felt a vague uneasiness when reading about them, thinking about them, or, lately, when using one. It's as though something were not quite right, and as hard as I've tried, I've never been able to put my finger on it.

I came up in hamdom from the Novice ranks using junky eighteenth-hand gear, and it was not until recently that all those classy multi-hundred-dollar FM portable transceivers fell within reach. So it still strikes me as odd that people will earnestly ask, "QRZed the frequency?" when no living soul is calling them on *any* frequency. Each new country has its own language, I guess, and I decided my uneasiness was only the acclimatization lag time of a stranger in a strange land.

The tales of repeater wars and users'-rights conflicts in LA amused me. One night while we slept, I supposed, the Good Lord tipped America on its side and all the loose nuts fell into southern California. No, Californians aren't any crankier than the rest of us, just noisier. If they're fighting about someting in LA, they're probably fighting about it—more quietly—everywhere else. My uneasiness remained, getting stronger every time I heard a new repeater take to the air.

Last fall I traveled east with my brand-new synthesized portable, clicking my way across the band on those marvelous magic thumbwheels. Repeaters were everywhere, and I talked on quite a few. There were many more which just didn't seem to hear me, regardless of how close I was. By the additional magic of PL™, they had shut themselves off in a world of their own, occupied by a few dozen calls and no more. My uneasiness got pretty intense listening to those unreachable machines, but I figured it was just sour grapes. My affable, rational side told me it takes all kinds to make a world and that there was plenty of room for everybody.

On a beautiful hill in Virginia, not far from Washington DC, I chose a quiet spot on the band and tried to see if I could latch into an apparent tropospheric duct and make some 2-meter distance. No one had spoken on that frequency since I had turned on the rig (about twenty minutes before), so I did the unthinkable and called "CQ 2 meters." A "good ol' boy" voice came back immediately and told me to kindly get off his private repeater input.

I'm used to 20 meters, perhaps a little more than I should be. When somebody says, "This frequency is in use," I apologize and scram. So, standing on my beautiful Virginia hilltop, I apologized and scrammed. It didn't hit me until late that night, while in the shower with a cold spray on my face, that my hilltop frequency had *not* been in use for at least twenty minutes. "Cool off, Chief," I told myself. "After all, it was his frequency." *His* frequency?

Like hell!

Suddenly, everything which had ever bothered me about repeaters became as clear as cocktail ice. I laid hands on a license manual and thumbed frantically until I found the paragraph in the rules which had eluded my thinking:

> 97.63. Selection and Use of Frequencies. (a) An amateur station may transmit on any frequency within any authorized amateur frequency band.

That seems pretty plain to me. Every ham who sweats his way into pos-

session of a license shares all frequencies permitted his license class. Nobody can stake out a point on the radio dial and defend it against all comers. 'Tain't legal, friends.

One outcome of Repeater Appreciation Day in LA was the demonstration of the fact that a repeater is an extension of the repeater licensee's home station. The only user with any rights is the repeater owner. Everybody else is a guest in the man's shack, and the owner may set any rules for guests which he desires. This seems to include limiting guests to whichever group the owner desires to have use the machine. That seems to make sense. After all, he paid for the repeater, and he keeps it running.

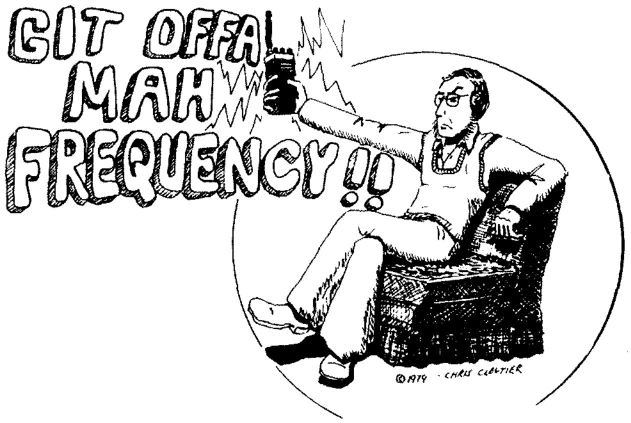
So much for the machine itself. But what about the *frequency*? A great many repeaters in urban areas now operate twenty-four hours a day. That means that, in effect, one man's ham station is sitting on a pair of frequencies for what may turn out to be years, with breaks for maintenance only. If I did that on 20 meters, they'd lock me up and throw away the key.

Of course, a repeater's carrier is not on at all times. But every ten minutes, like clockwork, comes the little announcement of callsign, location, local time, temperature, and God knows what else. In the wee hours of the morning, the repeater may not be keyed up for hours on end. But you can bet that, should a friend and I attempt to work simplex on the repeater's input frequency on any regular basis, a gang of DF-loaded station wagons would descend on us, loop antennas twirling, threatening to beat the both of us to marshmallow cream. The ham bands belong to all hams—says so right on the label.

This problem hasn't arisen until recently because, until recently, repeaters were something of a novelty. They were the new kids on the band, one here, one there, with lots of room in between and no objections from any of them to the ham who just wanted to jump in and say hello. Then the baby-boom babies grew up, bought Icoms, and started planting repeaters across the band like so many Johnny Appleseeds. We now have wall-to-wall repeaters, with more hams than all of them can handle. Hams, I've found, are incredibly courteous. If they find they're interfering with someone, they'll gladly slide up or down the band. But these days you can't take one step on 2 meters without stubbing your toe on somebody-or-other's repeater. Even more commonly, those repeaters are closed to the general hamming public. Do we have a problem? We sure do!

I now see the LA users'-rights crazies in an entirely new light. Out in the State of Excess, with more of everything per square inch than anywhere else, free space on the 2-meter band is probably pretty scarce. I have a hunch that the screamers are motivated by a feeling, just beneath the surface of rational expression, that the people who operate repeaters owe them something for the airspace that the repeaters take up.

In this new world of scarcity, nobody gets anything for nothing. We hams occupy our little sliver of God's good frequency spectrum because we provide free communication in times of national and international need. Have you forgotten that already? You shouldn't, because it's the only card we hold among the high rollers at WARC. A repeater cannot slide around the bands at will, the way that a man with a transceiver can. If a repeater effectively monopolizes a pair of frequencies, where's the justification?



At the present time, there isn't any. A repeater is an extension of a ham's private station, to do with as he pleases. My reading of the rules is pretty plain: A frequency pair is no man's own. If repeaters are to continue to sit on increasingly scarce frequencies, they must do what all the rest of us do for our country and our world—provide a service.

If a visiting ham slides into town and gets lost, he can key up a repeater and ask directions, right? Maybe, maybe not. If some drunk plows into him, he can key his HT and summon an ambulance on a repeater, right? Well, maybe. . .if he has the right PL. Otherwise, he'll just have to listen to the locals jaw about how soon they'll reach the work QTH while the drunk bleeds to death.

Rendering a worthwhile service may be no more complicated than keeping a repeater open to all incoming carriers, regardless of whether the incoming station is a club member, financial contributor, or somebody nobody has ever heard of.

I can already hear the gnashing teeth of repeater operators wondering how they'll support their machines if people aren't required to support them. Well, when I decided I wanted a transceiver, I saved my nickels and dimes until I got one. I did it because I *wanted* to. If a repeater club can't rake in enough voluntary support to keep its repeater running, maybe that repeater should be run in a less expensive location, or with reduced power, or without autopatch. Or maybe not at all. Does anyone else get the impression that there may be a few too many repeaters floating around?

Certainly, I see no justification at all for closed repeaters. They provide a service to only those few who are required to pay financial support, and still deny use of the frequency to licensed hams who do *not* want to use the repeater. This is a double violation of the rules that really ought to be looked at a little more closely. The users of repeaters have no rights to the machine, but they do have a right to an equal crack at the airspace. Or, perhaps, on the other hand, if the repeater keeps all rights to the frequency, then all hams deserve an equal crack at the machine. Does anyone agree? It's something we should talk about before we all become strangers on 2 meters, shouting vainly at repeaters which choose to hear only their favored few.■

My TRS-80 Is Here . . . Now What?

—first steps in programming your computer

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You unpacked the large box, examined the contents, and carefully plugged it all together . . . and it works. By now, you have read the excellent book that comes with the TRS-80 or, if you are lucky enough to have Level II BASIC, then you had two books to read . . . and digest.

The nicest thing for any beginning programmer is no different from the nicest thing for the beginning ham: a starting point to get from the superregenerative receiver to the superheterodyne. Both problems relate in this fashion. A complex radio is really nothing more than a collection of properly associated simple circuits which make up the whole. A whipper-doodingbust-golly-gee computer program is more of the same. The trick is to grab a firm hold of the elements from a simple starting point.

For purposes of illustration, I have chosen to work over a nice program in the TRS-80 level I BASIC book which sets forth a 24-hour clock program.

Taken verbatim from the book:

```
10 CLS
20 PRINT AT 407, " H M S "
30 FOR H = 0 TO 23
40 FOR M = 0 TO 59
50 FOR S = 0 TO 59
60 PRINT AT 470, H; ":" ;M; ":" ;S
70 FOR N= 1 TO 500: NEXT N
80 NEXT S
90 NEXT M
100 NEXT H
```

When entering this program and running it, you see the hours, minutes, and seconds start to count from 0:0:0.

With this much as our starting point, we can operate upon the basic program a bit at a time, so we do not byte off so much that we eschew it.

Like any sensible person, if you bought a timepiece at the local emporium, got it home and found you had no way to set the time, you could rightly work up a bit of indignation. Well, this clock so far is in that fix, but you can program it into practicality with the following few steps. Remember, we are listing new or revised lines to the fundamental program as we go.

```
52 X=X +1
54 IF X = 1 THEN 110
72 CLS
105 GOTO 30
110 INPUT H,M,S
120 GOTO 60
```

Now if you enter the program and run it, a header will appear as before, but this time there will be a "?" showing along with the header. The computer is saying, tell me what time you want me to start counting from. You enter the requested information by typing 3,0,0, which could be three am or three pm, depending on your life-style. Now when you hit ENTER, the clock starts keeping time from the entered data. You have added a knob to "set the hands."

What the whole process really amounts to is educational self-help. Working a bit at a time to alter programs means you will master the skill of programming. After all, you did not buy the machine to use someone's canned programs for the sheer thrill of getting typing practice.

So much for the philosophy. How about another small change? This time, let's humanize the program by changing it from a 24-hour clock to the usual 12-hour variety. This takes one more change to the program. Line 30 now becomes:

```
30 FOR H = 1 TO 12
```

You probably are not too happy with that vertical string of zeroes in the original program or any stray

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zero on the left side of the screen. We can de-zero the display by changing the contents of two lines in the program, namely lines 20 and 60. They now become:

```
20 PRINT "H M S"
60 PRINT H ; ":" ;M; ":" ; S
```

Now that we have de-zeroed the display, just a word about clock accuracy. The book suggests the number 500 in the timing loop in line 70. With the particular machine I had before me, 300 seemed to give a country-fair minute.

So far, we have a rather conventional clock which, without too much effort, can be turned into a conventional down-counting timer. With these changes, you have a timer that starts from a predetermined starting time of your choice, starts counting at the push of a button, and stops counting when it reaches zero.

These are the program changes to make the timer:

```
30 FOR H = 11 TO 0 STEP -1
40 FOR M = 59 TO 0 STEP -1
50 FOR S = 59 TO 0 STEP -1
105 END
```

The first three lines shown here reverse the order of counting from up, as needed for the regular clock, to down as desired for the advertised down-counter. The final change (line 105) makes the counter stop when the count has wound down to zero.

Small programs like this may not have the oomph of Lunar Lander or Star Trek but they lend themselves to piece-by-piece manipulation on a somewhat intuitive basis. (Reading the books that came with your computer also helps.) This is one way to achieve familiarity with the programming language that you must master if your computer is going to be more than a large, expensive paperweight. ■

Teaching Your Micro to Count

—two methods for adding counter capability to your 6502 machine

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One of the handier pieces of test equipment for digital circuits is a counter. If it's used to troubleshoot or design systems which involve a microprocessor (μP), it need not be expensive, since it need not count at a rate faster than a few MHz. Then, too, if it's used with an already-existing μP system, it is simple to construct, since the μP system can replace some of the hard-wired logic that is normally required.

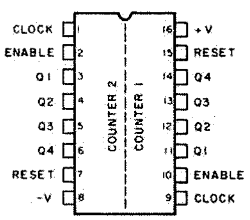

Fig. 1. Pin connections of 4518 dual BCD counter.

In the context of a μP system, we can implement a counter in more than one way. The first is straightforward, involving ICs which do the counting. The second way is also straightforward, but rather unconventional. The implementation consists almost entirely of a program, and we need add little or no hardware at all to our system. By comparing the two implementations, we can learn a little about replacing hardware with software and see what trade-off is involved. Our primary goal, though, is simply to add a useful piece of equipment to our system. As we'll see later, the conventional implementation produces a more versatile counter, so we'll consider it first.

Q_4	Q_3	Q_2	Q_1
0	0	0	0
0	0	0	1
0	0	1	0
0	0	1	1
0	1	0	0
0	1	0	1
0	1	1	0
0	1	1	1
1	0	0	0
1	0	0	1

Fig. 2. Response of counter to square wave.

The Counter IC

The principal component of our first counter is the 4518 dual BCD counter. Its pin connections are shown in Fig. 1. As its name implies, there are two independent BCD counters within the IC. There is no particular significance to the designations "1" and "2" in the figure.

Each counter has a RESET input. Applying a high level to this input forces outputs Q_1, Q_2, Q_3, and Q_4 to 0. Applying a high level to the ENABLE input and a low-to-high transition to the CLOCK input then advances the count from $Q_4Q_3Q_2Q_1$ = 0000 to $Q_4Q_3Q_2Q_1$=0001. As long as we hold the ENABLE input high, each successive low-to-high transition advances the count by one until a count of nine (1001) is reached. The next transition returns the count to 0000. Similarly, if we hold the CLOCK input low and apply a high-to-low transition to the ENABLE input, the count will advance.

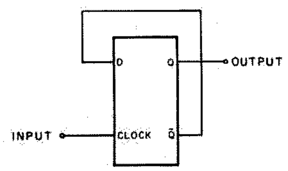

Fig. 3. Conditioning circuit.

If we want to determine the fundamental frequency of a square wave, and we know that it's between one and nine Hz, we can make at least an approximate measurement by applying the square wave to the ENABLE input and carrying out the following sequence of operations:

1. Take CLOCK input high.
2. Reset counter.
3. Take CLOCK input low for one second.
4. Take CLOCK input high.

At the end of this sequence, the count is numerically equal to the frequency of the square wave in Hz, give or take a Hz.

Alternatively, we could accomplish the same thing by applying the square wave to the CLOCK input, taking the ENABLE input low, resetting the counters, and taking the ENABLE input high for one second.

A Multi-Digit Counter

To make useful measurements, we very often need a counter which can count beyond nine. For this, we can use the output of one counter to drive an input of a second counter, and so on. Since the digital display of my system has six digits, I used a total of six counters (three 4518s).

Although the waveform which we want to measure can be applied to either the CLOCK or the ENABLE input of the first counter, we have to be careful about the way in which we interconnect the remaining counters. As successive cycles of the waveform toggle the first counter, the outputs of that counter change as shown in Fig. 2. Each time the count changes from 9 to 0, the next counter should be toggled once. That is, as the count in a particular counter goes from 9 to 0, that counter should generate a carry for the next counter. For this purpose, we can use the Q_4 output of the counter. As the count goes from 9 to 0, that output makes a high-to-low transition. Thus, we need only tie the Q_4 output of the first counter to the ENABLE input of the second counter, and tie the CLOCK input of the second counter permanently low. We can add as many more counters as we like, in a similar way.

Measuring a Frequency—The Timebase

At this point we have a multi-digit counter, but we need a way to enable or disable counters so that we know how much time was spent accumulating a particular count. That is, we need a timebase. A ½-Hz square wave is a reasonable choice, since it's high for one second, low for one second, and so on. If we apply such a square wave to the CLOCK input of the first counter and apply the waveform which we want to measure to the ENABLE input, the first counter will count for one second, stop counting for one second, and so on. Since the first counter won't generate carries when it's not counting, the five remaining counters will count and stop also. To make a measurement, we let the counters count for one second and then process and display the count during the next second.

If we use a ½-Hz square wave as a timebase, the count which is accumulated during one counting period is numerically equal to the frequency in Hz of the unknown waveform. Since our counter has six digits, 999,999 Hz is the highest frequency which it can measure under these conditions. We can extend that range by a factor of ten if we use a 5-Hz square wave as a timebase, since such a square wave is low for only a tenth of a second at a time. During that time, a 9.99999-MHz waveform will produce a count of 999999, which our display can accommodate. In this case, the count is numerically equal to the frequency in Hz/10.

Since the CMOS counters which we'll use can't be toggled faster than about 2-3 MHz (when a 5-volt power supply is used), we have no immediate need for a timebase which is higher in frequency than 5 Hz.

At this point, then, we have in hand the necessary ingredients to make measurements of frequency. Before we turn our attention to the hardware itself, however, let's consider one additional topic.

Measuring a Period

We've seen that measuring a relatively high-frequency waveform isn't all that difficult, but what if the unknown waveform has a frequency of, say, 10 Hz? If we use a ½-Hz square wave as the timebase, then 10 counts will be accumulated at a time, and our measurement will be accurate to only one part in ten. For many purposes, that's adequate. However, if we want to count long enough to take full advantage of our counter, we'll have to use a 1/20000-Hz square wave as the timebase. Of course, that means that the counter will count for about five and one-half hours at a time!

There is a better way, and it involves using the unknown waveform as the timebase while the counter counts cycles of a waveform for which the frequency is known. For example, if the known frequency is 1 MHz, and a count of, say, 97,350 accumulates during one "on period" while using the unknown waveform as the timebase, then the "on period" is 97,350 micro-

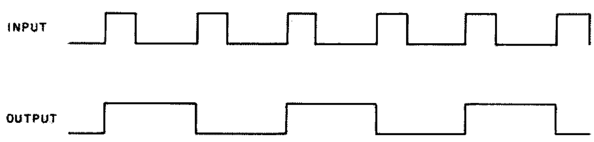

Fig. 4. Effect of conditioning circuit.

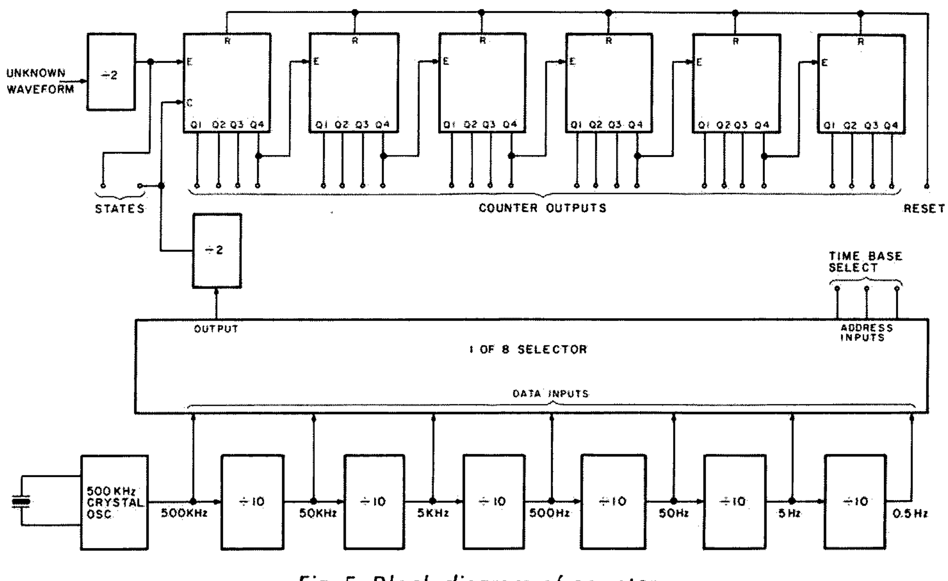

Fig. 5. Block diagram of counter.

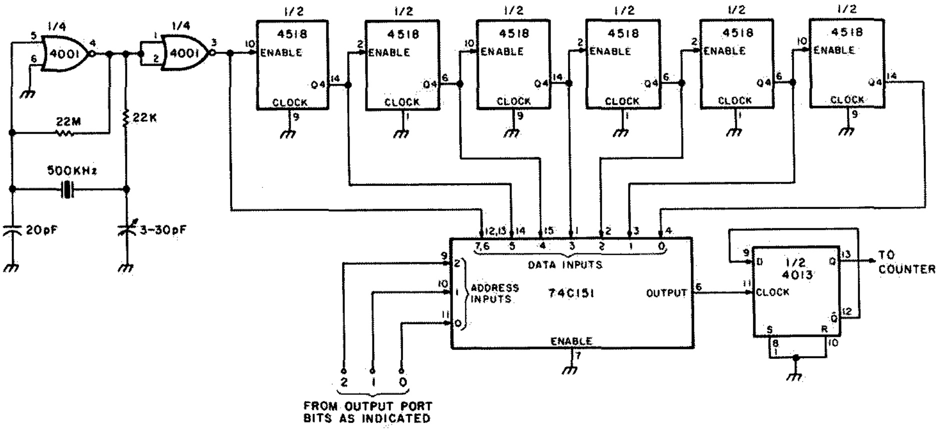

Fig. 6. Timebase for counter. Note: Ground reset terminals of 4518s (pins 7 and 15).

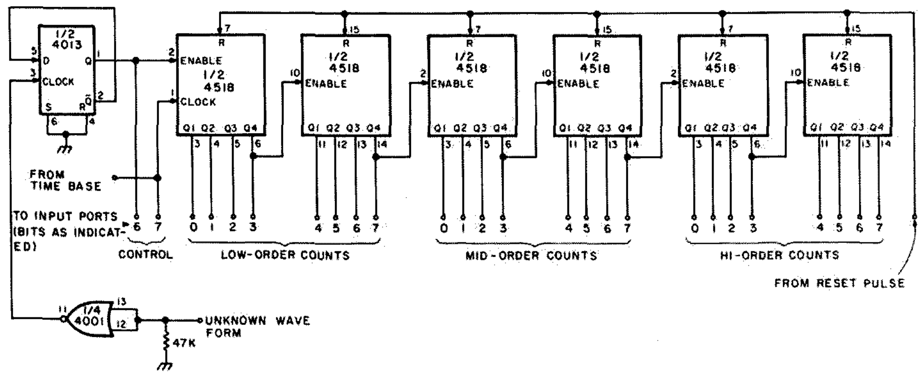

Fig. 7. The counters. Note: Unless otherwise specified, ground clock terminals of 4518s (pins 1 and 9).

seconds. (The duration of one cycle of a 1-MHz waveform is one microsecond.) Since 97,350 microseconds is 0.097350 seconds, the unknown waveform must have been high for 0.097350 seconds. Assuming that it's low for the same amount of time that it's high, then the period of one cycle of the waveform is two times 0.097350, or 0.19470 seconds. Thus, its frequency is 1/0.1947, or 5.1361 Hz. By using the modified technique, we've made a measurement which is quite accurate, and done so in less than a second.

Two problems remain, however. First, this technique measures the time during which the unknown waveform is high. However, not all waveforms are high for the same amount of time that they're low. That is, not all waveforms have a 50% duty cycle. The problem is that unless we know the percent duty cycle of such a waveform, we can't make an accurate measurement of its period. A solution to the problem is to apply the unknown waveform to the circuit which is shown in Fig. 3.

The unknown waveform is applied to the CLOCK input of a type D flip-flop. Thus, each time the waveform undergoes a low-to-high transition, it triggers the flip-flop. This transfers to the $\overline{Q}$ output whatever level is present at the D input when the transition occurs. Thus, since the $\overline{Q}$ output is applied to the D input, the Q output will change state in response to each transition. This behavior is summarized in Fig. 4.

What's important for our purpose is that we have a waveform which is high for one period of the unknown waveform, low for the same amount of time, and so on. That is, the derived waveform has a 50% duty cycle and we can measure its period easily.

The second problem which remains is one that we won't consider further at this time. It's simply that once we've measured the period of a waveform, we must compute the reciprocal of that number in order to determine the frequency of the waveform. Those with a floating-point package in the software of their system will have no problem doing this.

Finally, we should note that the circuit in Fig. 3 produces only one high-to-low transition at its output for every two low-to-high transitions at its input. In effect, it divides the unknown frequency by two. Thus, if we make the circuit a permanent part of our counter, we must take this into account. An easy way to do this is to halve the frequency of the conventional timebase so that the timebase is high for two (or 0.2) seconds and low for the same amount of time.

A Block Diagram

At this point, we can rough out a block diagram of at least part of our counter, as shown in Fig. 5.

The unknown waveform is applied to a divide-by-two circuit which, in turn, drives the first of six BCD counters (each is half of a 4018). A 500-kHz crystal oscillator generates the timebase. It drives the first of six BCD counters (each is half of a 4018). Since each counter counts to nine and generates a carry, we can view each as a divide-by-ten circuit as well as a counter.

The lowest available frequency which is available from the timebase is 0.5 Hz. A little arithmetic will show that, in this case, that value will produce a count which is numerically equal to half the frequency in Hz of the waveform—but we'll soon remedy that. A one-of-eight selector passes the selected timebase on to the input of a divide-by-two circuit. In turn, that circuit drives the CLOCK input of the first counter, and our problem is remedied.

We could use a 250-kHz crystal and dispense with the divide-by-two circuit, but 500-kHz crystals are less expensive, and the flip-flop IC which we'll use (4013) contains two flip-flops.

The Interface

To interface the counter to a µP system, we need four input ports and an output port. In addition, we need a pulse which is similar to a

WRITE pulse, to reset the counters. Such a pulse can be generated by using one line of a second output port. Writing 0-1-0 onto the line produces a positive-going pulse.

Three of the input ports are used to read the contents of the counters. The fourth is used to monitor the states of the CLOCK and ENABLE inputs of the first counter. Depending on which counting technique is used (frequency or period), the state of one or the other of the inputs indicates whether or not the counters are counting.

The output port is used to apply a number to the address inputs of the one-of-eight selector, to choose the timebase.

The Timebase

The circuit of the timebase is shown in Fig. 6.

Two gates from a 4001 quad two-input NOR IC, a 500-kHz crystal, and a few passive components make up the timebase generator. The output of the oscillator drives a chain of three 4518 dual BCD counter ICs. The outputs of the six counters are applied to the DATA inputs of a 74C151 one-of-eight selector. Depending on the number which is applied to the ADDRESS inputs of the 74C151, a particular timebase is passed on to the counters via a divide-by-two circuit.

The Counter

The circuit of the counters is shown in Fig. 7. The unknown waveform is applied to the input of a 4001 NOR gate which acts as a buffer. (Good practice dictates that lines which originate off the board should not be connected directly to the CLOCK input of a flip-flop, in the interest of immunity to noise.) The NOR gate drives half of a 4013 type-D flip-flop IC which is configured as a divide-by-two circuit. The output of that circuit drives the ENABLE input of the first of a chain of three 4518 dual BCD counters.

Using the Counter With the BMPS

The counter was originally designed for use with a beginner's microprocessor system based on the 6502 μP. That system is described in detail elsewhere.[1] Those who have built such a system may use the counter by adding the interface which is shown in Fig. 8. (Of course, the interface is not needed if the builder has expanded the basic BMPS to provide additional I/O parts.) Those who will use the counter with other than the basic BMPS should ignore the next two paragraphs.

A circuit which provides the necessary control signals is shown in Fig. 8(a). It consists of a 4514 decoder, a 4011 quad two-input NAND gate, and a 4081 quad two-input AND gate. Address lines A_0, A_1, A_2, A_{14}, and A_{15} are applied to the inputs of the 4514. Four READ signals are generated by ANDing the R/W line with outputs of the 4514. Two pulses are generated by NANDing the ϕ_2 line with other outputs of the 4514. One of these is a WRITE pulse of the sort which we've used before. The remaining pulse is complemented and used to reset the counters. When we want to reset the counters, we use a STA, STX, or STY instruction in the program. No port exists which will accept the operand of the instruction, but the pulse is generated. The address of each READ and WRITE signal is as shown in Fig. 8(a).

A circuit which provides the I/O ports is shown in Fig. 8(b). A latch (4042) and solid-state switches (4016) are used as described in Reference 1.

Construction

The foil side of the PC board and the component layout are shown in Figs. 9 and 10, respectively. Those who will not use the counter with the basic BMPS may prefer a more compact layout which does not include the unnecessary portion of the I/O circuit.

The timebase should be checked out first. If the oscillator does not start reliably when power is applied, the values of one or more passive components should be varied slightly. With the oscillator working, we then check the 74C151 selector. Writing a number from 000 through 111 to its address inputs should tie the output of the selector to the designated one of its seven inputs. We then add the 4518s to complete the timebase. When that's done, writing a 000 to the address inputs should produce a 0.25-Hz square wave at the output of the 4013. That frequency is low enough to be observed with a logic probe.

When the timebase is working properly, we can use it to check the counter ICs. To do this, we temporarily remove the 4013 from its socket. We then

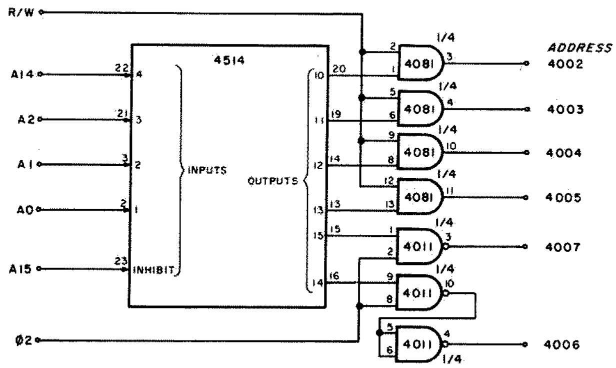

Fig. 8(a). Partial schematic of interface to BMPS.

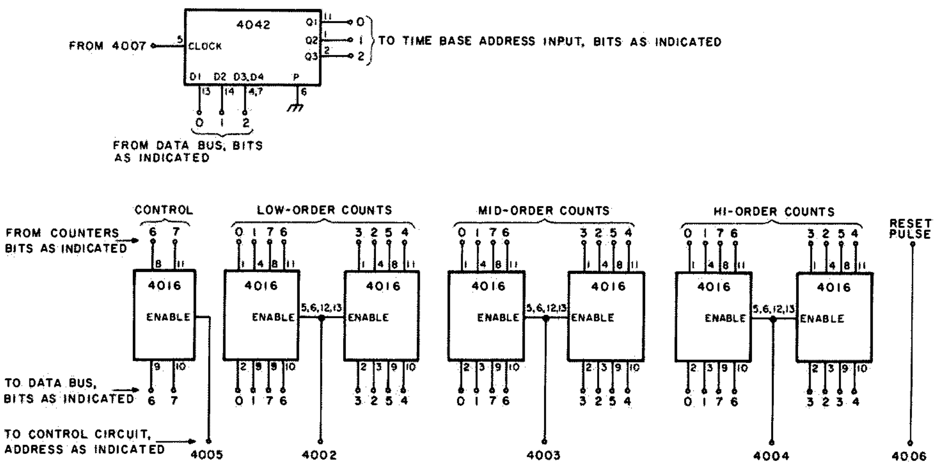

Fig. 8(b). Partial schematic of interface to BMPS.

connect the output of the timebase to the ENABLE input of the first counter and ground the CLOCK input of that same counter. The net result is that the timebase toggles the chain of six counters. Those using

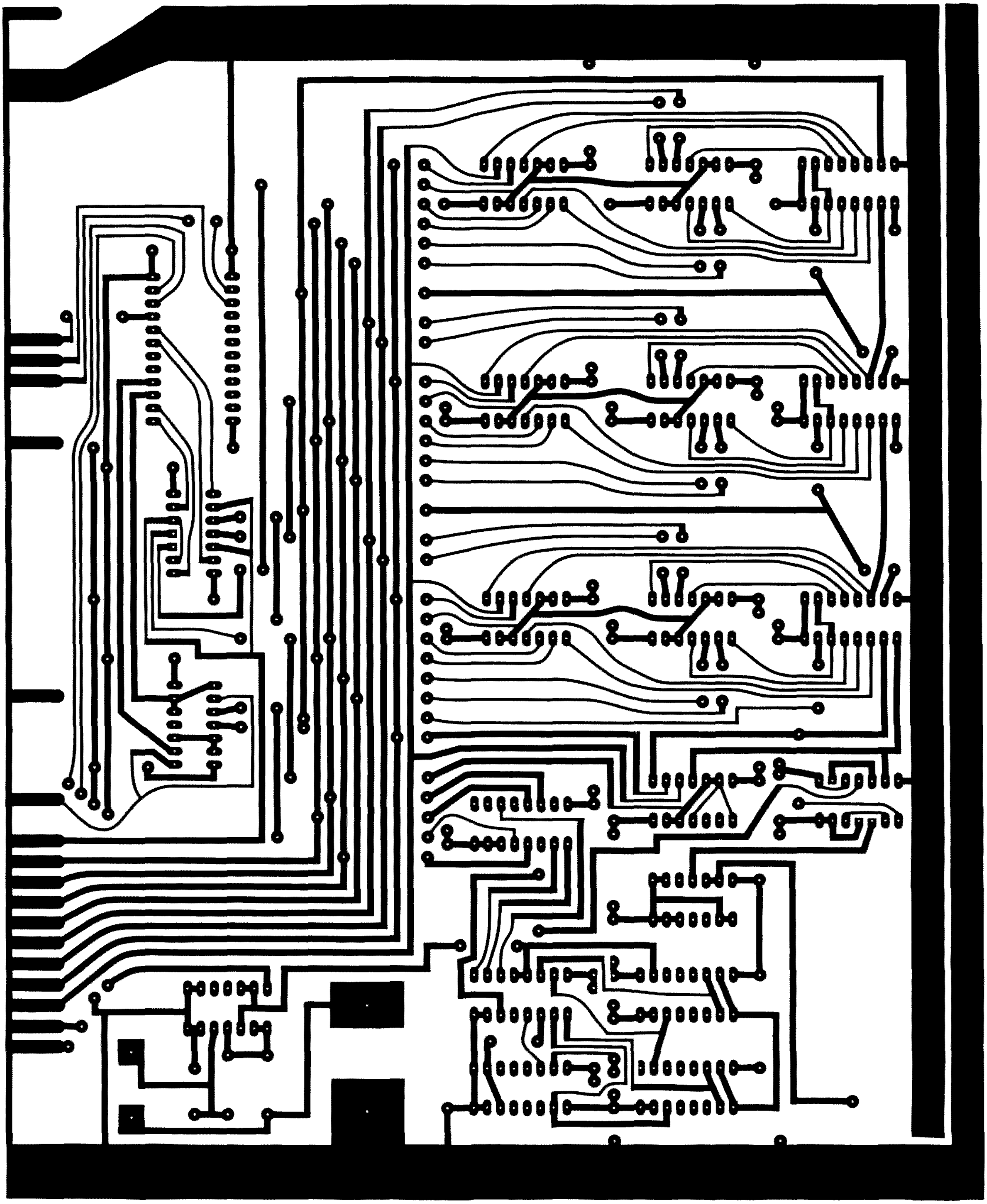

Fig. 9. Foil side of printed circuit board for counter. Install crystal socket on this side. Install a 0.1 μF disc ceramic capacitor across power pins of each 45189 and 4013.

the basic BMPS should load the program which is shown in Fig. 11 and monitor output port 8200. In this way, the outputs of any one of the pairs of counters can be observed. Others can check the outputs of the counters with a logic probe. Finally, we restore the 4013 and disconnect all temporary connections.

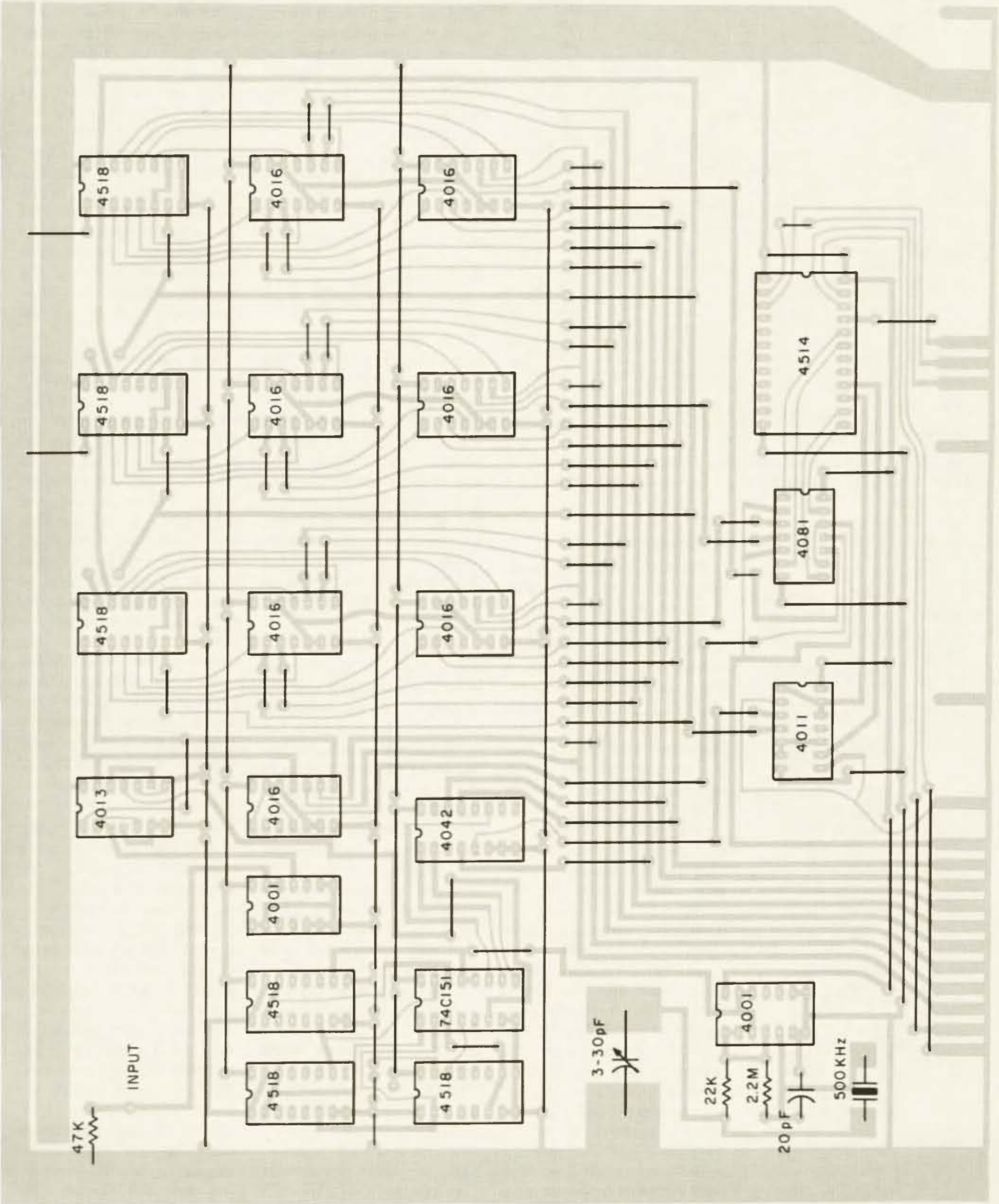

Fig. 10. Component side of printed circuit board.

Location	Instruction	Contents
FFE0	LDA TBASE	AD
1		FF
2		FF
3	STA 4007	8D
4		07
5		40
6	LOOP LDA 400X	AD
7		0X
8		40
9	STA 8200	8D
A		00
B		82
C	JMP LOOP	4C
D		E6
E		FF
F		–
FO		–
1		–
.		.
.		.
.		.
.		.
.		.
C		F0
D		FF
E		–
F		F8

Fig. 11. Program to test hardware, using the BMPS. Note: In FFE6, X = 0, 1, or 2, depending on which register is to be examined.

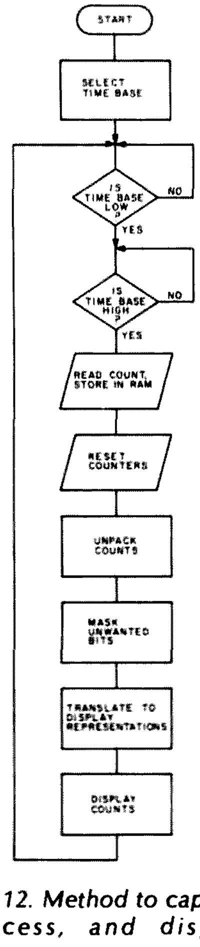

Fig. 12. Method to capture, process, and display counts.

A Counter Program

At this point, the hardware is complete and checked out. We can select the frequency of the timebase, read the outputs of the counters, and reset the counters. We'll now examine a program which will perform these functions in the proper sequence to produce a useful counter. A block diagram is shown in Fig. 12.

The first step is selection of a timebase. Nothing of significance happens then until the output of the timebase is first low (counters counting) and then high (counters not counting). We then read and reset the counters. Once this happens, we have in memory three eight-bit numbers which represent the counts that were accumulated by the six counters. Each eight-bit number consists of a pair of BCD numbers "side by side." Accordingly, the next order of business is to "unpack" the numbers so that each BCD number is in the four lower-order bits of its own individual location in memory. We then reset to 0 the four higher-order bits (unused) of each word, translate the BCD numbers into the correct representations for the digital display, and display the results. The entire process is then repeated.

A program which will do what we've been talking about is shown in Fig. 13. It's written for the BMPS, but since I/O address assignments are given, modifying it for any 6502 system should be no problem.

The operator must load into location FFFF the number which represents the desired timebase. (Only the three lower-order bits are used.) The instructions which lie between FF80 and FF8F read the number in location FFFF, store it in the 4042 latch (thus selecting the timebase) and delay further execution of the program until the timebase has gone low and then high.

When the timebase has gone high, a count has been accumulated and the counters have stopped counting. Accordingly, the instructions which lie between FF90 and FF9C read the counters, store the results in locations 0002, 0001 and 0000, and reset the counters in anticipation of the next count. At this point, the counts are stored as shown in Fig. 14(a), and they must be transformed for display as shown in Fig. 14(b).

The first step in the process is to unpack the BCD digits. The instructions which lie between FFA0 and FFB5 accomplish this. The XR and YR are each set to 0. A 0000-based, YR-indexed LDA and a 0003-based, XR-indexed STA are then performed. The contents of the ACR are shifted right four places, the XR is incremented, and a 0003-based, XR-indexed STA is performed. At this point, the least-significant count (in the form of a BCD number between 0 and 9) occupies the four less-significant bits of location 0003. The next more-significant count occupies a similar position in location 0004. Of course, the next more-significant count also occupies the four more higher bits of location 0003 as well, but this is of no consequence. After three traverses of the loop, the counts occupy the locations which are shown in Fig. 14(c).

The instructions which lie between FFB9 and FFCE accomplish what remains: to display the counts. The XR is set to 5 in order to process six counts. An 0003-based, XR-indexed LDA is accomplished, and 0F is ANDed with the contents of the ACR. This sets the four more-significant bits of the number to 0, so that only the desired count remains. The next instruction, TAY, transfers the count to the YR. An FFD0-based, YR-indexed LDA is performed. Since the seven-segment representations of the numbers from 0-9 are stored starting at location FFD0, this places the representation of the count in the ACR.

The final step is to store the representation in the appropriate display element. Since the addresses of the display elements don't fall in the same order as the addresses of the source locations, we use a somewhat roundabout method to accomplish this. An FFDA-based, XR-indexed LDY is performed. This places in the YR the least-significant hexadecimal digit of the address of the appropriate display element. Performing an 8000-based, YR-indexed STA then accomplishes what we desire.

Fig. 13. Program to implement counter. Note: In FFF0, X = 3, 4, 5, 6, 7, or 8, depending on which register is to be examined. In FFFF, X = 1, 2, 3, 4, 5, 6, or 7, depending on which timebase is to be used.

Location	Instruction	Contents
FF80	LDA FFFF	AD
1		FF
2		FF
3	STA 4007	8D
4		07
5		40
6	LOOK1 LDA 4005	AD
7		05
8		40
9	BMI LOOK1	30
A		FB
B	LOOK2 LDA 4005	AD
C		05
D		40
E	BPL LOOK2	10
F		FB
90	LDX #2	A2
1		02
2	FETCH LDA 4002,X	BD
3		02
4		40
5	STA 0000,X	95
6		00
7	DEX	CA
8	BPL FETCH	10
9		F8
A	STA 4006	8D
B		06
C		40
D	NOP	EA
E	NOP	EA
F	NOP	EA
A0	LDY #0	A0
1		00
2	LDX #0	A2
3		00
4	LOOP1 LDA 0000,Y	B9
5		00
6		00
7	STA 0003,X	95
8		03
9	INX	E8
A	LSR	4A
B	LSR	4A
C	LSR	4A
D	LSR	4A
E	STA 0003, X	95
F		03
B0	INX	E8
1	INY	C8
2	CPY #3	C0
3		03
4	BNE LOOP1	D0
5		EE
6	NOP	EA
7	NOP	EA
8	NOP	EA
9	LDX #5	A2
A		05
B	LOOP2 LDA 0003,X	B5
C		03
D	AND #F	29
E		0F
F	TAY	A8
C0	LDA REPS,Y	B9
1		D0
2		FF
3	LDY DISPS,X	BC
4		DA
5		FF
6	STA 8000,Y	99
7		00
8		80
9	DEX	CA
A	BPL LOOP2	10
B		EF
C	SEC	38
D	BCS LOOK1	B0
E		B7
F		--
D0	REPS	24
1		77
2		1C
3		15
4		47
5		85
6		84
7		37
8		04
9		07
A	DISPS	06
B		05
C		01
D		02
E		03
F		04
FFF0	LDA 000X	AD
1		0X
2		00
3	STA 8200	8D
4		00
5		82
6	JMP FF86	4C
7		86
8		FF
9		--
A		--
B		--
C		80
D		FF
E		--
F		FX

Location	Type	Contents
0000	memory	counts 1,2
0001	memory	counts 3,4
0002	memory	counts 5,6
0003	memory	count 1
0004	memory	count 2
0005	memory	count 3
0006	memory	count 4
0007	memory	count 5
0008	memory	count 6
4002	input port	counts 1,2
4003	input port	counts 3,4
4004	input port	counts 5,6
4005	input port	control bits
4006	output port	reset
4007	output port	timebase
8001	output port (display)	count 3
8002	output port (display)	count 4
8003	output port (display)	count 5
8004	output port (display)	count 6
8005	output port (display)	count 1
8006	output port (display)	count 2

Most-Significant Count

Location	0002	XXXX	XXXX	Contents
	0001	XXXX	XXXX	
	0000	XXXX	XXXX	

Least-Significant Count

Fig. 14(a). Location of counts in memory.

Location	Contents
8004	Most-Significant Count
8003	.
8002	.
8001	.
8006	.
8005	Least-Significant Count

Fig. 14(b). Destination of counts.

Traversing the loop six times stores all six counts.

The remaining instructions (CLC, BCC) cause the program to branch to location FF86, and the process starts again. To change the timebase requires a reset.

The NOP instructions which are located in FF9D-FF9F and FFB6-FFB8 serve no useful purpose and may be omitted. (Change the operand of the BRANCH instruction at FFCD, if done.) However, if either set is replaced with JMP FFF0, the short program which starts at FFF0 will store a selected pair of counts into the output port which is located at 8200. This is convenient when checking out the program.

Finally, if measurements of period rather than frequency are to be made, ASL instructions should be inserted between LOOK1 LDA 4005 and BMI LOOK1, and between LOOK2 LDA 4005 and BPL LOOK2, so that the proper bit is examined. Then, too, BMI LOOK1 should be changed to BPL LOOK1, changed to BMI LOOK2, to take into account the difference in the way the bits must be interpreted.

Location	Counts	
0008	-	6
0007	6	5
0006	-	4
0005	4	3
0004	-	2
0003	2	1

Fig. 14(c). Location of counts after unpacking.

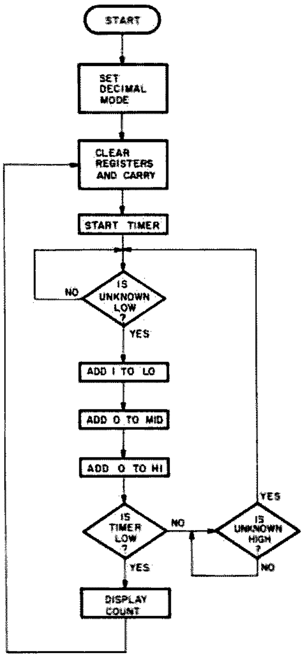

Fig. 15. Software implementation of counter function.

Location	Instruction	Contents
FF80	SED	F8
1	START CLC	18
2	LDX #2	A2
3		02
4	LDA #0	A9
5		00
6	LOOP1 STA 0000,X	95
7		00
8	DEX	CA
9	BPL LOOP1	10
A		FB
B	STA 8100	8D
C		00
D		81
E	LOOP2 LDA 9000	AD
F		00
90		90
1	BMI LOOP2	30
2		FB
3	LDA #1	A9
4		01
5	ADC 0000	65
6		00
7	STA 0000	85
8		00
9	LDA #0	A9
A		00
B	ADC 0001	65
C		01
D	STA 0001	85
E		01
F	LDA #0	A9
A0		00
1	ADC 0002	65
2		02
3	STA 0002	85
4		02
5	LDA A000	AD
6		00
7		A0
8	BPL AHEAD	10
9		08
A	LOOP3 LDA 9000	AD
B		00
C		90
D	BPL LOOP3	10
E		FB
F	JMP LOOP2	4C
FFB0		8E
1		FF
2	AHEAD LDA 000X	A5
3		02
4	STA 8200	8D
5		00
6		82
7	JMP START	4C
8		81
9		FF

Fig. 16. Program to implement a counter in software. Note: In FFB2, X = 0, 1, or 2, depending on which register is to be examined.

Doing It the Easy Way

The counter which we've just discussed is a useful and versatile addition to almost any system. However, if we can tolerate a limitation in speed, then we can have a counter just by using the system itself, provided it has a timer and a digital display. We can write a program to simulate the action of a counter. The basic principle involves using the timer as a timebase and counting the number of high-to-low (or low-to-high) transitions which the unknown waveform makes while the timer is "on." What's involved in the context of the BMPS is shown in Fig. 15. Using the technique with other systems should be straightforward.

The first step is to set the 6502 μP to the decimal mode. This means that in any operation which in-

volves an ADC or SBC instruction, the μP treats the eight-bit numbers which are involved as pairs of BCD digits. The next step is to clear the carry bit and three locations (registers) in the RAM. We designate the locations as LO, MID, and HI to indicate which pair of counts each holds.

We begin counting by starting the timer. We then check to see if the unknown waveform is low. If so, we add 1 to LO, 0 to MID, and 0 to HI. (Adding 0 to a number adds the carry, if any, from the next less-significant count.) If the output of the timer is still high by this time, we wait until the unknown waveform goes high and then low, and again modify the registers as appropriate. The process is repeated again and again until the output of the timer goes low. At that time, we process the counts in exactly the same way as if they had come from the counter board.

Only a few connections to the BMPS are necessary in order to implement the counter. The WRITE pulse for the output port at location 8100 is used to start the timer, while the most-significant bit of the input port at location A000 is used to monitor the output of the timer. The unknown waveform is tied to the most-significant bit of the input port at location 9000.

A program which will provide the function of a counter is shown in Fig. 16. Little comment is necessary, since it closely follows the flowchart.

The instructions which lie between FF80 and FFB1 in this program perform essentially the same function as the instructions which lie between FF86 and FF9C in the previous program. In each case, the counts are stored in locations 0000, 0001, and 0002. Thus, the portion of the previous program which processes and displays the counts clearly should be usable with this program, although I've not tried it. The instructions which lie between FFB2 and FFB9 in the present program provide a simple way to examine the contents of any of the registers. All that's necessary is to monitor the output port at location 8200.

Once we've implemented the counter in this way, all we need do further is to adjust the period of the timer until it's some convenient value, such as 1 second.

The price we pay for doing it the easy way—substituting software for hardware—is a loss of speed. In this case, the time between low-to-high transitions of the unknown waveform must be longer than the time which is required for the μP to traverse the inner loop of the program. This means that the frequency of the unknown waveform must be less than a few kilohertz.

A Preamplifier

Either counter is directly usable as is on CMOS-compatible signals. Those who will use the counter on other types of signals should add a signal-conditioning preamplifier of the sort shown in Reference 2 (substitute a 4049 CMOS hex inverter for the 7404, for example). There is room at the upper left corner of the PC board to do this. ■

References

1. Creason, *How to Build a Microcomputer*, 73, Inc., 1979.
2. Moraller, "Latest K2OAW Counter Update, *73 Magazine*, May, 1975.

Lora Ennis WD8LPN
214 Old Street
Clio MI 48420

Operation Santa!

—spread holiday cheer with this super club project

Photos by K8ZIS and W8WN

Photo A. Even without the red suit and long, white beard, Dave W8IFK looks and sounds like Santa.

"Santa's on television and wants to talk to you!"

How could that be? Well, once again old Santa made an appearance for the kids at McLaren Hospital in Flint, Michigan, to try to cheer up those who would be confined to the hospital over the holidays. Nothing unusual about that? This electronic Santa came to them via radio, color television, and (it is reported, perhaps with some imagination) via a multiple relay of stations all the way from the North Pole.

Santa has been coming to hospitals for many, many years, and amateurs have been able to let the kids in other hospitals talk to Santa "way off at the North Pole" via amateur radio for more years than most of us can remember. But a year ago, McLaren Hospital, in Flint, apparently was one of the first hospitals in the nation to go one step further. It initiated the practice of having Santa also appear on the in-house color TV system so that the kids (and anyone else in the hospital who wished to tune in) could not only hear the old gent, but also could see him in living color as he replied to their questions and requests.

"Operation Santa" for 1978 began as WD8KQI (Dr. Dan Bonbrisco, D.O.) and a couple of other members of the Genesee County Amateur Radio Emergency Service let the kids at the Flint Osteopathic Hospital talk with Santa via the 147.87/.27 Flint Hainer repeater. Meanwhile, Santa, also known as W8IFK, was across the street at McLaren Hospital trying to talk with the kids and get into his Santa suit at the same time.

After everyone in the pediatric ward at FOH had talked with the resident of the North Pole, the telephone operator at McLaren announced over the PA system that Santa would be on a certain TV channel in a few minutes to talk to the children there. Color bars were punched up, amateurs and hospital technicians made sure the TV sets in the pediatric sections were

tuned and working properly, and all the children who could walk or be moved were taken to the sun rooms.

When all was ready, W8UPV put out a call over the Hainer repeater for Santa Claus. He didn't get him, but he did get another amateur "near Greenland" who said he could relay the traffic. Two more relays, including one "from an amateur at a DEW line radar post," got them close to the North Pole, but Santa didn't seem to be available. An autopatch, though, brought an answer from Santa's private secretary, who said that Santa was in his workshop but would be arriving momentarily. Meanwhile, slides of various operators at their shacks, the OSCAR satellites, etc., were being shown on the TV screen.

The screen suddenly went to color bars again (to allow the camera to be pivoted 180° in a very crowded photographic studio there in the hospital), and then came alive and focused on a large chair in front of a deep blue background just as a jolly, white-haired fellow, carrying a TR-22 and an extra mike, came in and sat down. Santa had arrived, and he said he wanted to talk with boys and girls in the hospital there in Flint, Michigan!

After a few minutes of getting himself composed, while describing the work he had been doing in the workshop, Santa asked to talk to the first little boy. But before the first one had even said anything over the mike of the HT down in the sun room, Santa had already called him by name and said he was sorry he had to be in the hospital; he even named the exact illness the boy had!

This was very mystifying—how could Santa know who was going to talk first? The same thing happened with all the other children—Santa knew names, illnesses, ages, and sometimes other facts about each one of them. One little boy became very excited. It seems that he had talked with "Santa" in one of the stores a couple of weeks earlier and had given him his name. "He remembered me!" the boy shouted, causing a great deal of merriment among the hams and nurses.

Since the children were busy watching the child who was talking and watching the TV screen to see Santa as he replied, most did not notice the other amateurs in the back of the room getting advance information on the next child and relaying it via .52 simplex to the photographic studio upstairs. Neither could they see the large chalkboard, just behind the TV camera, where names, ages, and illnesses were being written down (next to a permanent list of Santa's reindeer team, without which old Santa seemed to experience his one memory lapse).

Did you ever wonder just how Santa can listen to the requests kids make and give an answer that satisfies them without putting too much pressure on parents? This is a talent in itself. The requests run from the simplest, a doll, to the more expensive and elaborate, such as a real racing car or a diamond ring. Santa would laugh and compliment the child on his wanting reasonable things (if that were the case), or on how big his ideas were (for some of the more unreasonable ones). He would admonish them to be good, tell them that he would see what he could do, and that he thought he could find something that they would like (while never saying that he would give them what they actually asked for).

Many children, of course, just wanted to get out of the hospital in time for Christmas. For these, Santa had especially kind words, also reminding them to follow the doctor's instructions. One teenage boy was especially depressed—he had just broken both legs while skiing. While his injuries were not really serious, it was a bleak holiday season for that young fellow.

After talking with all the children in each of the sun rooms, the operators visited the rooms of the children who could not join the group. Invariably, they came upon nurses who were watching the TV screen but could not leave to see what was actually happening. Often they surprised the nurses with the opportunity to talk with Santa (much to the delight of Santa!), and he would then proceed to identify them and talk with them, also to the delight of the

Photo B. "Santa" (W8IFK) talks to the kids via his TR-22 and the in-house color TV system while WA8IUS mans the camera. Note the second mike cord going under Santa's beard.

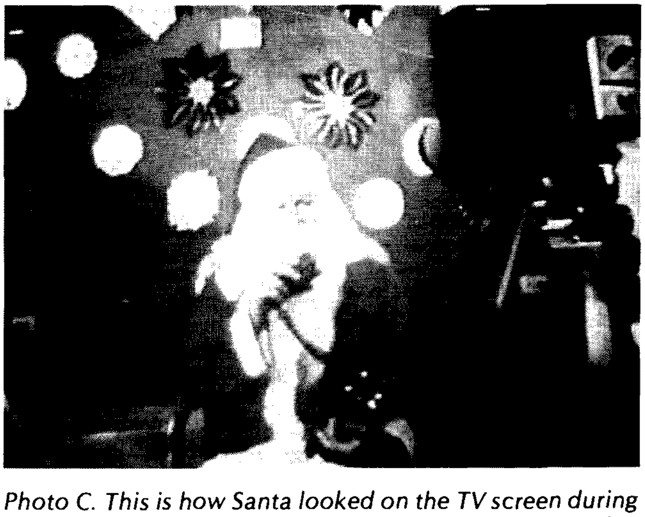

Photo C. This is how Santa looked on the TV screen during a newscast which gave a little extra PR for amateur radio.

children, doctors, nurses and all who were watching.

After talking with all the children (and some of the nurses) in McLaren, as the TV operation was being closed down, Santa talked with the grandchildren of several amateurs who had been monitoring. A news photographer from one of the local TV stations had arrived and filmed the scene in one of the sun rooms, so "Santa" had to get set again while a little newsreel footage was filmed.

"Operation Santa" had been done several times in Flint in the past, but in 1977, K8ZIS, medical photographer at McLaren Hospital, suggested that it be put on the newly-installed in-house TV system. Apparently, two other hospitals in other parts of the country also had the same idea at about the same time, and this has provided much pleasure for the children in those hospitals. But not only for the children—it has been noted that the adult patients, nurses, and doctors seem to enjoy watching the show as much as the kids themselves. It was not unusual to find sun rooms and wards all over the hospital crowded with patients, nurses, and interns watching their local "Operation Santa" on their own TV channel.

The Genesee County ARES provides emergency communications for the seven area hospitals as well as for a number of other groups. "Operation Santa" is hardly an emergency, but it is one of those little public service events that brings pleasure to someone else while improving our public relations. With the closed-circuit TV system, amateur radio is even more visible than ever.

Photo D. Santa's "memory" of the names of children was updated on this off-camera blackboard.

Operators who took part in the 1978 "Operation Santa" in Flint were W8IFK (who makes a magnificent Santa, even without the bright red suit), K8ZIS (medical photographer at McLaren who originated the TV idea locally), W8UPV, WD8JCN, WD8KQI WA8IUS, K8XN, W8YCN, WD8LMP, WD8CCG, and WA8ZQM. The operation was sponsored by the Genesee County Amateur Radio Emergency Service, Inc., the Hainer Repeater Association, and McLaren Hospital.■

✓ Reader Service—see page 259

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Tools and Techniques for Wire-Wrapping

—an excerpt from 73's new book

Editor's note: This article is an excerpt from 73's new book, *Tools and Techniques for Electronics*, by A. A. Wicks W6SWZ. The book is a comprehensive guide to construction practices, from soldering to PC boards to metalworking. It's available from 73's Radio Bookshop, Peterborough NH 03458. The price is $4.95 (plus $1.00 tor shipping and handling).

As experimenters and hobbyists become more and more involved in integrated circuitry and equipment that utilizes these and other miniature devices, a technique that has been used in industry for many years becomes attractive to use. Although originally developed in the early 1950s, a solderless interconnection technique known as wire-wrapping did not immediately gain popularity within industry until automatic and semiautomatic wire-wrapping equipment, for the most part using programmed tape equipment, provided a low-cost, rapid method of making thousands of these solderless connections on the "back panel" of component boards.

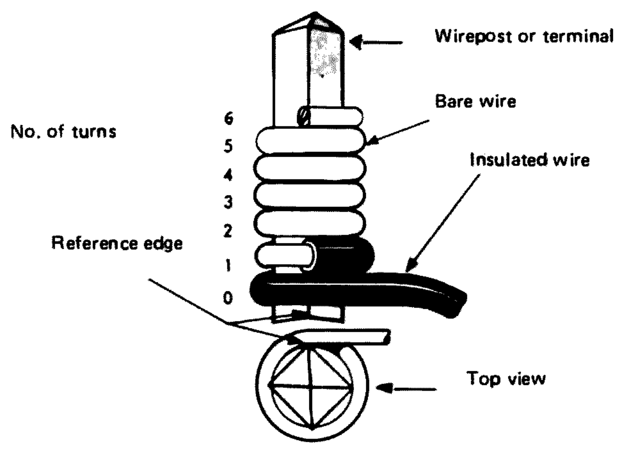


Fig. 1. Wire-wrapped terminal and references.

A wire-wrapped connection is shown in Fig. 1. It is exactly that—a wire, "wrapped" around a terminal post several turns, which provides an absolute metal-to-metal, gastight connection. At first, these connections were made by using a hand-operated tool. Then, speed was gained by driving this tool with an electric motor in the form of a "gun" in which the tool was inserted and locked. This technique continued to be used industrially, even with the advent of programmed machinery which, point-by-point, moved the electric tool over a back panel, at which point a human operator inserted a pre-cut and pre-stripped length of wire in the tool, lowered it over the wire terminal post, made the wrap, then allowed the tool to move to its next location. This technique continues to be used today, but in more sophisticated applications of mass production, the whole operation is programmed and automatic.

While this was going on, the engineering laboratories were involved in prototype production, but, as is obvious, prototypes do not warrant the expense of specialized programmed equipment worth tens of thousands of dollars.

Therefore, back in the lab, engineers and technicians continue to use hand wire-wrapping tools, both manual and electric. And it is to this level, the prototype level, that we, as experimenters and hobby work-

ers, direct our interest.

The techniques of wire-wrapping are especially desirable in place of printed circuit boards (frequently called "cards"), when only one unit is to be produced. Printed circuit layout and preparation for one assembly, although creative fun and very effective, is more work than enjoyment in many instances, especially for the person anxious to have a circuit completed and ready for operation quickly. (A combination of printed circuit and wire-wrapping will be discussed later in this section.)

The information provided here is directed for the most part to those who have never performed wire-wrapping. A person already involved in this type of construction is usually extremely enthusiastic about its time-saving and "second-chance" possibilities (a printed circuit is *very* difficult to change, once etched). Before proceeding, we should mention some of the terms of wire-wrapping and what they mean, so that you may discuss the equipment and tools with your supplier.

First of all, there are two styles of wire-wrapping in use, as far as serially-connected terminals are concerned. One "daisy chain" is shown in Fig. 2(a). "Level-ordered" is shown in Fig. 2(b). Daisy-chain wiring is not recommended, as a moment of study will show that if you wish to change the wiring on two terminal posts (or wire-wrapping terminals) that have been daisy-chained, you may have to remove six wires (the maximum number of wire levels being three), whereas with level-ordered wiring, four would be maximum.

Wires placed on posts by level order are identified as levels 1, 2 and 3, with level 1 being the wire nearest the component board (Fig. 3).

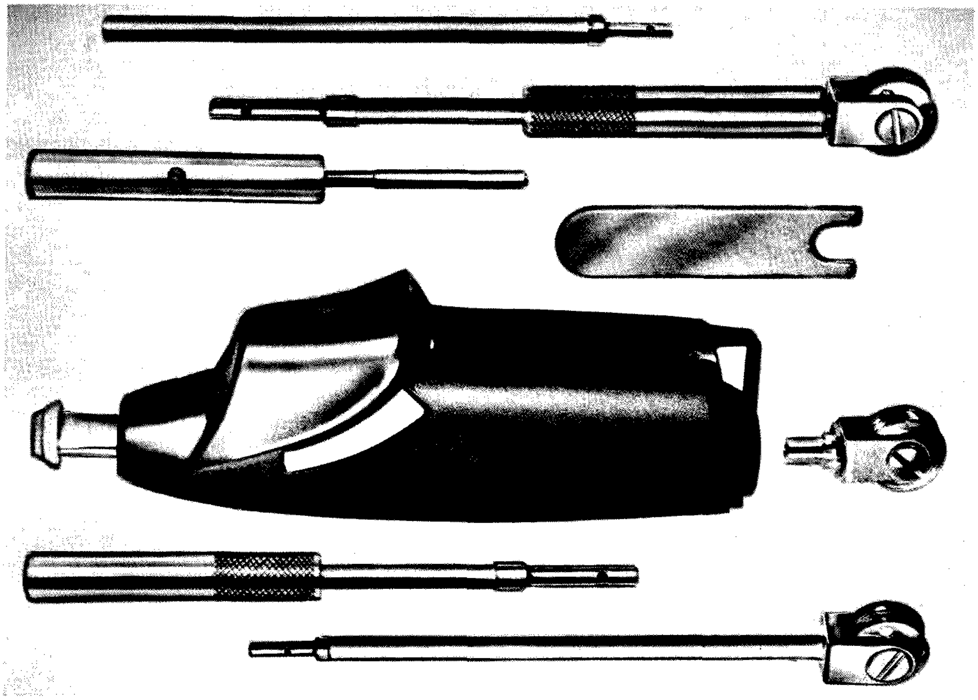


Photo A. Low-cost manual and electric wire-wrapping tools.

Ordering of Wiring

Although not absolutely essential, especially on a smaller project, it may be desirable to *"order"* your wiring prior to commencing the actual job. That is, you must consider that certain wires will go on level 1, certain others on level 2, and so on. The only real reason for this, of course, is for later corrections, modifications, and additions. With all three levels full, and density wiring, it is of immense help to *know* that the wire you wish to remove is on "terminal post 6, IC23, level 2," for instance. This information can be part of your "wire list" prepared directly from the circuit diagram. If you have a good wire list, you can rapidly wire a back panel using wire-wrapping techniques, without reference to the schematic. In fact, electronics laboratories have persons skilled in wire-wrapping, but unskilled in electronics, doing this constantly.

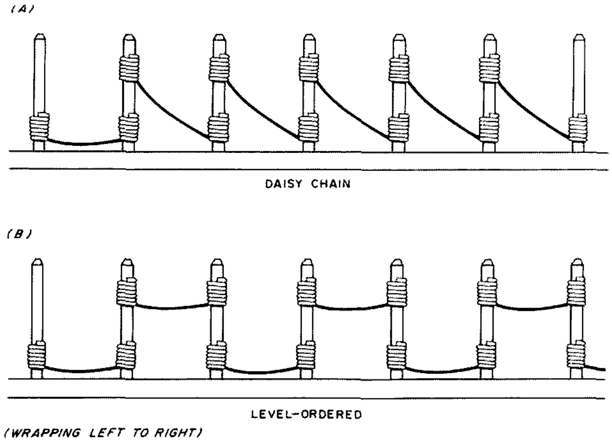


Fig. 2. Daisy-chain and level-ordered wiring.

Wire-listing

Whether or not you level order your wires, do plan on wire-listing your connections as mentioned above when wiring complex circuitry. Make up a wire-list table, as shown in Fig. 4, and, working from the schematic, such as that shown in the figure, draw a line through the schematic as you enter the information on the wire list.

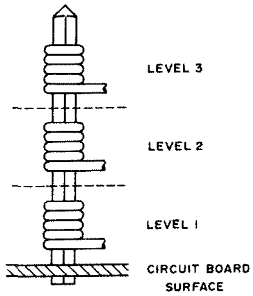
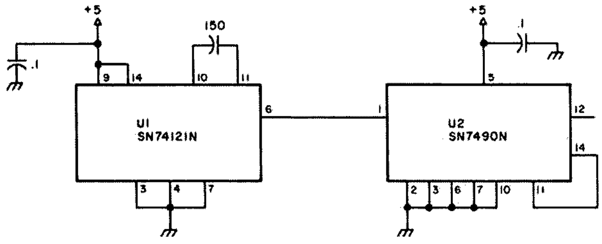


Fig. 3. Level orders of wire-wrapping.

Check this over, and your chances of wiring error are minimal. If you *do* mis-wire, locating your error is done quickly.



Component Reference	From	To	Remarks
U1	U1-9	+5	Vss
	U1-9	U1-14	
	U1-9	.1	.1 uF to gnd
	U1-10	150 pF	150 pF to U1-11
	U1-3	G	Chain
	U1-4	G	Chain
	U1-7	G	Chain
	U1-6	U2-1	
U2	U2-5	+5	
	U2-5	.1	.1 uF to gnd
		etc.	

Fig. 4. Typical wire-list table.

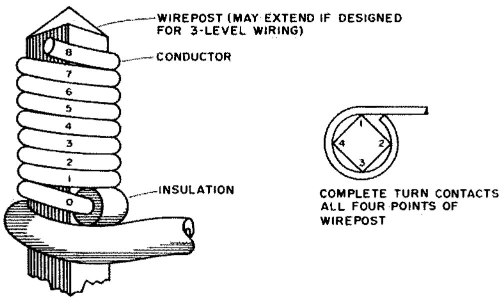


Fig. 5. Turns application to wirepost.

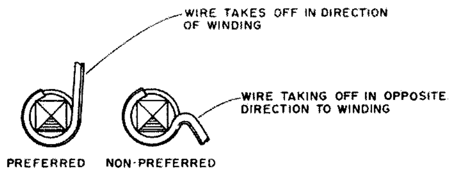


Fig. 6. Preferred way for wire to leave post.

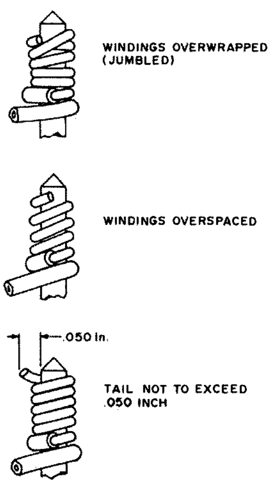


Fig. 7. Three types of unsatisfactory wraps.

Wire Application

Using conventional wire-wrapping tools, whether electric or manual, is the same, as far as the wiring on the post is concerned. We say "conventional," because later on we are going to describe some newer tools that have been produced with you, the at-home constructor, in mind.

Wires wrapped on a post should look like the greatly enlarged sketch in Fig. 5. The number of wire turns should be six of bare wire (plus two turns, minus one turn as a variable), in addition to one-half to three-quarters of a turn of insulated wire. This also is shown in the above figure, and applies to wire sizes of no. 26 AWG (0.0159-in.) or smaller. The purpose in allowing some insulation to wrap around the post is for strength and to avoid short circuits (as could happen if several wires bared of insulation extended from the posts).

A completed turn is considered as having been made when the wire has made contact with all four corners of the terminal post (Fig. 5).

Even though only one wrap is needed on a terminal, always put the first wrap at level 1. If you find it necessary to unwrap a wire from a post, never attempt to reuse it, but remove the other end also, and discard the wire. Once applied and removed, wire is structurally damaged so that it is totally unreliable for reuse. Caution should also be used in attempting to reuse terminal posts too many times. After ten or so wraps and unwraps, inspect the post closely, with a magnifier if possible, for damage such as loss of plating, corrosion, nicks, and structural weakness. This is more important if a powered wrapping tool has been used, as manual use is not so likely to apply as many stresses.

Route your wires rather openly from terminal to terminal. It is not unusual to loop the wires in an upward direction and dress them carefully later. Do not draw them tightly around other posts or parts, and never kink or sharply bend the wires. As long as electrical factors such as rf, hum, choke effect, etc., are not a consideration, multiple loops are acceptable in order to take up slack if the lead is too long. Always inspect the wires as the work progresses for any bare spots that may have been made in the insulation of the wire between wiring points. Never repair; always replace, if any are found.

Whenever possible, have the wire wrapped on the post in an orientation that allows the wire to leave the post without any tendency to unwind, as in Fig. 6. This means that you should always look ahead to see where the next post is that is to be connected.

With most tools, you cannot make other than perfect wraps. However, a non-perfect wrap, should it occur, is one that has the wires "jumble-wound" (a wire on top of itself in a spiral) or a wire that has too much space between each turn (should not be more than one-half the wire diameter). Last—but certainly very important because of short-circuit potential—do not permit the end of the wire resulting from the last turn to project out from the post more than .05 inch (1.3 mm). Spacing between two of these wire ends should be a minimum of 1/32 inch (.08 cm). See Fig. 7.

All of the preceding makes wire-wrapping sound difficult and complex—which is far from being true—but these hints are merely ways to do the job well. Now let us consider some of the tools that make the job easy.

A wire-wrapping tool used in a power-operated device is known as a bit, just as for a drill. Bits are provided to accommodate various sizes of bare

wire, e.g., no. 22-24, 24-26. A sleeve, customarily used, is insulated and protects adjacent terminals. The bit rotates within the sleeve. Photo A shows several wire-wrapping tools.

A tool for manual operation is known generically as a wire-wrapping tool—sometimes as a hand-wrapping tool. A number of trade names are in use. We also have "unwrapping" tools, discussed later.

The basic tool is composed of a handle, as a screwdriver has, and a narrow cylinder about two inches long. The operating end is approximately .070 inch (1.8 mm) in diameter to permit easy working between terminal posts. These tools are usually made of metal, although one manufacturer produces a low-cost tool made with fiberglass filled nylon. A tool manufactured by Vector Electronic Company, Sylmar, California, uses a hardened beryllium copper bit, and can easily wrap multilevels. This particular tool will accept no. 26 through 30 gauge wire, and has the unique capability of accepting bare wire through the top end for continuous wiring.

The bit end of the tool accepts the bared end of insulated wire or the end of uninsulated wire. The principle of inserting the wire and wrapping is similar. The enlarged view of the bit end shown in Fig. 8, through the courtesy of Vector Electronic Company, Inc., is used here for illustration.

The wire to be inserted should be held in one hand with your thumbnail 1.3 inches (3.3 cm) from the end of the wire. The side of the bit that has the wire tunnel may be identified by the probe hole on the side of the tool tip.

Holding the tool horizontally, or with the tip elevated slightly, insert the wire end into the tunnel. If the position of the wire probe hole has been noted, there should be no problem. But if you have inadvertently inserted the wire into the wirepost hole, the wire will not enter as far as your thumbnail holding the wire. Therefore, remove the wire and try again. Once it is inserted correctly, remove the wire about half of its length, bend it slightly and reinsert it. This will hold it securely. Now, releasing the wire, bend it at 90° at the tip.

Place the tool down over the wire-wrap post, and route the other end of the wire toward the next terminal post to be wrapped. Hold the loose end of the wire to the board with a firm but soft tool (an alignment tool is good for this, or a small screwdriver with a piece of heatshrink tubing on the end), make one clockwise turn using no downward pressure. Continue, using slight downward pressure, for the full number of turns. If the amount of insulation removed is correct for the number of turns, the tool should release itself. But if you continue to turn and exert downward pressure, jumblewrap (or overwrap) will result.

Wires may be stripped as you wire, using standard wire-stripping tools (they must be for the small wire sizes used, of course), or you may strip ahead of time. Considering the relatively minor cost involved, this rather irksome task may be avoided by purchasing your wire pre-cut and pre-stripped. The Cambridge Thermionic Corporation (Cambion®), for instance, supplies kits of 25 pieces each of 1.5-, 2.5-, 5.0-, and 7.0-inch (3.81-, 6.35-, 12.7-, and 17.78-cm) no. 30 AWG kynar-insulated wire. Each length is stripped one inch (2.54 cm) on each end.

Unwrapping may be done by carefully gripping the wire with needlenose pliers and unwinding the spiral. But this is tedious and time-consuming if many unwindings are to be made. An unwrapping tool, manually operated, is very low in cost and should be on hand.

In order to unwind a wrap, all that is necessary is to place the tool over the post, press it down slightly, and turn it counterclockwise. As previously mentioned and again emphasized—discard the wire.

One rather innovative approach to prototype wire-wrapping has been made by Vector. The tool used for this purpose is the Model P180, and has been designated "Slit-n-Wrap." A Motor-driven model, the P160-4T, is also available, but utilizes the hand tool as a driving bit, thus permitting you to upgrade your initial purchase if you desire.

The wire normally used for this tool is no. 28 AWG, nylon-polyurethane insulated, but it is also possible to wrap using standard no. 28 or no. 30 gauge pre-stripped and pre-cut wire. The wire may be obtained in clear, red, green, or blue, and is run from a spool attached to the top of the tool.

The system has been designed so that six turns provide extremely low resistance connections, each contact being approximately 0.003 Ohms. The secret to the success of this tool is in the removal of insulation from the wire as it passes over a narrow sharp edge in the bit. As the tool is rotated, the wire rolls along a path from this sharp edge to the wire post, which further opens the slit in the

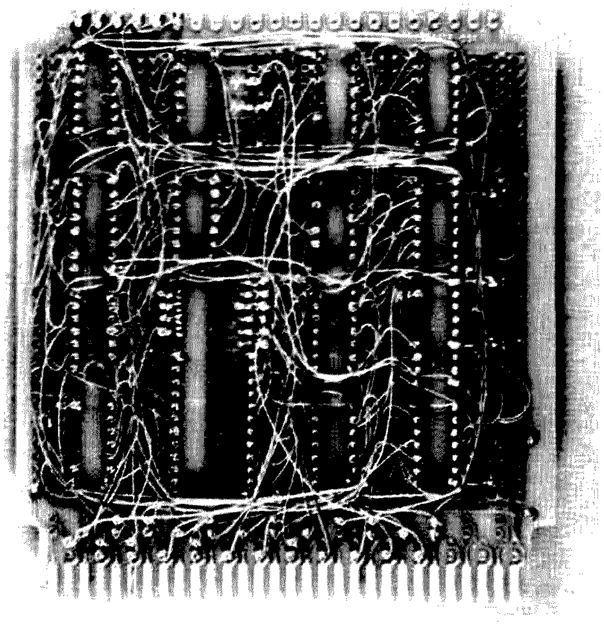


Photo B. Typical wire-wrapped circuit board. This board is of "universal type" with printed circuitry on opposite side.

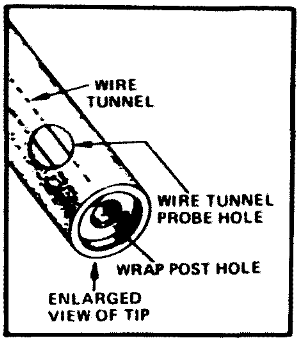


Fig. 8. Wire-wrap (Vector).

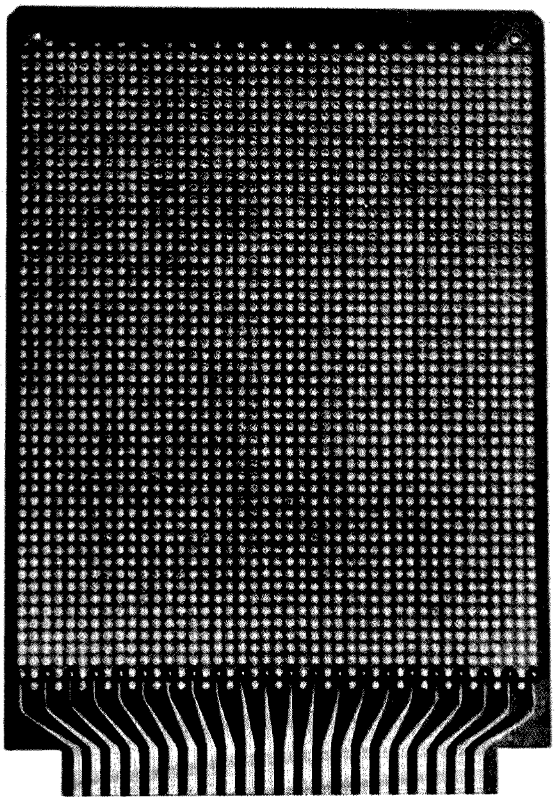


Photo C. Universal perforated board with end connectors (PLUGBOARD by Vector).

Fault	Probable Cause
Spiral or spread out wraps	Lifting tool during wrapping
Overlapping (jumble) turns	Excessive downward pressure during wrap
End tall too long	Removing tool before sufficient rotations have been made
Insufficient turns	Insulation not stripped back far enough. Wire not inserted fully into bit
Excessive turns	Too much insulation stripped

Table 1. Wire-wrapping problem guide.

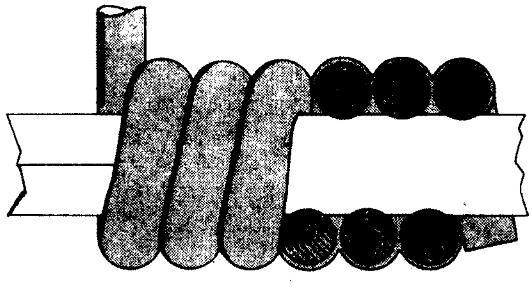


Fig. 9. Cross-section of "Slit-n-Wrap" connection (Vector).

insulation at the point where the bare copper contacts the post. The wrapping action indents the wire and the post, to produce gastight joints (seven turns will produce 28 contacts). Insulation removal only occurs when wrapping takes place, not when wire is removed from the tool.

Fig. 9 shows a cross-section of how the wire wraps on the post. Any insulation that is displaced reforms in the space between the wire turns. Wire is held close to the board (when starting or moving to the next terminal) using a dull wire-holder. No looping is necessary, and this type of wiring is amenable to daisy chaining. Wire is not cut until the end of a run or until a circuit path is reached.

Circuit Boards for Wire-wrapping

You may design and make your own PCB that will permit you to use wire-wrapping techniques. You may purchase "universal" PCBs (Photo B) that allow complete flexibility of design using wire-wrapping. And you may purchase component boards containing prepunched holes for mounting parts to be connected by wire-wrapping.

The technique of wire-wrapping is the same in each case. However, with a board etched for a specific project there is little or no flexibility, which is intended.

Universal-type wrappable boards have an overall grid of 0.042-inch-diameter (1.1-mm) holes on 0.1-inch (2.5-mm) centers, and use tinned interleaved buses. Any one or more Dual In-line Package (DIP) sockets may be installed anywhere on the boards. If parts such as resistors and capacitors are placed on the board, they should be installed using component carriers in order to take full advantage of wire-wrapping shortcuts (or, the circuit paths may suffice). A component carrier looks like an IC with the "lid" off, has wire-wrap terminals in this case, and on the open top surface has solder terminals to accept resistors, etc.

Sockets are also available for SCRs, transistors (all cases), and other components.

At least one manufacturer produces these boards with card connector terminations on one edge. This makes each board a separate entity within a system, with only the edge connector receptacle wiring between boards needed to complete the system.

End connector boards, by the way, frequently develop open circuits between the card and the connector. This can usually be corrected by removing the card and then reinserting it. If this doesn't work, the edge connections should be cleaned with alcohol, or even with a soft pencil eraser.

Component boards, made up of either epoxy paper or epoxy glass, use no copper etching paths except possibly as an edge connection. Typical of these boards is the one shown in Photo C, again manufactured by Vector under the name "PLUGBOARD." As in the case of etched boards, this carrier has 0.042-inch holes on 0.1-inch centers. A great deal of flexibility can be used in making prototypes with these boards, as parts of any reasonable physical size may be placed on them. They also have the advantage of being less costly than etched boards.

Wrapped-wire-type square pins are obtainable to insert into the holes on component boards or to use as parts holders or connecting points.

Wire-wrapping Problem Guide

Causes and cures for wire-wrapping problems have been mentioned throughout the preceding paragraphs. These have been summarized in Table 1. If you encounter difficulties in your initial wire-wrapping endeavors, check the table to analyze your problem. ■

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Working with Transistors

—useful knowledge begins where gobbledygook ends

Author's Note: This article was about to be sent in to *73* when an excellent article, "*73* Reveals Bias," by Carl C. Drumeller W5JJ, appeared in the September, 1978, issue of *73*, p. 136.

He used a method very similar to mine to determine transistor component values. There are differences in our approaches, though, and this article also covers material which he did not present. So, after talking with *73*, it was decided to go ahead with this one, too.

I recommend that you compare the two approaches to the problem and particularly note the different choices we each made in circuitry as well as the similar pragmatic answers.

Some years ago, I was able to take the Navy's "two-pound" course in basic electronics. It starts with "this is an electron," and ends up with "this is a computer."

There was a full section on transistor theory and application. This was good, as I didn't know anything about transistors.

By some fluke, I completed that part of the course with a high score. I also came away with one other important piece of information: I still didn't know anything about transistors.

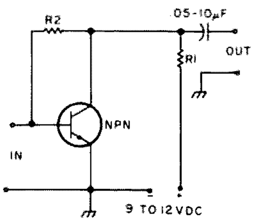

Fig. 1. Basic transistor voltage amplifier.

This was not the fault of the course or my lack of application. The information was centered on having total control of specifications and technical information on the devices being used.

Out in the real world, the slide-rule approach simply would not work at all. I never could get all the info needed to work the formulas, and I still did not have a firm grasp of what I was trying to do.

Contrast the almost religious devotion to the slide-rule approach to transistors with the usual way one learned about tubes, as I was introduced: Here is a tube (a type 30). It has a filament, a grid, and a plate. You connect three volts and a rheostat to the filament, like this, and the B battery to the plate circuit and one side of the filament, like this. Now, here's how you hook it up to make a radio (a one-tube regenerative set). Don't hook up the B battery backwards and don't connect the B battery to both sides of the filament or you'll burn it out.

That and a book of old tube circuits was about it as far as the theory was concerned. Then I was in business. The time required from start to finished product was the better part of an afternoon. If there was such a thing as the electron theory, parameters, and other assorted drivel, it was not mentioned and was not missed for some years.

A slight amount of reflection should yield the following: The 30 took two voltages. A transistor only takes one. Therefore, a transistor should be easier to work with than a tube. Why isn't it?

Basically the problem is gobbledygook—too many words got in the way. The transistor had to be sold as something new and different and an entire mythology was created to obscure everything about the transistor. You can hardly make head or tail of the little beasties. The nice thing to remember about transistor mythology is that most of it is bunk. What's needed is some how-do-you-use-it information and this is much easier to get than is commonly thought.

First of all, we need some parameters. What's a parameter? That's a catch-all phrase to cover all of the operating conditions of your pampered little transistor.

Tubes have parameters, too, only they don't know it. They have a maximum voltage for the filament, one for the plate, voltage limits between other elements, a maximum current, maximum signal input, etc. With tubes, it's no big deal, but with a transistor, everything gets a fancy title. Let's try and isolate what we need from the rest.

Transistors can work with one voltage. This is the supply voltage. It has a maximum value which the device can take. As with any device, but particularly with a transistor, you don't even want to come close to this. Figure a design maximum of 12 to 18 volts for most uses. The maximum rating is usually more. They also have a maximum current rating just like a tube does, but instead of the plate glowing cherry red and giving you a chance to shut it off, transistors go pffft the first time. Dead transistors are nature's way of telling you not to do that again.

While there are a myriad of transistor parameters available, the only other one that you need to know right now is the maximum voltage which can be applied between various elements. The next biggest cause of a terminal pffft, after too much collector current, is too high of a signal being applied to the base or emitter junctions. Too much signal will blow them. In time, you may want more parameters to play with, but those are enough for the cut-and-try experimenter.

There are reams of equations for determining all the resistance values in a simple transistor amplifier circuit. Since you probably won't have the information you need for them, there has to be another way. At least this is what I thought after sitting and staring at my collection of unknown transistors. I had come through the course in fine shape but I sat there without the faintest idea of what to do. A few basics came to me. I had little information, my transistors were unknown, and what was the worst thing that could happen? I could blow out a nickel transistor. That's not too bad for some experience. But, as I worked on just how to do it, some of the course material trickled through to the top.

It is these cut-and-try basics which I will try to present as an organized approach to starting to experiment with transistors.

Transistors are of two main types, PNP and NPN. This refers to the polarity of the internal material. This is theory, but there are theoretical and pragmatic considerations which are important about this.

In many of the older types you might work with, the NPN version of an identical PNP type might have a higher frequency range than the PNP transistor. This might be important in some circuits. Also, the polarity of the device determines how the polarity of the supply hooks up. The NPN is the one which hooks up with the same polarity that you are used to with tubes.

The B+ goes to the collector (plate) and the minus goes to the emitter (cathode). This makes it easy to get it right. Also, a pragmatic effect which I noticed was that, in many cases, the identical circuit was far more stable using an NPN rather than a PNP. There is one mechanical disadvantage to working with NPN power transistors; this is heat sinking. Here the voltage polarity works against you. It's nice to be able to work with the same voltage polarity as with tubes, but you pay for it when compared to the PNP.

With a PNP, the collector gets the minus voltage. With most power types, the collector is also connected directly to the case. With a PNP transistor, you can then mount the transistor directly on the chassis and also make the chassis be ground for your supply. A heat sink may or may not be needed, too, but it also can be grounded to the chassis directly.

With an NPN, you can't just do this. The usual method is either to use a transistor mounting kit with a mica washer and insulated hardware so that the transistor can still be mounted to the chassis, or to insulate the heat sink from the chassis.

I never was too happy with the washer method, and prefer the separate heat sink, but there is still a disadvantage to this: There then becomes a voltage difference between the chassis and the heat sink or transistor which might be a safety hazard. The best bet here is to shield the heat sink so that direct contact with it is avoided. You can connect the transistor directly to the chassis if you make your plus voltage the one which is grounded and leave the minus floating. If there is an internal supply for the unit, this is not hard to do. However, it is confusing, to say the least, and if there is other equipment connected to the unit, you may have conflict between various ground connections and power supplies.

For most breadboard use, I just used the transistor mounted on a big heat sink by itself. Connections were made by sloppy clip lead, anyway, so the problem of mounting the transistor in equipment never came up. It worked for test purposes. If I wanted to produce a finished circuit, I would go for the insulated heat sink and shield it mechanically so that there would be no shock hazard.

There may be times when a special purpose needs a PNP transistor, but for starting out and most uses, divide your transistors first by NPN and PNP. Then put the PNP transistors away where you will not be tempted to use them. The remaining NPN types can be roughly divided into three important main categories. These categories reflect both a basic application and a rough measurement of their power-handling abilities. The three categories are: small signal—up to 10 mA of current, general purpose—10 to 100 mA, and power types—100 mA and up.

This disregards the distinction between audio, rf, switching, or other special-purpose types. It does, though, give a rough guide for immediate application and to introduce a way of thinking. Your two basic immediate needs are to see that the device does not have its ratings exceeded, and to see that it is not overdriven.

To start with a mostly-unknown transistor, assume that it is a small-signal type. By the way, many large-signal or higher-power devices can also be used for small-signal use, and do a very good job. The basic transistor amplifier circuit is usually

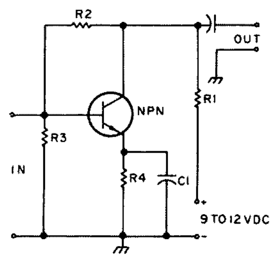

Fig. 2. Complete textbook circuit.

a small-signal application, both in audio and rf. It makes an ideal place to start.

Some equipment will be needed for experimentation. Besides the usual transistor hardware and parts, you will want an oscilloscope, a VOM, a resistance substitution box or handful of potentiometers or resistors, and a signal source.

Start with a microphone. It's safe. An FM tuner or audio signal generator would also be nice for further testing. An adjustable amplitude is highly desirable. The simple one-stage small-signal transistor voltage amplifier is a fiend to design by formula but it is quite easy to do pragmatically. This is where some of what the course taught me really helped. The basic circuit is shown in Fig. 1. R1 and R2 are the two key resistance values in the circuit. They will have to be arrived at experimentally but it is quite easy to do once you get the hang of it. The important thing is the safety of the device. Protecting the transistor is what takes up your time at the start and makes it seem a little clumsy to do.

According to theory, a class A transistor amplifier will draw half its allowable current at rest (no signal). The output signal goes above and below the midpoint. This gives us two assumptions. The first is that we are using a small-signal device (even if we are not). This also means that we are limited to 10 mA.

Our first practical calculation is a resistance value which will limit the current to 10 mA in the worst case, that is, if the transistor were a dead short. This gives you a value of R1. This is not critical, so pick the next highest resistance which you have if you can't get the exact value. Remember, this will not be the actual final value, but a working load resistance to start with which will protect the device.

In most cases, the actual value for best results will probably be much higher —similar to a triode tube voltage amplifier which usually has quite a high load resistance. However, start with the value derived in that manner. Hook up your VOM to measure the actual current at the collector. At this point, with one resistor, there should be no current. Without some form of bias to the base, the transistor should be cut off and no current should flow.

Now, take your resistance substitution box and, starting with the highest value at R2, click your way down until the transistor just starts to draw some current. At this point, there should be some indication that the circuit is functioning. Use your mike and a sensitive range on your scope, and watch the waveform. I also used the output from an FM tuner. Even at these low levels, I got an indication of circuit function and could see obvious distortion or clipping. The circuit should work, but not too well. Here is where the fun starts.

Replace the substitution box with a fixed value at R2. Put the substitution box in place of the fixed value at R1. Starting at the original R1 value, increase it and see what effect it has on the signal. You should get more amplification and less distortion up to a point. If you don't, try going a few clicks in the other direction, but watch the meter. When you get better results, replace the box with the appropriate fixed value and go back to R2 with the substitution box and see what effect changing that will have. A simple circuit like this should have quite a range of practical values over which it will work. It should only take a few back and forth trips to make an optimum choice.

At this point, you have a working amplifier. Usually there are a few more resistors which get put in the circuit for stability or other reasons. These get put in last. They are shown in Fig. 2. R3 is not critical. There is a simple formula for doing it by math: R3 is usually about 1/10 the value of R2. R2 and R3 act as a voltage divider and also help to tame the base-emitter circuit by providing a load to help limit current flow in the circuit.

When you have the basic circuit going, just hook up the substitution box and see what effect different values of R3 have to the actual signal. Start high, and as you click down, the signal will begin to be attenuated by the resistance. At that point, or a little lower, is the point at which you want to stop.

R4 is another matter. It is something like a cathode resistor but it doesn't work the same way. It also has a stabilizing effect on the transistor circuit, and helps limit the current of the stage. It also may have the effect of permitting a wider range of input signal without distortion. That doesn't mean you can exceed the element-to-element rating, but, as with tubes, the added bias can place the signal on a more-favorable part of the current curve.

Use your scope and a variable input. The values are quite similar to the tube values, several hundred Ohms, with 1000 and 2200 Ohms used quite commonly. Watch the scope and see at what point your signal starts to distort or clip. Put in the resistor and see what effect the values have on the signal. If there is an improvement, increase the signal to get the distortion again. Try different values and see what that does. You may want to go back and try some new values for R1 and R2 at this point, too. However, R4 will probably be a minor factor in the overall amplifier circuit.

As with vacuum-tube cathode resistors, the emitter resistor is usually bypassed. This is a husky electrolytic often in the same range as those used with a tube. 20 uF on up to a few hundred uF are common values. When the resistor is not bypassed, it also has some degenerative effect. The output will be less, but you will also get the stabilizing effect of an emitter which is not bypassed. You can see the difference on the scope as you try different resistance values or bypassing. Just play around with a few electrolytic values and watch what happens.

The main killer of transistor circuits is heat. They have the habit of drawing more current as they warm, which makes them warmer and they draw even more current, and pffft. If you work well within the ratings, you should have little trouble. Most devices are run too close to what they can handle.

The only other thing is to keep it from becoming externally heated. Don't put the transistors right over the power transformer. Allow room for ventilation. If you avoid extremes of both heat and cold, you should get reliable results with this circuit. The only way to assure operation at temperature extremes is to test

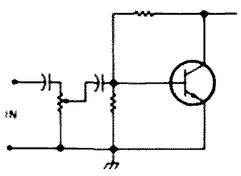

Fig. 3. Transistor volume control.

your circuit at the temperature extremes which you will normally encounter. Use husky transistors and parts and derate them for extremes. With care, this should not be any great problem.

Input and output circuits provide little problem with this stage. Capacitor coupling is easy and common with such a circuit. The value is not critical. 10 uF, or so, is a common value.

The real stinker is the volume control. You can't just hook up an audio-taper pot in place of R3. When you turned it down, it would become a dead short across the emitter-base junction. A circuit such as that shown in Fig. 3 will do the job. A few extra parts are quite cheap at transistor power levels.

You can use one or two stages which are similar for an audio amplifier, depending on how much amplification is needed. The output will be high impedance and will drive a high-impedance pair of headphones with sufficient volume. More stages can lead to troubles such as feedback or motorboating. There are two things at work here. The higher gain of cascade stages is a troublemaker and the additional wiring picks up anything.

Driving a speaker is not hard to do either, if you are not overly squeamish. Much attention is given to proper impedance matching with transistors. If you can just ignore that urge, you should be okay.

Start with the circuit of Fig. 4. The transformer should be a medium-to-low-impedance transformer. It probably should be critical, but I have used anything from a 48-Ohm c-t transistor output type to a replacement tube type. Use the 8-Ohm output and whatever primary you have to start with. Here you just do the same thing that you did with the load resistance procedure. Adjust R1 with one eye on the VOM, and listen to the output.

It would be assumed that you would start with an audio power type, not a small-signal type. Then start drawing some current and listen for what you get. This circuit will not be the most efficient, but you will be surprised just how loud even a small amount of audio can sound.

I found that an amplifier in the range of 200 mW to a Watt, or so, was quite practical with this sort of set up. In fact, I even hooked the speaker coil in alone in place of the transformer. I don't recommend the practice, though. It's too easy for the steady dc current to exceed the rating of the speaker winding, and burn out an expensive speaker. It does improve the frequency response, though. With care, even with a junk-box transformer, there will not be any serious loss for communications use, and even music may be acceptable.

It is always stressed that the transistor is a current-operated device; you always get current ratings but little is said about voltage. Your total output power is the signal voltage times the current through the impedance which you are using. The value can be found by Ohm's Law.

For example, the measured output voltage across the speaker winding divided by the impedance gives you the current (ac). The voltage is again used to calculate your power output. Or, even easier, use $P = E^2/R$.

It usually is thought that you get more output if you can get the transistor to deliver more current to the speaker coil. It's a nice theory, but just drawing more transistor current doesn't automatically deliver more output. As effective output goes up, so does the output current and the output voltage. At no point can the effective output voltage exceed the actual supply voltage to the transistor. It usually will be somewhat less. While your formula sounds great that 12 volts at 2 Amps would give you 24 Watts, at twelve volts, the transistor may not deliver that two Amps.

Enjoy the extra safety margin. You can get enough from just a simple power stage to hurt your ears at close range. Here, too, watch the scope for distortion. Measuring your output voltage values will give you the full story. When you drive the transistor to its supply voltage, you get clipping and distortion.

A common thing with transistor amplifiers is direct coupling between transistors. This is one of the all-time headaches to design and debug. Or repair, if it comes to that. Without going into convulsions on how to do it, there is one basic circuit configuration which is easy to play with, shown in Fig. 5.

Q1 and Q2 can be small-signal types. Q3 is shown as a 2N3055, which is quite common. I have used three 2N3055s and a number of oddball combinations. Try for some sort of method to your choice.

There is one important consideration you should keep in mind when working with power transistors. They are very rugged current-wise when compared with the smaller ones, but many of them can only accept a small input voltage without damage. Many which I worked with would only take about four volts between emitter and base. Many small-signal types would take 35 volts between emitter and base. That's a very strong case for using small-signal types to drive the power stage for you. Also, in many cases, the small-signal type will be more sensitive to weaker input signals.

An FM tuner is a high output signal source. So may be the output from a detector in a receiver. However, in a simple set, the audio stages may have to supply some of the small-signal gain needed for the set. Try some combinations when you work with these circuits so that you get a feel for different operating conditions.

I have worked with many sets which had impressive bench test specs, but on-the-air tests with weak signals showed the importance of real sensitivity to weak signals and the effect small amounts of change in distortion, clarity, and other conditions have. You just do not notice these effects without real on-the-air testing.

R1 is chosen the same way as in the first amplifier: first for the current, and then for the sound. This amplifier is about the simplest "complex" amplifier that you can build. The first two stages are working as voltage amplifiers and the last is the power output stage. This circuit will also work well with just two transistors if less preamplification is needed.

I did not build these circuits into any equipment. I just used these circuits to learn on. However, I found even the simple circuit like Fig. 5 to be quite stable. I had it running on the bench for hours at a time as an amplifier for an FM tuner, and most of the other successful circuits worked

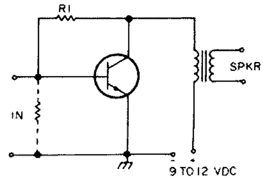

Fig. 4. Basic transistor power amplifier.

well with no problems. Even without all the resistors which a classic circuit is supposed to need for stability, they just sat there and worked for hours on the bench.

I think the key is to pick husky transistors and run them very conservatively. The power amp only draws a few hundred milliamps resting, if that, and the first stages use a tiny amount of current. However, as stated earlier, many of these stages were tried with the PNP transistors which were exact equivalents, and there was trouble. It appeared to be thermal runaway. The stage would start drifting into a higher-current condition and then I would get distortion and other problems.

There did not appear to be an easy fix for this condition. Even though the circuit could be stabilized so that it would not draw dangerous current, it was not tame, which means it's not reliable. And yet the same circuit with NPNs was a joy to work with. Stay away from PNPs. They will lead you into trouble.

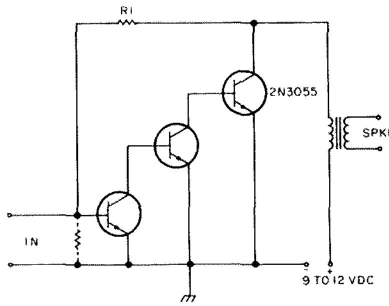

Fig. 5. Simple multi-stage power amp circuit.

There are a number of other simple configurations which can be done with just a few transistors. Any good transistor manual should have a number of basic circuits which can be tried.

There are also combination circuits using both NPN and PNP transistors tied back to back. Stay away from the more complex direct-coupled circuits with lots of components, dual power supplies, and the like. You get into servicing and reliability problems which you really don't need.

I found that none of the other simple combinations which I tried really gave me anything which these simple circuits didn't. There were differences in operation, but they were not significant for any normal use which I wanted to make of the circuit.

By the time you have played for a few weeks or a month with these simple circuits, you should have gotten over the fear of transistors. Then you will have built-in safety procedures to use when you are breadboarding, and it should not be hard to progress to more specialized simple circuits such as i-f amplifiers or rf circuits.

If you play by the important transistor rules and ignore many of the rest at first, you can learn a lot about the exact function of the circuits, how to get them going without formulas, how to deal with parts substitutions, and how to get wide operating tolerances.

You will learn to see what is actually happening inside the circuit as you make changes. The faults you find will also help you to debug other circuits which you may work with. ■

A Digital Clock with Analog Readout

— this is progress?

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The clock described here brings you the best of two worlds—the digital and the analog. It combines the reliability of the no-moving-parts, all-electronic clock with the instant readability of a clock with hands.

I built this clock for two main reasons. In the first place, I wanted an all-electronic clock that I could read from a distance of three or four feet in the dark without my glasses. If you happen to be as myopic as I am, you know that the ordinary digital clock might as well be just a night light after you have retired and have put your glasses on the shelf. This clock face can be as large as you wish.

In the second place, I wanted a clock that gives the instant readout of the old-fashioned clock with hands. One swift glance at an old-style clock and you know immediately how close you are to that 1:00 deadline. With the ordinary digital clock reading 12:53, it takes a bit more than a quick look to tell you that you've got seven minutes left. There's something about a clock with hands that makes 8:20 look like "twenty *after* eight" and 8:40 look like "twenty *to* nine." This visual shift doesn't occur with a digital readout. I suspect that this is one reason why Texas Instruments has come out with an analog readout on a digital watch. I predict that the clock-makers will follow suit. Even if you're not a nearsighted clock-watcher, you may find this project to your liking.

General Description

Two concentric circles of discrete light-emitting diodes form the "hands" of this clock. The outer circle is for the minute hand; the inner circle, with a diameter about three-fourths that of the outer one, is for the hour hand. One LED in each circle is on at any given time. Another, LED5, is on continuously at the center of the circles to act as a visual point of reference so that the eye somewhat automatically constructs each hand of the clock out of the central LED and the peripheral minute or hour LED. As additional reference points, particularly for nighttime viewing, there are blinking LEDs (1-4) of a different color located at 12:00, 3:00, 6:00, and 9:00. They show that the clock is running. They also are used in setting the clock, as is explained later.

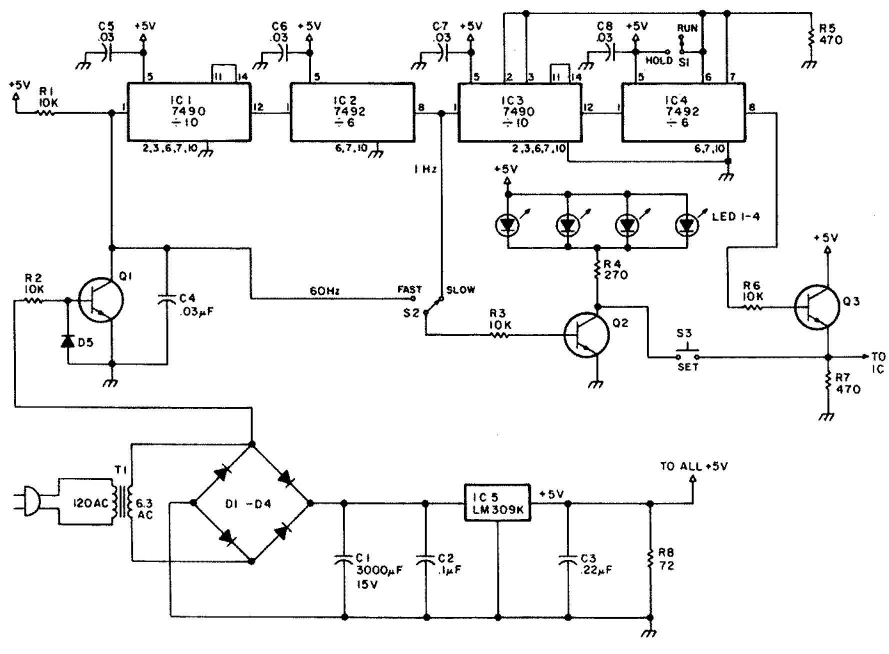

Fig. 1. Power supply and timing circuit.

A one-pulse-per-minute signal operates the clock. A one-pulse-per-second signal shows that the clock is running and, along with a 60-Hz signal, is used to set the clock. The 60-Hz signal is obtained from the collector of Q1, which squares up the sine wave to operate the TTL integrated circuits. This frequency is divided by 10 in IC1 and by 6 in IC2 to give a 1-Hz signal. This is again divided by 10 and 6 in IC14 and IC15 to produce the one-pulse-per-minute signal that operates the clock.

The 74154 integrated circuit is a 4-line-to-16-line decoder. For any binary number from zero to fifteen on input pins 20 to 23, one of the sixteen outputs goes low and turns on one LED. Since there are 60 LEDs for the minute hand, we need four of these ICs. Only one of them is enabled at a time, by a low on pins 18 and 19. the other three are turned off by a high on pin 18 or 19. The 7493 counter, IC6, puts out the binary numbers from 0 to 15 in sequence when pin 14 is pulsed once per minute by IC4. Q3 isolates IC4 from the setting signal. The binary numbers are fed to all four decoder ICs. The one which will give a readout is determined by the 7476, IC7. This is a dual J-K flip-flop which is made to flip every time a negative-going pulse comes from pin 11 of the 7493. This pin contains the most-significant bit of the binary output, and it drops to zero when the output goes from 15 (1111) to 0 (0000). The 7476 puts out a low on the following pairs of pins in sequence: 11 and 15, 11 and 14, 10 and 15, and 10 and 14. These pairs then enable IC10 to IC13 in sequence, and one LED lights up as determined by the binary number on pins 20 to 23. The other 74154s are inactivated since they have a high on pin 18 or 19.

With 64 outputs but only 60 minutes per hour, the last four outputs are unused, and the minute hand would disappear for four minutes if IC13 were enabled for its full count. To prevent this, IC6 must be reset to zero after the 59th minute. The low appearing at the 60th minute on pin 14 of IC13 is inverted by one section of a 7400 and fed to pins 2 and 3 of IC6. This resets IC6 so that its output goes from 1100 back to 0000. The negative-going pulse on pin 11 clears IC7 so that pins 11 and 15 are both low again and IC10 is enabled to begin the first minute of the next hour.

The hour hand functions similarly but we don't need as many LEDs. Twelve would not suffice since there would be a period of ambiguity depending upon when the hour hand jumped to the next hour. One could, of course, use 60 LEDs. I settled for 24, which is sufficient to prevent any ambiguity. When the clock is set on any hour, the hour hand stays on the hour until the beginning of the 16th minute after the

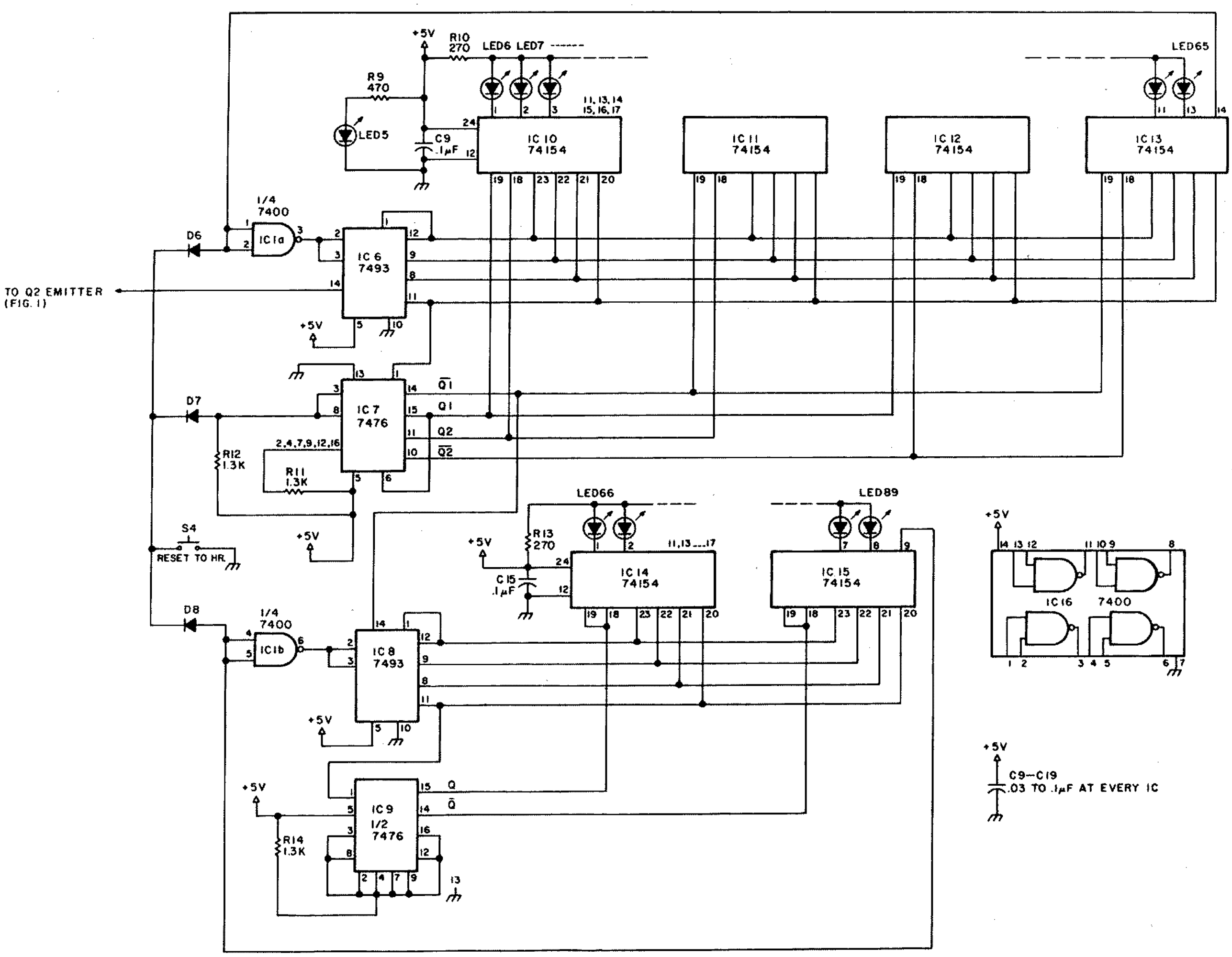

Fig. 2. Readout circuit.

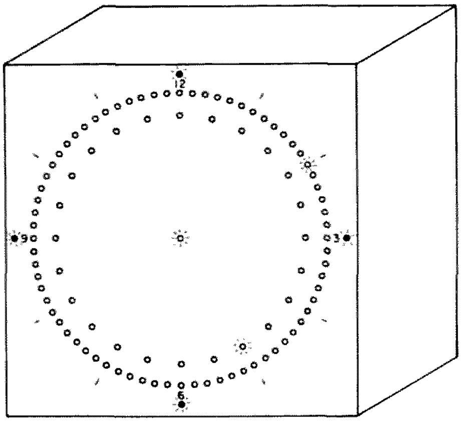

Fig. 3. Face layout.

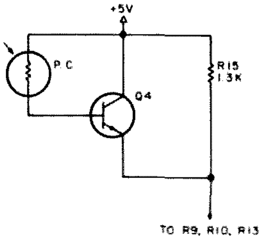

Fig. 4. Dimmer circuit.

hour. It then jumps to the next half-hour point. It remains in this position until the beginning of the 48th minute after the hour. Then it jumps to the next hour position. These points were chosen because signals are available at these times from pin 14 of IC7. The signal from this pin operates the hour hand just as the one-pulse-per-minute operates the minute hand. We need only two 74154s for the 24 LEDs. The hour hand is reset to the zero hour at what would be the 25th half-hour by the output from pin 9 of IC15, just as the minute hand is reset by IC13.

The signal from IC2 turns Q2 on and off, making the LEDs blink once per second and providing a slow-setting signal. For fast setting, the base of Q2 is connected to the 60-Hz square wave at the collector of Q1. In order to start any particular minute exactly on time, IC3 and IC4 are set to zero by S1 which puts a high on reset pins 2 and 3 and 6 and 7, respectively. This keeps the output of IC4 low so that the setting signal from Q2 can pull pin 14 of IC6 low.

The hour hand should be on the hour from 12 minutes before the hour through 15 minutes after the hour. When the clock is first turned on, this may not be the case. By resetting IC6 and IC8 and clearing IC7, S4 sets the clock to 12:00 or 8:00, depending on the state of IC9. This ensures the proper relationship between the two hands. D6, D7, and D8 isolate the ICs from each other.

Checking It Out

After double-checking all the wiring, put S2 in the SLOW postion, then apply power to the clock. The four indicating LEDs should blink. One or both of the hands may fail to light up since there are positions on the 74154s that are not connected to any LEDs, and these positions may be activated with random settings of the guiding ICs (IC6 to IC9). Pushing S4 should remedy this situation, and the clock should read either 12:00 or 8:00. Now put S1 in the HOLD position and S2 in the FAST position. The blinking LEDs should appear to light up continuously since they are now blinking at 60 Hz. Pressing the set button, S3, should make the minute hand revolve once per second and the hour hand jump twice per second. The latter should jump as the minute hand passes from 15 to 16 minutes after and from 13 to 12 minutes before the hour. If either hand doesn't go continuously around but skips whole sections, this would indicate a defect associated with one of the 7476s since they should sequentially enable the 74154s. If either hand disappears temporarily before the 12:00 point, this would indicate that the reset signal is not getting back to the 7493s. Check for a defective IC16, IC6, or IC8. I had a 7493 that counted beautifully but would not reset.

Now put S2 in the SLOW position. Holding S3 depressed should move the minute hand around once per minute while the hour hand jumps twice. Now put S1 in the RUN position, leaving S2 on SLOW. After sixty seconds, which you can count on the blinking LEDs, the minute hand should move to the next minute. If not, check out the divider chain. If the blinking LEDs have been working properly, IC1 and IC2 must be functioning, so check IC3, IC4, and Q3. Also check the wiring of S1.

In general, troubleshooting this clock is not difficult if you understand its operation and analyze the problem accordingly.

Setting The Clock

Put S1 in the HOLD position and S2 in the FAST position. Momentarily push S4. Then set the hour hand with S3, releasing the switch as soon as the hour hand reaches the desired spot to avoid overshooting with the minute hand. Then put S2 in the SLOW position and use S3 to set the minute hand to the next minute. In setting the minute hand, you probably will find that the hand jumps a number of minutes when you first depress S3 or when you release it. This is due to bounce in the switch contacts. It can be prevented by watching the blinking LEDs and depressing and releasing S3 only when the LEDs are *on*. When the LEDs are on, the collector of Q1 is low and, since pin 14 of IC6 is also low when S1 is in the HOLD position, the setting switch cannot send in a series of pulses when it bounces. This method of setting is not difficult, but it takes a bit of practice since you have to watch the blinking LEDs and the moving minute hand at the same time. When your reference clock reaches the next minute and zero seconds, immediately put S1 in the RUN position. The clock should now run correctly with the minute hand changing right on time.

Variations and Options

Since this clock uses a large number of LEDs, I used the cheapest bargain LEDs I could find. Assuming you'll do the same, I haven't specified the type in the parts list. Resistors R9, R10, and R13 will have to be adjusted for the particular LEDs you use.

The blinking LEDs could be replaced by a single one, or by a dozen, if you want one at every hour point. A single LED may not let enough current through to set the clock, in which case a resistor could be added in parallel with it. If you use a dozen LEDs, only some of them may light, or they may differ in brightness. This will require the addition of individual resistors of different sizes to even out the brightnesses.

If you wish to vary the brightness of the hands for daytime and nighttime, add a resistor from +5 V to the common connection of R9,

R10, and R13. It should be large enough to make the clock as dim as you want it for nighttime. Then use an NPN transistor and a photocell as in Fig. 4. As light falls on the photocell, its resistance drops, feeding more current to the transistor, which then partially shorts out the nighttime dropping resistor.

In my first version of this clock, I used a 5316 clock chip for the timing signals, eliminating IC1 to IC4 and Q1. It was a bargain chip because the alarm was defective. If you happen to have one of these chips in your supply and would like to use it, I can furnish the circuit diagram on request. Please send an SASE!

If you find the fast-set signal a bit too fast at 60 Hz, you can connect the fast contact on S2 to the output of IC1, which will give you a 6-Hz setting signal.

Construction

There is nothing critical about the construction, but the TTL ICs can cause erratic operation if they are not properly bypassed. Each IC should have a capacitor connected right at the IC from the +5 V input to ground. The LEDs are wired so that pin 1 of IC10 and pin 1 of IC14 go to the LEDs at the 12:00 location on the clock face; the other pins go to the LEDs that follow, clockwise around the face. I used wire-wrap technique for part of the clock and point-to-point soldering for the rest.

The face of the clock can be made as large as you desire. If it is large enough, the ICs can be mounted on the face itself. A black sheet of cardboard can be used to cover the electronics, or you can cover the whole face with a dark red plastic sheet. I used a dry letter transfer kit to put white numbers on the dark face of the clock. I built a case for the clock out of wood. If you are good at carpentry, you can make this clock into a neat and functional piece of furniture that you won't want to keep hidden in the bedroom. ■

Parts list

R1, R2, R3, R6—10k, ¼ W
R4—220 Ohms, ½ W
R5, R7, R9—470 Ohms, ½ W
R8—720 Ohms, 2 W
R10, R13—270 Ohms, ¼ W
R11, R12, R14, R15—1.3k, ¼ W
C1—3000 uF, 15 V
C2—.1 uF
C3—.22 uF
C4-C19—.03 to .1-uF bypass disc capacitors from +5 V to ground at every IC (not all drawn on diagram)
T1—120 V ac/6.3 V ac, at 2 A
IC1, IC3—7490 counter
IC2, IC4—7492 counter
IC5—LM309K 5-volt regulator
IC6, IC8—4-bit binary counter
IC7, IC9—7476 dual J-K flip-flop
IC10-IC15—74154 4-line-to-16-line decoder
IC16—7400 quadruple NAND gate
S1—SPST toggle or slide switch
S2—SPDT toggle or slide switch
S3, S4—NO push-button switch
Q1-Q4—2N718 or similar small-signal NPN transistor
LED1-LED4—any small yellow or green light-emitting diode
LED5-LED89—any jumbo red LEDs
PC—VT133L or similar photocell

Reader Service—see page 259

Turn Off Repeater Windbags

—HT mod brings welcome relief

Gary L. Long WD5HYQ
Route 5, Box 267
Muskogee OK 74401

At last a nifty circuit is available that can be used in the Wilson 1402 to make it a monitor (automatically).

Perhaps you are one of those people who really like to monitor the repeater, but find that there are always those few hams around chewing the rag so that continuous monitoring is more trouble than turning off the rig. Well, cheer up, Bunky, I have just what you need—a time-delay circuit that lets the Wilson operate normally for about 10 seconds after the squelch opens and a call is made or a conversation is started. After the 10 seconds has elapsed, the circuit mutes the speaker until the call in progress is over. No more will you have to listen to all of those dull, long-winded conversations just to be sure that you won't miss a call, and the circuit is automatically disabled when you need to get in on the conversation.

Circuit Details

The circuit uses the 0-to-4½-volt transition when the squelch opens in the Wilson 1402, as a trigger to set the timing in motion. This voltage is picked off the top of the end-mounted 6.8k-Ohm resistor which is directly above the LD 3030 audio driver IC on the printed circuit board. This makes all wiring connections available on the top of the board for ease in construction. The basic circuit design is that of a switching transistor with a timing circuit and an audio gate transistor tied to it.

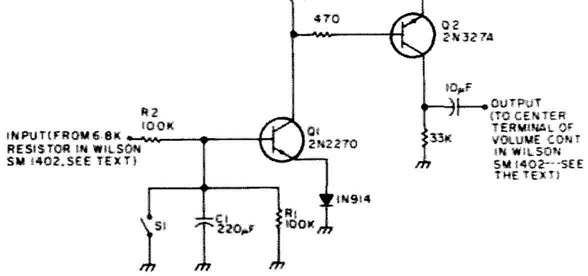

Fig. 1. Schematic of automatic muting circuit.

Circuit Operation

When the squelch opens, a voltage at the 6.8k resistor goes from 0 to around 4½ volts. This voltage is applied to the circuit to start charging the R1C1 combination through R2. As soon as about 1.2 volts is attained on the base of Q1, Q1 switches on which in turn switches on Q2. Q2 is provided as an audio gate, and also to isolate the timing switch from the audio switch. When Q2 is switched on, it gates the audio that normally would have been fed to the audio driver IC from the center tap (wiper) of the volume control pot to ground.

Anyway, I guess it goes to ground, since it works. It might be going through the batteries, but wherever it sends the audio, it effectively shorts whatever audio is available to operate the driver IC to ground and kills all the audio output from the speaker. This takes about 10 seconds for the choice of resistors and capacitors I used.

When the 1402's squelch closes, the voltage at R2 goes to zero and C1 is discharged through R1 until Q1 switches off, which switches off Q2 and restores the audio to a squelched receiver ready for the next call. This takes about 6 seconds for the values that I used. The measured current draw for this circuit is less than 1 mA, and if you are running the audio level fairly loud (volume control at ½ maximum or louder) the circuit also will function as a battery saver. This is because the circuit clips the audio on extended conversations to zero, which reduces the radio's current draw to that of minimum specs for unsquelched operation.

The switch S1 can be any kind of an SPST switch, but since I didn't want to drill a hole in the radio, I used a mercury tilt switch similar to the one in most residential wall-mounted heating thermostats which I found in my adequately-stocked junk drawer. The switch is positioned inside the radio so that when the radio is lying on a table, the switch is open and will let the capacitor, C1, charge. When the radio is picked up and held in the vertical handheld operating position,

the switch is closed, which holds capacitor C1 permanently discharged for the normal two-way operation of the radio.

Construction Hints

I built all the components in the area at the top of the radio around the volume and squelch controls. This was done with hard wiring since space is limited, and also since there really isn't much to wire. The largest component was the capacitor, and it fit nicely in the small recess beside the S-meter. The resistors were ¼-Watt jobs, and the mercury switch was one that I had which was larger than necessary, but fit nicely in the gap between crystals in the crystal deck. I adjusted the mercury switch so that the mercury ran away from the contacts when the radio was lying flat.

After connecting all the items as shown, the unit can be checked out by holding it in the horizontal position and breaking the squelch. After about 10 seconds, the audio will mute and will remain that way until the squelch is closed or until the unit is picked up and held in the vertical position.

In closing: An idea that I didn't try out, that came to me after I built the circuit, is to use a LED instead of the 1N914 diode which would give a visual indication of a muted radio. Also worth noting is that I tried several transistors for Q2, but found that with some, as soon as they were connected, a loss in the radio's audio occurred. This was not the case with the 2N327A, and I heartily recommend being careful of substitutes in this area. ■

Build a $5 Coax Switch

—why pay more?

$3.47 or $5.02.

Jerrold Swank W8HXR
657 Willabar Drive
Washington Court House
OH 43160

A two-way coax switch is a real convenience for switching between two antennas, or for grounding an antenna, or for switching one antenna to another rig. Take a small minibox, Bud #5A30005 or #5A3014, and with a 5/8" drill or a Greenlee punch cut three holes as shown in the drawing in Fig. 1. These are cut on the three sides of the U-section.

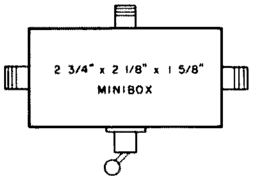

Fig. 1.

Mount three SO-239 connectors on the three sides of the U-shaped section. Then punch a ½" hole in the other section and mount a heavy-duty toggle switch—SPDT. I used a DPDT and strapped the two sections together to take heavier current.

Connect as shown in Fig. 2. Use a flexible piece of coax shield from RG-58/U for connection to the "common" connector so that the box can be put back together easily.

Use #12 wire or the center conductor from RG-8/U coax for the other connections.

The total actual parts cost was $5.02, saving about $35 over a commercial switch of the same type.

The same idea can be used without the toggle for an emergency T connector, by connecting all three SO-239s together. Cost: $3.47. ■

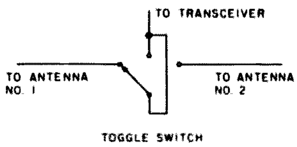

Fig. 2.

James Kates WB8TCC
3887 North M-52
Owosso MI 48867

Hamdom's Evangelical Crusade

—born-again ops, arise!

I have given up trying to explain ham radio to my wife. And who can blame me? Last time I mentioned that something was wrong with my keyer, she called a locksmith. And how could I try to explain *that* to someone who thinks TVI is what you get when you sit too close to the television set?

So, I've decided to keep my thoughts in that area to myself. Except for the Tuesday-night gathering of hams at our place (at which my wife, by the way, chews us out for always talking about OSCAR but never having the courtesy to invite him over), I've pretty much regressed into a domestic ham fantasy-world.

Which is not all too bad, actually—it beats trying to explain the thrill of operating 160 meters to someone who thinks it's an Olympic running event.

Take last Thursday night, for example: The XYL and I, having finished the dinner dishes, had settled down for an evening of the all-American, middle-class, intellectual challenge—watching television, of course. I sat in the easy chair, fiddling with a 450 MHz handie-talkie, which my wife proudly tells her friends is "an expensive CB."

Like I said, who can blame me?

My wife had long since given up on what channel I want to watch, since I usually mumble something about "20 meters" (unless the band happens to be a total disaster, in which case I grumble something about "the gang on two"). So as I sat fiddling with a stubborn battery pack, she flipped to the "Billy Graham Crusade."

She settled herself on the couch and picked up her knitting. "Is that alright with you, dear?" she asked. "Mfgpht," I said. She went back to her knitting and I went back to my battery pack. Finally, I got the thing in place. I stuck an earplug in the jack, fiddled with the squelch control a bit, and then turned the channel selector to the local repeater. With that odd combination — Billy Graham in the right ear and some guy testing an autopatch in the left — I sat back in the chair and promptly fell asleep.

What was it that Freud said about people who were depressed by daylight — that all their secret thoughts revealed themselves in dreams? Anyway, the last thing I remember thinking is, "Wouldn't it be great if we had someone who could do the same thing for ham radio that Billy Graham is doing for religion?" Then, I had my first glimpse of a frustrated ham's vision.

Madison Square Garden. The Astrodome. The Hollywood Bowl. It didn't matter; the scene was the same every time. Hundreds of thousands of people stream into the nation's gathering places to learn about ham radio. CBers, SWLers, and even stereo freaks crowd the auditoriums and stadiums of the nation to hear the world's greatest spreader of the ham's way of life. Suddenly I awoke with a start, sat up in the chair, and said aloud:

"Ham. Elmer Ham."

My wife put down her knitting and stared at me quizzically. "What was that, dear?" she asked.

"Nothing," I said, and then I pointed to the handie-talkie. "Just thought I heard a friend of mine." I knew it was pointless to say any more, because trying to explain ham radio to my wife usually resulted in disaster. Last time I'd spoken of inductance in her presence, she'd called the Pentagon and begged them not to draft me.

She shook her head. "Honestly, dear. I'd swear all you ever think about is your silly little radios."

"Mfgpht," I said cheerfully. Before long I was asleep again, and the vision returned.

The Astrodome. Thousands pour into the stadium; millions more watch on television. Elmer Ham doesn't appear immediately, of course — they save him for the last while they warm up the audience. Maybe they will play tapes of rare DX QSOs over the stadium PA system, or have a choir chanting in CW — something like that. Ushers pass out Novice-class study guides as the curious throng floods through the doors; attendants begin circulating straight keys and antenna tuners throughout the audience as the stadium fills. And then Elmer Ham takes the stage.

He's a dynamic, charismatic man, and the audience responds enthusiastically as he extols the virtues of ham radio. An attendant in a white lab coat wheels up a cart full of equipment, and Elmer Ham goes through the rounds of explaining the mysteries of hamdom to a hundred thousand gaping neophytes. They "ooohhh" at SSTV. They "aahhh" at DX and RTTY. And they

The VBC Model 3000, the world's first and only narrow band voice modulation system is now a proven success. Leading communications engineers were enthusiastic about the NBVM system from the beginning. Now the idea of more QSO's per kilocycle has fired the imagination of Amateurs everywhere. The benefits of this advanced communications system are being demonstrated all over the world.

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For more detailed information please call or write. The Model 3000 will be available from most Tempo dealers throughout the U.S. and abroad.

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"wowww" as Elmer effortlessly copies CW at 65 wpm.

After a good hour, he makes the big pitch: Would anyone in the audience be interested in obtaining a ham license? Thousands raise their hands. Elmer warns them that they'll be required to learn their code and theory, that the battle won't be won without a little study and dedication. Some of them are afraid, but others have made up their minds that they're going to do it—and at Elmer Ham's invitation, they flock down to the stage where attendants sign them up for code and theory courses.

"Beautiful," I said aloud. Then I opened one eye. Billy Graham had been pre-empted by some commercial about a lady plumber, and my wife was still working at her knitting. And, of course, the gang was still jabbering away on the local repeater.

"What happened to Elmer Ham?" I asked.

"Who?"

"Billy Graham. I meant Billy Graham."

"Oh, him. He's all over, and you missed the best part. It was so exciting," she said.

"I know." I continued to fiddle with the handie-talkie until the next program—a rerun of "I Love Lucy"—hit the air.

"This all right with you?" my wife asked methodically.

"Mfgpht," I said, and settled back into the easy chair. This one, I mused, would require a little more thought. How about a Cuban bandleader who keeps in touch with his crazy redheaded wife through 2 meters? Hmmmm . . . ■

Tom Merrick W1WUO
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The Memorizer Flies Inverted

—something Yaesu never told you

The popular Yaesu FT-227R Memorizer presented me with a hidden capability one evening. I had always envied those who could instantly "go inverted" with one flick of some super-switch thoughtfully provided by some brilliant designer. It was a great pleasure to discover that this was an unspecified option in my own transceiver! It was even more fun to think that I had discovered something that even the designers on this unit hadn't thought of.

This operating procedure, which requires no physical modifications at all, causes the transceiver to exchange 600-kHz-offset transmitting and receiving frequencies with one click of the function switch. It is accomplished by using a not-obvious combination of control settings which is not mentioned in the instruction manual.

The following steps specify how to memorize the lower frequency, set to the higher frequency, energize the memory recall, and utilize the MEM and +600 positions of the function switch.

1. Release M (Memory) and MR (Memory Recall) switches.
2. Set the frequency display to the *lower* of the repeater input and output frequencies.
3. Press M switch.
4. Set the frequency display to the *higher* of the repeater input and output frequencies.
5. Press MR switch.
6. Set function switch to the MEM or +600 position.

The frequency display now indicates the receiving frequency. Choose the frequency you want to listen to, the repeater input or output. When the transceiver transmitter is keyed, the output frequency will be offset 600 kHz *up* or *down* as required to effect the desired operation.

For normal operation on repeaters with a low-side input frequency, use MEM. In this position, the transmitter is forced to be the memorized (lower) frequency and the MR switch function is defeated so that the received frequency (higher) is what is set into the dial. When you set to the +600 position to go inverted, the MR becomes effective so that the memorized (lower) frequency is recalled and the transmitter is offset up by 600 kHz.

For normal operation on repeaters with a high-side input frequency, use +600 and switch to MEM to go inverted.

As long as the memorized frequency is not lost, the transceiver can be used on other frequencies with any offset you want and returned to this special mode by following steps 4 through 6.

If you have to ask what this type of operation is good for, I'm surprised you have read this far. In truth, I don't know of much practical use unless your favorite repeater frequently goes off the air due to timeout failure. At least it is fun to be able to use all of the capability of the equipment.

See you on the output—direct! ■

Double-Duty Decoder Project

—listen to SCA and tune in RTTY

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San Antonio TX 78227

Here are two projects that I've had in mind for a long time. Since they are very similar in design, I am combining them into one article divided into two parts. Part One covers the SCA decoder, and Part Two covers the FSK decoder.

Part One

For a long time I have been wanting to receive the background music that many FM stations broadcast. I had read several construction articles describing decoders, but they were all too complicated. I wanted something simple and easy to build. I knew that a 565 PLL could be used to decode SCA broadcasts, so out came the *Signetics Data Book*. A schematic shown in Fig. 1(a) is included, along with the specifications on the IC. Another schematic (Fig. 5) demonstrated that FSK decoding is possible. Since the two circuits were very similar, I designed a printed circuit board to permit constructing either circuit by installing the appropriate parts.

SCA is uninterrupted background music transmitted by some FM stations for use in offices and commercial businesses such as department stores. The SCA signal is on a 67-kHz subcarrier of the regular FM channel, and is only ten percent of the total signal. The subcarrier is frequency-modulated, and has a bandwidth of plus and minus 7 kHz.

An input signal greater than 50 mV is required by the 565 to be able to operate properly. A resistive voltage divider is used to establish the correct operating bias for the inputs, and a high-pass filter is used to attenuate the regular FM channel audio. The 67-kHz operating frequency of the 565's vco is set by the RC constant of R6 and C3. The vco requires only approximate tuning, as it will lock over a range of plus and minus 30 percent. However, a test point is provided so that the vco may be set exactly with a frequency counter. A low-pass filter and de-emphasis network is formed by resistors R7, R8, and R9, along with capacitors C6, C7, and C8. This filter removes most of the bias that usually accompanies the SCA signal.

The audio output from the 565 is approximately 30 to 50 mV and may be fed into your receiver's stereo demodulator. Most receivers today utilize an IC as a stereo demodulator and can distinguish between mono and stereo signals. A mono signal lacks a 19-kHz pilot signal, and the demodulator will automatically apply the same audio to both output channels. Coincidentally, these ICs also require about 50 mV of audio signal at the input. Most of these ICs also include the proper de-emphasis network for the regular FM signal.

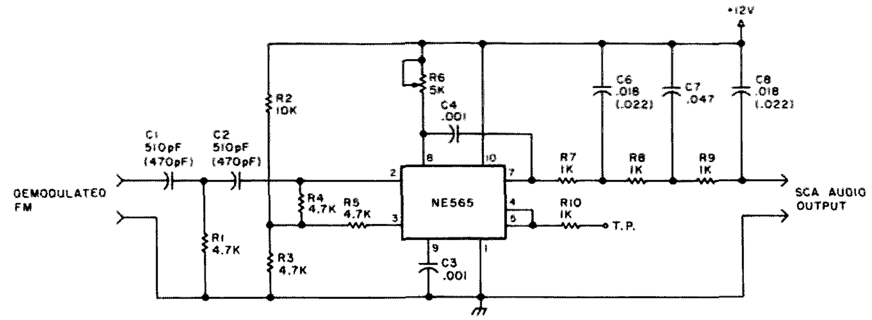

Fig. 1(a). Schematic of SCA decoder. Values in ( ) are acceptable substitutes. Adjust R6 for 67 kHz at TP.

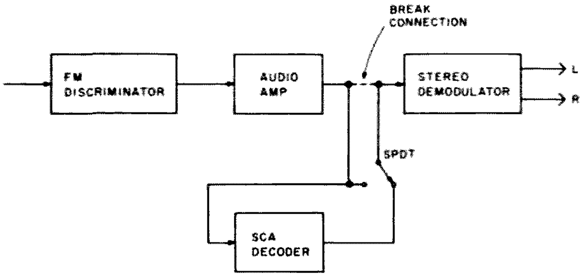

Fig. 1(b). Typical connection for decoder.

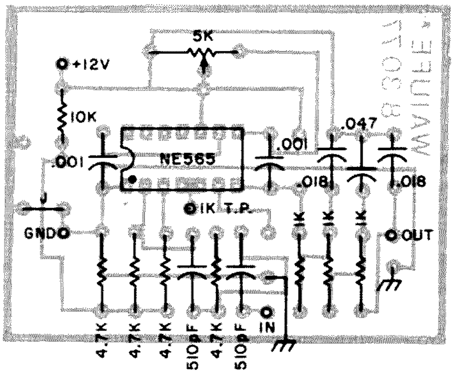

Fig. 2(a). Parts layout of decoder.

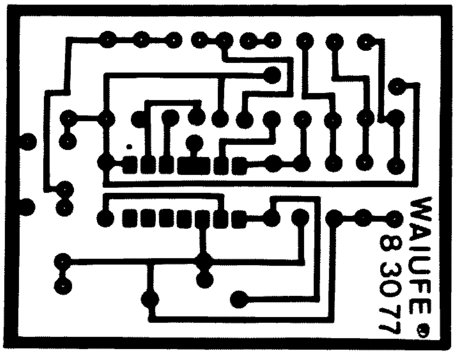

Fig. 3. SCA/FSK decoder board. Board is 2" x 2½". Foil side view.

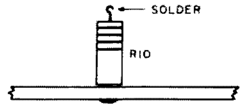

Fig 2(b). R10 TP. Mount vertically and form top lead into a loop.

The input of these ICs is usually preceded by a transistor-amplifier whose input comes from the receiver's discriminator. This signal contains both the SCA audio and the FM multiplexed audio. The demodulator normally eliminates the audio signal above 50 kHz. Fig. 1(b) shows a typical connection scheme for installing the SCA decoder. It may be to your advantage to obtain the schematic for your receiver to locate the proper connection point.

I installed an SPDT switch so that I could alternate between the regular channel and the SCA signal. This also makes it easy to locate a station in your area that transmits SCA. Just tune to each station, and flip the switch. It may be necessary to increase the volume control due to the low level of the SCA signal.

Use ¼-Watt 5% resistors and Mylar™ capacitors, except for C1 and C2, which may be disc type. If you have difficulty obtaining exact values, acceptable substitutes are noted in parentheses. These are the values I used, and I encountered no trouble in the operation of the decoder.

Also, use shielded audio cable if the decoder is to be mounted more than a couple of inches away from the tie-in point. This will reduce the possibility of hum being picked up and amplified. Power consumption is about 8 mA, so a power switch should not be needed. Just find a point in your receiver where you can obtain +12 volts and wire the decoder to it.

Part Two

The FSK decoder is a little more difficult because of the dual power supply requirement. Both plus and minus 5 volts and 12 to 15 volts are needed. Fig. 9 shows a schematic for a suitable power supply.

Fig. 4(a) shows an audio processor stage to supply an approximate 50 mV signal to the input of the 565. These two amplifiers have a gain of .1, so you'll need more than 500 mV of audio input. You should be able to tap off from your receiver's headphone jack.

Fig. 4(b) is the digital processor stage. The signal from the 565 output and reference is applied to IC2a which buffers the signal. The output from this amp is a distorted square wave. IC2b further conditions the signal, and the 200k potentiometer is adjusted for a 3-volt peak-to-peak signal at TP1. IC3 converts this signal to a clean square wave. Pin 3 of IC3 should be set at −.2 volts for proper symmetry of the output signal. However, this is only an approximate setting. Due to differences in components, it may be necessary to align this stage.

There are two methods of aligning this stage. The first requires the use of a general-coverage receiver capable of tuning RTTY signals. Start by tuning in a good strong FSK signal. Try one of the RTTY net frequencies. Connect the output of the decoder to the keying circuit of your page printer, and be sure that the printer is set properly for the speed of the signal being received. Use a high-impedance voltmeter between pin 3 of IC3 and ground, and adjust the resistor while watching the printer for the best copy. Take note of the reading for future reference.

The second method is for all you purists who have everything. You will need: frequency counter, oscilloscope, square wave generator with variable baud width and amplitude controls, and a voltage-controlled sine wave generator with amplitude control.

Set the sine wave gen-

For Figs. 4(a), 4(b): IC1, IC2—uA747, 14-pin DIP. Pins 9, 13 — +15 V, pin 4— −15 V. IC3—uA741, 8-pin DIP. Pin 7— +15 V, pin 4— −15 V.

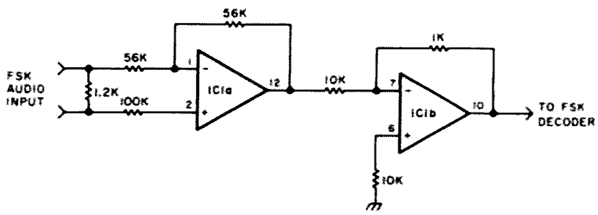

Fig. 4(a). Audio processor. Audio input>500 mV ac.

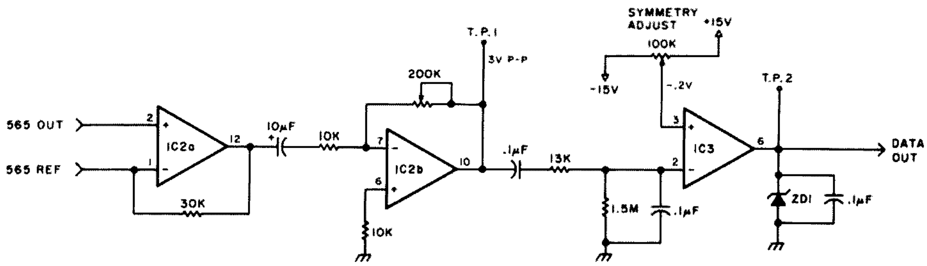

Fig. 4(b). Digital processor. Choose ZD1 for maximum output voltage required.

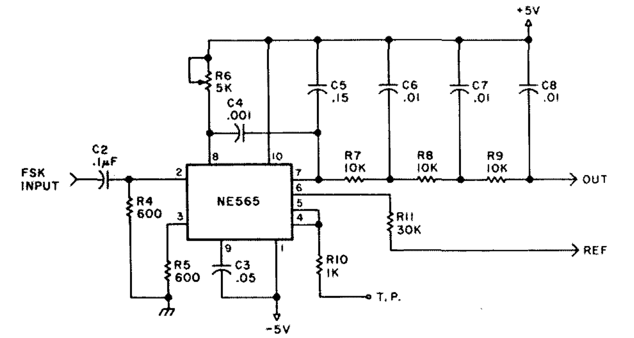

Fig. 5. Schematic of FSK decoder. Uses same board shown in Fig. 3. Adjust R6 for 2550 Hz with no input signal, for operation at 2125 Hz to 2975 Hz, 850-Hz shift.

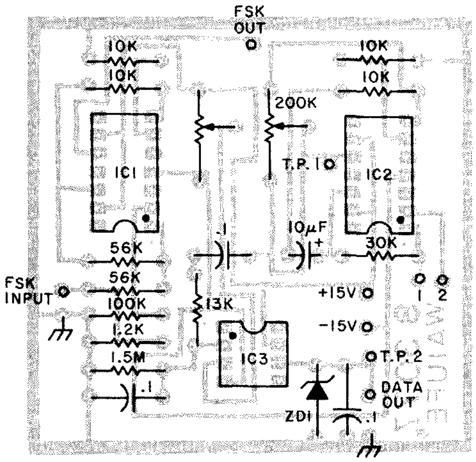

Fig. 6. Parts layout. Audio/digital processor. Pin 1, IC2: 565 reference input. Pin 2, IC2: 565 output input. Be certain that both decoder and processor boards have common ground when used together.

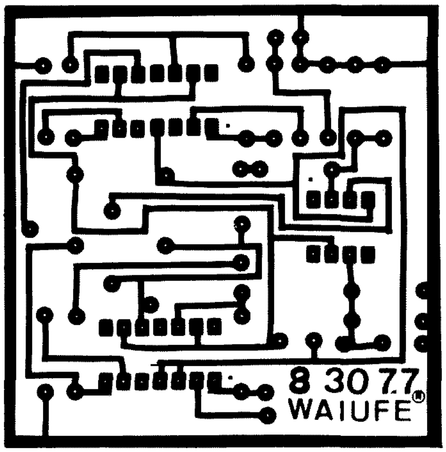

Fig. 7. Audio/digital processor board. Board is 2½" x 2½". Foil side view.

Parts List

SCA Decoder

Quantity	Resistors
4	1k, ¼ W, 5%
4	4.7k, ¼ W, 5%
1	10k, ¼ W, 5%
1	5k Pot. Bourns E-Z-Trim 3067P-1-502 or Weston 43P502
	Capacitors
2	510 pF Disc (470 pF)
2	.001 Mylar
2	.018 Mylar (.022)
1	.047 Mylar
	ICs
1	NE565
	Processor Board
	Resistors
1	1k, ¼ W, 5% (unless otherwise noted)
1	1.2k
4	10k
1	13k
1	30k
2	56k
1	100k
1	100k Pot. Bourns E-Z-Trim 3067P-1-104
1	200k Pot. Bourns E-Z-Trim 3067P-1-204
1	1.5M
	Capacitors
3	.1 uF Mylar
1	10 uF 25 V Tantalum Electrolytic
	ICs
2	747 dual op amp
1	741 op amp
	Misc.
1	Zener Diode (see text)
	FSK Decoder
	Resistors
2	600 Ohm, ¼ W, 5% (unless otherwise noted)
1	1k
1	5k Pot.—same as SCA Decoder
3	10k
1	30k
	Capacitors
1	.001 uF Mylar
3	.01 uF Mylar
1	.05 uF Mylar
1	.1 uF Mylar
1	.15 uF Mylar
	ICs
1	NE565

erator to a frequency of 2550 Hz and 500 mV or more output. Adjust the square wave generator for 11 ms bauds. The output of the square wave generator goes to the voltage control input of the sine wave generator. Set the square wave generator for positive output only, and adjust the level to bring the frequency of the sine wave generator to 2975 Hz. Switch to negative output only, and adjust the level for a frequency of 2125 Hz. Recheck the positive level again, and adjust, if necessary. Switch the square wave generator back to square wave output. The output from the sine wave generator should now read 2550 Hz—or close to it. Using the scope on pin 6 of IC3, adjust the potentiometer for equal positive and negative baud widths. The board should now be aligned, and operate properly with FSK RTTY signals.

Fig. 5 is the schematic for the FSK decoder. Note the differences in values for the change in operating frequency. Use ¼-Watt 5% resistors and Mylar capacitors here, also. R6 sets the vco frequency to 2550 Hz for 850-Hz shift RTTY. This circuit is capable of decoding down to 150 Hz shift, although for narrow shift

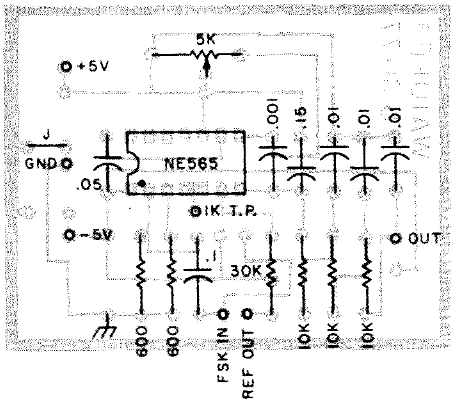

Fig. 8(a). Parts layout for FSK decoder.

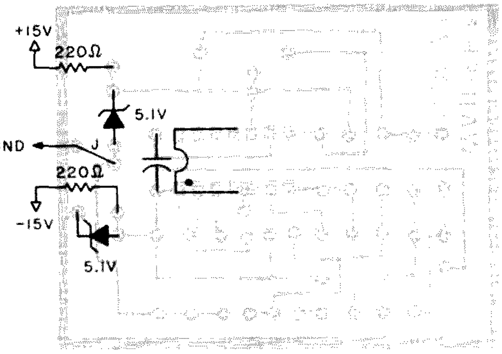

Fig. 8(b). Alternate layout for use with ±15 V supply only. Mount 220Ω resistors vertically.

RTTY, it may be necessary to add a 10k resistor between pins 6 and 7 of the 565. This will narrow the lock range, and improve the tracking of the vco. Always tune the vco for a frequency halfway between the upper and lower limits of the signal you wish to decode, with no input applied to the decoder.

Choose the zener diode at pin 6 for the output voltage required for your application. For TTL circuits, use a 1N751, 5.1-volt zener. A 1N757 will give you 9 volts.

I haven't tried it yet, but it would seem that if the FSK decoder is tuned to 1800 Hz, it may operate for decoding audio tapes using the Kansas City Standard of 1200-2400 Hz. If it does, tape decoding for microprocessors is possible, and that makes this a three-in-one project.■

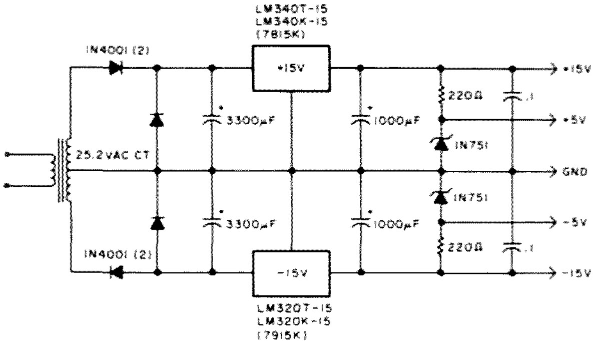

Fig. 9. Power supply for FSK decoder and processor.

Bob Buckman W6SMJ
3954 Hillview
Santa Maria CA 93454

Build a Simple HT Charger

—doubles as a 12-V supply

When I acquired my Standard handie-talkie in 1972, I went all out—leather case, rubber ducky, mini mike, fistfull of crystals, and a shiny black charger.

The SCH HUC1 charger was prone to losing its filter capacitors (bad lot or something) without giving any indication of malfunction except that a full charge would last only a few hours. Since Standard chose to use a voltage quadrupler circuit, that loss required four new 100-uF capacitors.

Recently, I bought a Heathkit 2 meter 10-Watt amplifier for use with the handie-talkie on trips and in rental cars. The amp takes about 100 mA in transmit. I decided to build a 12-volt two-Amp power supply in the charger case and replace the charger circuit with one of the new three-terminal regulators in a constant current mode.

The circuit is easy—all the parts are available at the friendly neighborhood Radio Shack. When you open the charger, take *everything* out. The slide switch is too big with the new transformer in place and you have to drill some holes anyway, so take everything out and drop the remains in the junk box. You will use only the line cord and the cabinet. The chassis is the S-shaped piece of steel surrounded by the outside shell.

I used banana jacks ¾ of an inch apart for output terminals and a small piece of P-type vectorboard to hold the small parts. If you use the existing switch hole for one end of the transformer, there is just enough room for the two 1000-uF filter capacitors to be crammed lengthwise against the transformer frame. There is not much room, but underneath the capacitors, is a five-terminal phenolic terminal strip bolted to the other mounting hole of the transformer. This terminal strip holds the four-terminal bridge rectifier, the positive ends of the filter capacitors, provides a ground contact, and connects the secondary of the power transformer.

I tried to use a 12-volt rms transformer, but, with only 2000 uF in the filter, the output voltage under load drops to about 8 or 9 volts. Using a higher voltage transformer allows the regulator circuit to handle the ripple dynamically, since the dc instantaneous value never drops below 14 volts.

Output ripple under load was measured at under 30 millivolts; no hum is detectable without instruments on the rf carrier. The pass transistor is bolted to the bulkhead inside the charger case. Install it with a mica washer and be sure that there is no short between the collector and the case. Note the fuse in the schematic for short-circuit protection. It

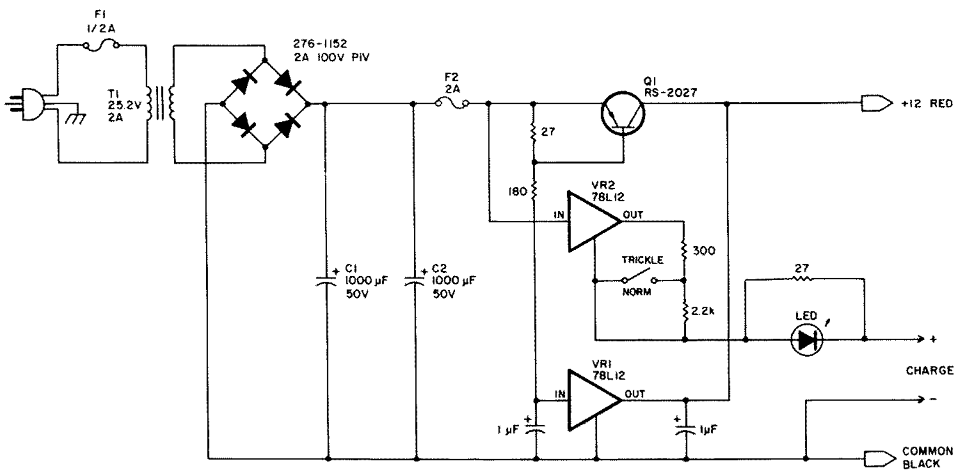

Fig. 1.

was hard-wired into the lead from the bridge to Q1, and its ends were covered with tape.

Because the open circuit charging voltage is over 25 volts, be *sure* your handie-talkie's external power jack is wired so that the nicads are always connected to the charger pads and disconnected from the radio power bus when the external jack is plugged in.

The constant-current regulator, VR2, maintains the regulator voltage across the series resistance. To find the resistance value for any constant current within the regulator's power range, divide the regulator voltage by the desired constant current.

With the switch in the normal charging position, the regulator delivers a constant 43 mA (just like the Standard circuit was supposed to) even into a short circuit with no ill effects. I connected two battery packs in series and the current was still just 43 mA. The LED gives positive indication of charging current—43 mA will never hurt the nicads. The trickle-switch position reduces the charge current to around 7 mA and is used when the handie-talkie gets only infrequent use. The 27-Ohm resistor across the LED shares the current in the normal charge mode to prevent burning out the LED. In the trickle mode, not enough current is left to illuminate the LED. The normal/trickle switch is installed in one of the rivet holes from the old slide switch; the LED is spot-epoxied into the other rivet hole.

I now have a charger I'm sure of and a utility 12-volt supply as well! ■

Charles Willson K2GMZ
505 East Main St.
Palmyra NY 14522

Do-It-Yourself Carrying Case for Wilson HTs

—save $14.88

I'm the proud owner of a new Wilson Mark II HT,

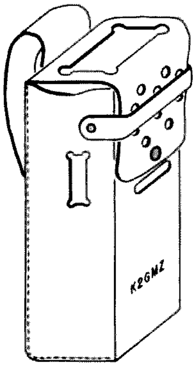

Fig. 1. Instamatic camera case—after surgery.

which I had the good fortune to win at the 1978 Syracuse hamfest. This little gem came complete with .52-.52 xtals, rubber ducky antenna, and a wall charger for the nicad battery pack.

The first thing I did, after I came down to earth, was to fire off an order to a *73* advertiser for crystals for several local repeater frequencies.

Next, I needed a carrying case. Ouch. The Wilson (no relation, unfortunately) leather case lists at $18.95. Seemed like an extravagant outlay for a case to carry around an HT which merely cost me the price of a dollar raffle ticket!

An alternative which came to mind was, "Can a nearsighted, middle-aged ham with two left hands consisting of ten thumbs cut out and sew a leather or vinyl case which would have enough class to house this fabulous HT?" The painfully obvious answer to this question was a resounding "No!"

While wandering through the camera department of a local discount department store (K-Mart), I spotted a top-grain cowhide leather Instamatic-type camera case which had the exact dimensions I needed. Cost? $4.07 plus sales tax.

A few minutes worth of surgery using an X-acto knife as a scalpel, and *voilà*, a case which could compete with the high-priced spread. In addition to the openings shown in Fig. 1, I punched a hole in the bottom which allows me to plug in the charger without having to remove the unit from the case. ■

Come On In—
The Viewing Is Fine

—an update on trends and developments in SSTV

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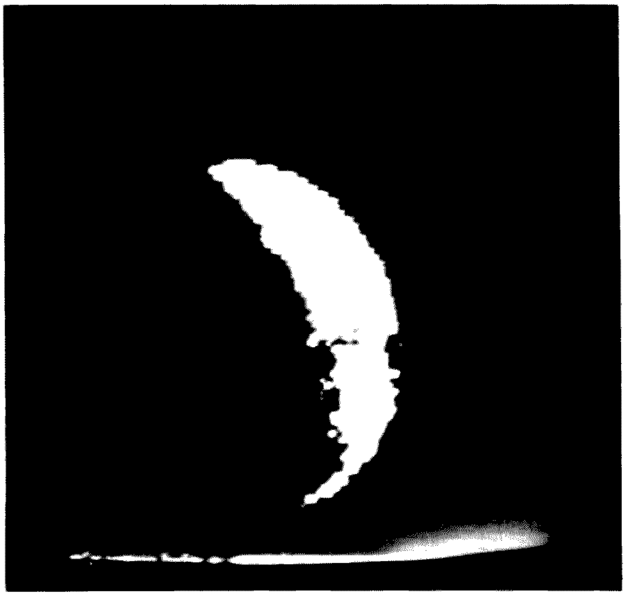
The interest, excitement, and technical advancements affecting the fascinating world of slow-scan TV during recent times have been a phenomenal experience. Newcomers and old-timers alike are enjoying the pleasures of visual communications as this amateur frontier continues expanding on an unlimited basis. While some operation-minded amateurs are visually sharing their lives and interest with SSTVers thousands of miles away, others are diligently pursuing new developments—many of which may be perfected before this article appears in print. This enthusiasm, devotion, and progress are prime indicators of the sheer fun awaiting all amateurs seeking new communication horizons.



Voyager II, *150,000 miles from Earth, looks back and acquires this crescent-shaped view of home. This picture was transmitted on 20-meter SSTV by Dick K6SVP.*

As an updating account, this article will describe some of the latest happenings in SSTV.

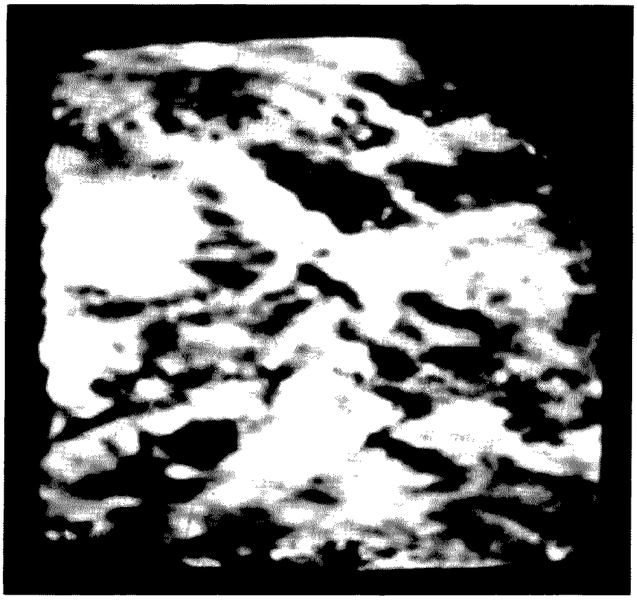
If you are thinking of joining our ranks, if you're a newcomer to SSTV, or if you haven't been overly video-active, this information should update you on recent innovations. Possibly, this article will send you racing back to the shack, anxious to share in the fun of slow-scan TV activity.

Trends and Innovations

Large numbers of SSTV newcomers continue to grace the airwaves, and their popular choice of gear is the Robot 400 system. Home-brew scan converters have dwindled in popularity due to their complexity and high cost, compared with the Robot or Thomas Engineering units. While the cost-per-bit of memory chips is somewhat expensive as this article is being written, a substantial change is expected in the near future. Indeed, the introduction of single memory chips capable of 65,000-bit storage may soon open new possibilities for inexpensive and compact home-brew scan converters.

Surprisingly, the interest in digital scan converters hasn't created a large open market for used P7 SSTV gear. While many slow-scanners retain their P7 equipment when progressing to a digital scan converter, others sell their P7 gear directly to an awaiting SSTV newcomer. The recent interest in medium-scan TV appears to be another major reason for continued P7 monitor popularity.

This W6VIO-retransmitted view of Jupiter shows multiple layers of ammonia ice crystal clouds surrounding the planet. The shadowing effect of the sun prevents full view of Jupiter. The phenomenal "red spot" is visible in the lower right of the picture. This view was obtained with a 1500-mm telescope aboard Voyager II. *The spacecraft was approximately 50 million miles from Jupiter at the time.*



View of Jupiter's atmosphere in an area not far from the noted "red spot." This picture was acquired by Voyager II *on March 5, 1979, and also retransmitted by W6VIO during their March "Commemorative" operations.*

Many slow-scanners consider using their freed equipment for this new 10-meter frontier.

Interest in SSTV keyboards appears to be declining, compared with a couple of years ago. Likewise, lengthy transmissions of pure text are being replaced by actual in-shack scenes and operator views. This aspect definitely indicates the ability to use SSTV rather than just prove that "the box works."

A second SSTV net recently began operating on 14,230 kHz, and its support has been extremely good thus far. This net begins at 2330 GMT each Thursday night. Net Controls are Tom N7AON and Stan WD4DCW. The prime objective of this net is providing technical assistance and SSTV newcomer guidance. A large number of fascinating SSTV pictures is exchanged during each net session, so that Thursday nights are becoming a very exciting time for all active SSTVers.

DX SSTV Drive

During the latter part of 1978, word was received in the United States of the extreme enthusiasm of two outstanding DX stations to operate SSTV. These stations were Tom Christian VR6TC, of Pitcairn Island, and VK9RH, of Norfolk Island. Soon thereafter, an appeal was introduced, both on the air and via magazine articles, and gear for both stations was acquired. The concern and support among slow-scanning amateurs is a phenomenal situation! As this information is being written, donors of SSTV equipment for VR6TC and VK9RH desire to remain anonymous. Their reasons for anonymity are quite simple: The donors do not desire special considerations of prima donna titles.

The *Yankee Trader* left Florida en route to Pitcairn during February, 1979. A part of the vessel's cargo was a Robot 400 system, complete with camera and monitor. Soon thereafter, a Robot 70 and 80 system was shipped to VK9RH on Norfolk Island. The Northern California DX Foundation assisted in this operation. Truly, this DX SSTV drive was one of amateur radio's most outstanding accomplishments during 1979.

Extremely close view of Jupiter's "red spot" reveals a boiling storm with electromagnetic radiation equivalent to several atomic bombs.

MSTV

An expanded frontier of SSTV development which is rapidly gaining widespread popularity is in the area of medium-scan TV. Essentially, the concept of MSTV permits limited-motion, long-distance TV

Classic picture of Jupiter's moon, Io, in front of the gigantic planet. That's Jupiter's atmosphere in the background. This was one of the most popular pictures relayed by W6VIO.

Jupiter's moon, Ganymede, as viewed by Voyager II *from 1.6 million miles away and retransmitted on 20-meter SSTV by W6VIO.*

communications in a 35-kHz frequency spectrum. This limited motion is accomplished through the use of scanning rates which are faster than slow-scan but slower than fast-scan. Special Temporary Authorization has been granted to several amateurs to allow their medium-scan TV transmissions on the high end of 10 meters. Any amateur with appropriate equipment may join the fun of viewing these transmissions. Don Miller W9NTP, of Waldron IN 46182, is spearheading this project. Additional supporters and STA stations include WØLMD, W3EFG, W6MXV, and WB9LVI.

During early 1979, the first phase of medium-scan TV swung into action. W9NTP placed a beacon transmitter on 29,150 kHz to check channel communications capability. The beacon was reliably received throughout North America and Europe, thus ensuring that a medium-scan TV signal could successfully be utilized on the 10 meter high end. As this information is being written, the second phase of medium-scan TV is approaching initiation. This phase will involve using modified P7 SSTV equipment for medium-scan TV operation. Ultimately, the P7 gear will be replaced with microprocessors and digital scan converters designed to the established MSTV parameters.

Modifying conventional P7 slow-scan gear for medium-scan TV requires a reasonable amount of experimentation, but the final results make all effort definitely worthwhile. Medium-scan TV will use a 5-field-per-second interlaced format with a horizontal line rate of 317 Hz. These sync signals must trigger a monitor's sweep driver circuits, which in turn must produce a MSTV raster. The horizontal ramp-generating capacitor must thus be decreased in value by a factor of 317/15 while the vertical capacitor must be changed from 1/8-field per second to 5 fields per second. The SSTV monitor's front end should be bypassed, and the approximately 20-kHz video signal should be wideband-amplified to an appropriate level and applied to the cathode ray tube. The previous concept should prove successful for modifying Robot or W6MXV P7 monitors for medium-scan TV operation.

The final phase of medium-scan TV development will consist of replacing P7 gear with converted digital scan converters and microprocessors. This phase will bear a close resemblance to the present scan converter evolution with SSTV. The medium-scan project is a rigorous undertaking, and success isn't absolutely guaranteed. True amateur spirit and widespread dedication are two essential ingredients which need additional emphasis at the time this report is being written.

The Voyager Spacecrafts and SSTV

Alert and sharp-eared SSTVers have some exciting times in store for them during future months and years. Members of the Jet Propulsion Lab Radio Club have been providing "ringside seats" during high points of the *Voyager* space mission, and views thus far have been fantastic. This deep space mission began during August, 1977, and it is projected to continue until approximately late 1986. A brief outline of the events of *Voyager I* and *Voyager II* are as follows.

Voyager II was scheduled to fly by Jupiter during July, 1979. As *Voyager I* passes Jupiter, a slingshot effect hurdles it on toward Saturn. Its estimated flyby of Saturn will be during August, 1981. During this pass, *Voyager I* will move to within 2500 miles of Titan, Saturn's largest moon. Titan is the only one of Saturn's moons which has an appreciable atmosphere. Assuming everything is then progressing

successfully, *Voyager I* will continue toward Uranus. Its estimated time of flyby is January, 1986.

Voyager II was approaching Jupiter as this report was being written, and the views were truly breathtaking. Most *Voyager* and/or JPL activity is on 14,235 or 28,680 kHz. The usual times of operations are during weekends and early evening hours. The JPL club station call is W6VIO (W6 Viking In Outerspace). Don't miss the upcoming views!

Looking Forward

A number of technical and operational advancements are due to affect the SSTV world favorably during the near future, and now is the opportune time for amateurs to prepare for these exciting times. Several SSTV contests, QSO parties, etc., are being planned, while on-the-air slow-scan activities are also beginning to reflect progressive ideas and personal interests.

AMSAT's Phase III satellites also should provide some unique SSTV capabilities, provided all satellite operators discipline their operating techniques. EME, transequatorial propagation, and packet radio communications are some other examples of future horizons which, if combined with data compression techniques, can provide unlimited video capabilities.

If you would like to fully renew your interest in amateur radio, try the fascinating frontier of slow-scan television. The cost of visually equipping an existing setup is truly negligible compared with the unlimited pleasures it affords.■

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Rack 'Em Up

—glass jars and orange crates are "where it's at" for parts storage

Over the years, many methods have been described for storing parts, including just about everything from shoe boxes to old tin cans. Perhaps, though, most popular is the ordinary food jar. The common jar is great as a parts container since it has a lid, is transparent, is easily available, and is inexpensive. Now, I use old jars to store my parts which I don't use too often, and while that is not too interesting, I feel that the method of storing these jars is.

A favorite way of storing jars full of components is to place them standing up on a shelf, but that has a couple of disadvantages. If you have a deep shelf and a number of rows of jars, the problem is that it is hard to see what is in the jars in the back, and you have to remove the front rows in order to get at those in the back. To alleviate this situation, you could have only one row of jars, but then you use up a lot of wall space with your jars. The solution is rather simple. When you put your jars on the shelf, lay them on their sides. That way, you can just slide out the jar you want. As for the problem of identification, you can put a label on the top of the jar. If you actually want to see what's in the jar, just put it on the shelf backwards so you can look through the bottom.

Now for some details on what I'm using. For jars, I've got tall and narrow iced-tea jars, with a rated capacity of 13 ounces. For the shelves, I'm using old orange crates stacked on top of each other. These crates are about 8″ × 11″ × 6″ and they're just about perfect for my jars. I can fit two rows of four jars and another row of three jars in there and there's just a bit of wasted space in the top two corners. I used what I had on hand but it shouldn't be too hard to throw together some sort of box for your jars. Don't make your boxes too big, since the jars might have a tendency to roll around. Also, I'd suggest that when you're picking your jars, find something which is tall as compared to its diameter.

So that's the story. The jars in their box sort of remind me of wine bottles in their rack. When you pull out a bottle from a bottom layer, the top layers drop down, so keep a hand on the jar immediately above the one you're taking out. Now, isn't that better than a bunch of old tin cans?■

Gadzooks! A Variable 0-260 V Ac Supply!

—junk-box delight

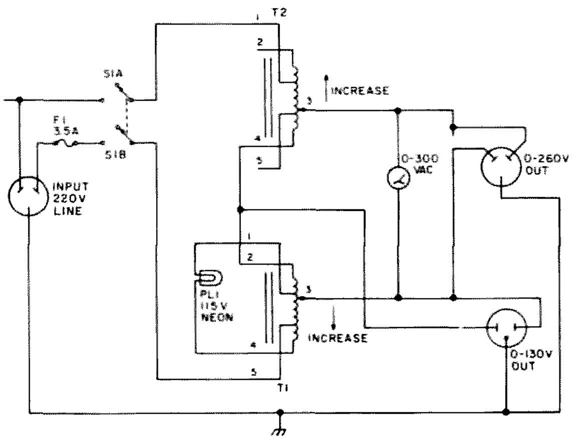

Fig. 1. Variable 0-260 volt ac supply.

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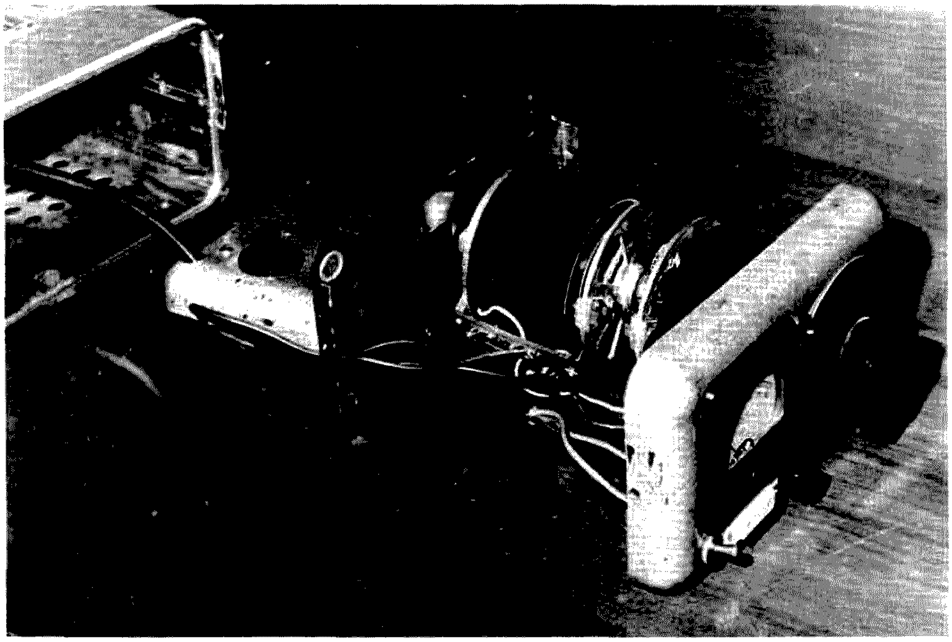
Ashland OH 44895

Need and the lack of money are the parents of home brew, it seems—at least in my case. I had a need to test plate transformers for power output under varying load conditions. I was trying to test various 220-volt primary transformers which were available to me for use in a linear amplifier. I had a 0-150 volt, 500-Watt supply which I used with a 110-220 volt auto transformer, but things began to saturate at about 700 Watts.

It occurred to me that two variable transformers hooked up in series might do the trick. I knew that I had tucked back in the junk box two Ohmite VT-4 rotary transformers which had come out of a piece of $2.50 surplus I had picked up years ago. I had long since used much more value than that in diodes, connectors, chassis, and cabinet, so the rotary transformers were just lying there for free.

I checked them out with clip leads to make sure everything worked OK. Then back to the junk box; out came a 0-300 volt ac meter of unknown origin, a large vibrator inverter supply which had long since given up the ghost, plugs, receptacles, switch, fuse holder, and a pilot light. Inspection showed that everything would fit snugly inside the old inverter cabinet. A few hours of work resulted in a nice in-



strument capable of more than 1000 Watts intermittent output.

The schematic (Fig. 1) shows the hookup and terminal numbers for the Ohmite units I used. Other models may be different. The two units must be coupled mechanically back to back. In my case it was necessary only to loosen the shaft setscrews and slide the shafts back enough to couple the two shafts together. I drilled out an old shaft coupler to fit the two shafts, then mounted a sheet metal support on the other end to support the rear transformer. The pilot light was hooked between 115-volt fixed taps, and a 0-130 volt output was taken from one of the variable transformers.

It should be noted that the hooking back-to-back is the only way to get one transformer to rotate clockwise (looking from the front) and the other to rotate counterclockwise. Otherwise, a set of gears would have been necessary. It can be seen from the schematic that the slider on T1 goes down to increase voltage output as the slider on T2 goes up to increase voltage output. If the two transformers were hooked up in tandem, the sliders would only track back and forth with a fixed 110-volt output.

Need a variable 220-volt supply for connecting to the 220-volt line? Can't find one available at a cost you are willing to pay? Do as I did and have the satisfaction of home-brewing something not too complex—and the best bonus of all for me was the cost—$0.00. You can't beat that! ■

Scrounger's Special: Used Dental Tools

—your DDS throwaways make dandy PCB drills

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Did you ever get to the middle of a PC project and find one of the holes too small to accept that end of tinned stranded wire? Or that square LED lead? Did you then get out your trusty drill and bit and proceed to accidentally damage either the PC board or a component or both?

If so, dear reader, perhaps your friendly dentist can help you.

Over the past years, I have paid out to my dentist about as much as I have contributed to the IRS welfare and pension funds, and have thus been able to help him maintain his private airplane and a pair of matched quarter horses. Dentists, like most people, are more than willing to explain what they are doing and how the procedure is performed. As a result of a recent visit and the usual question and answer session, my dentist gave me a set of conventional root-canal reamers he had discarded for no longer being sharp enough to be used on human teeth.

Root-canal reamers are similar to the familiar twist drill, come in various diameters, and have a knurled knob at the top end to permit the reamer to be twirled with the fingertips. The set given to me (in a plastic box about the size of a book of matches) contains six reamers, sized from about 1 mm to 2 mm. The reamer shanks are 1" long and the knurled knobs are 1/2" long by 1/8" in diameter. It is a simple matter to select the proper size reamer and enlarge the PC hole to accommodate the wire or component with just a few twirls of the fingers—and without damage to other components, PC board, or foil.

The next time you see your dentist, ask him to save his throwaways—they do come in handy around the shack. ■

First Look at Latest Radio Laws

—the official work

Read from right to left.

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Sour Lake TX 77659

1. All rules and regulations are printed in reverse order. They should be read from right to left for maximum comprehension.

2. Any section of Part 97 conducive to good operating procedures will be changed on the next FCC docket.

3. The FCC encourages all amateurs to improve their skills toward the goal of being allowed to operate in the 27.405-28.000-MHz band.

4. Propagation characteristics of HF signals are influenced mainly by the distance (in meters) between the transceiver and the nearest wall.

5. Propagation forecasts may be ignored, as they are formulated by those who understand the subject.

6. Minimize interference to other services by disconnecting the microphone (or key) from the transmitter. Note that in some cases, additional shielding may be required.

7. Wideband F3 emissions are not allowed below 50 MHz.

8. Wideband F3 emissions are not allowed above 50 MHz.

9. Average power is 1.5 times unmodulated power, which is 4 times the modulating power (1.717x) as related inversely to PEP/average ratio of 2 to 1 or 4 to 1, as the case may be.

10. Resistors and inductors are identical, and those of like values may be interchanged (see Ohm's Law). Capacitors react inversely and must be installed backwards.

11. Ohm's Law is an unproven theory which changes, depending on whether one reads *QST* or *73*. Note: *QST* takes the conservative view.

12. In ACs (audio circuits), black wires must be connected to black wires and red wires must be inductively coupled to red wires of the same gauge.

13. Circuits oscillate because of insufficient neutralization of tuned circuits. This leads to degeneration of the entire circuit. Such a condition may be prevented by careful adherence to #12 above.

14. Vacuum tubes are sacred instruments of the gods and should not be adjusted internally under any circumstances.

15. Transistors (and ICs) are instruments of the devil and should be left alone.

16. Semiconductor diodes are the source of many electronic problems, as they pass current in only one direction.

17. Toroidal inductors create a magnetic field and are very useful in picking up small items dropped into the rig. In normal operation, these devices attract metal. By reversing the leads (and thus the magnetic field), plastic and mica are attracted.

18. Resonant circuits in rf amplifiers cause a hollow, tinny sound in the transmitted signal. Key clicks may also be observed if a scope is attached.

19. The transmission line must be of a length sufficient to reach from the rig to the antenna. Insufficient length leads to nonresonance and reduced signal output.

20. If an antenna stays up, it is too small. (This information was obtained from other sources and is subject to personal verification.)

21. The oscilloscope is valuable in observing radio phenomena such as wavelength, resistance, impedance, and the size of the outer conductor.

22. "You can't work 'em if you can't hear 'em." (Illustrates the need for a receiver in all shacks.) ■

The Induction Relay: Self-Powered Switching

—this unusual actuator doesn't require a separate control voltage

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A standard relay requires a separate source of low-voltage current to pull in the armature, usually supplied by either a step-down transformer or a low-voltage dc supply. There's an interesting and potentially very useful way of controlling remote equipment without need for a separate low-voltage source: The induction relay.

An induction relay is particularly appropriate when a mechanical function such as opening a detent is needed.

In Fig. 1, a laminated core, such as an old transformer "E" core, is wound with the main or primary winding on one outside leg. The other outside leg is sawed off and used as the armature. A secondary winding of a few turns of heavier wire is placed around the center leg of the "E" to form the control winding.

The primary winding is connected across the 115-V supply line. With the control winding open, the primary winding induces a magnetic flux that flows through the path of least magnetic reluctance, the center leg of the "E", leaving the armature unaffected. When the remote switch shorts the control coil, the major portion of the flux shifts to the longer circuit path that includes the armature, pulling it in to close that magnetic circuit. Thus, only a minimum holding current flows through the control winding and external switch circuit.

The value of the open-circuit voltage is not important, but can be determined easily since it bears the same relationship to the source voltage as the turns-ratio relative to the primary. In essence, the signal transformer is incorporated in the relay itself.

Variations of remote control may be had by substituting mechanical linkages for the relay contacts, or by using both.

Representative winding data might be, for instance, 400 turns no. 26 or 28 for the primary, and 50 turns no. 18 for the control winding. Actual numbers are not critical, and minimum needs are a function of core cross-sectional area. However, the number of primary turns required would be roughly one and one-half times the number on the original transformer primary winding because the core area is reduced when the primary winding is transferred from the center of the "E" to the end. If all the original primary wire is rewound onto a smaller coil form, the number of turns will come out just right.

In the example above, the control voltage would be about 14 volts, open circuit, just right for a no. 18 bell wire pair, provided the run (distance from relay to shorting switch) is not excessive.■

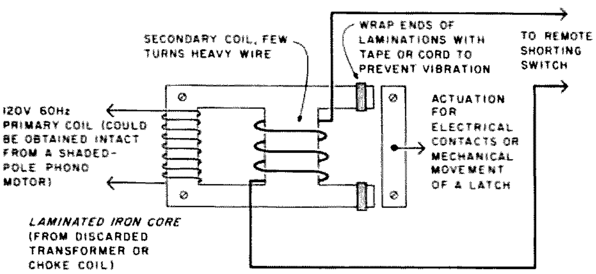

Fig. 1.

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The Further Adventures of Keycoder

—simplified wiring for the toroidal cores

In the July, 1976, issue of *73 Magazine*, there was an article about Keycoder I, a Morse code generator using a typewriter-style keyboard. This article by WA9VGS caught my eye. I had seen other circuits in the past, but this one seemed simpler. Besides, I'd just about had it with paddles and electronic keyers. I tried single paddles, dual paddles, finger keying, dot memories, dash memories, iambic, etc. Even with the Accu-Keyer,[1] I made too many mistakes.

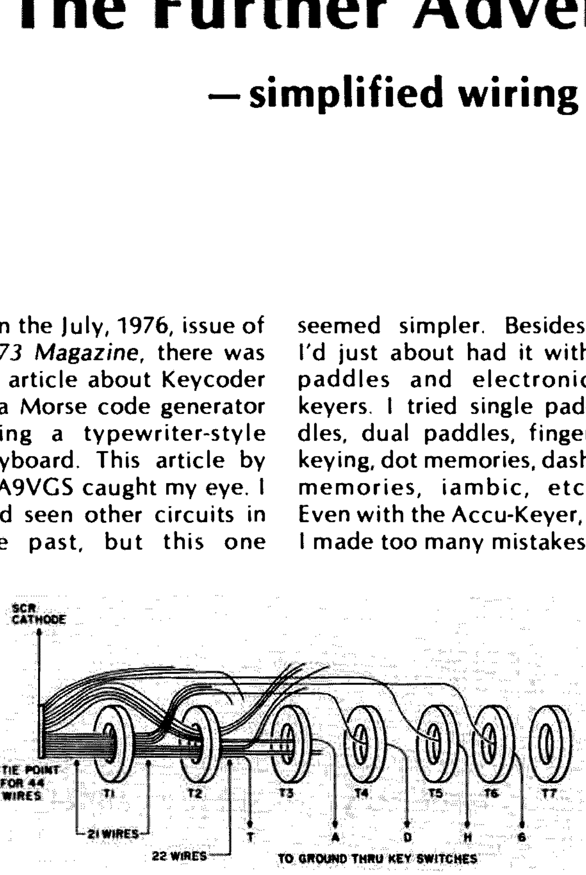

Fig. 1. Typical wiring. Note that only five characters are shown here, for simplicity.

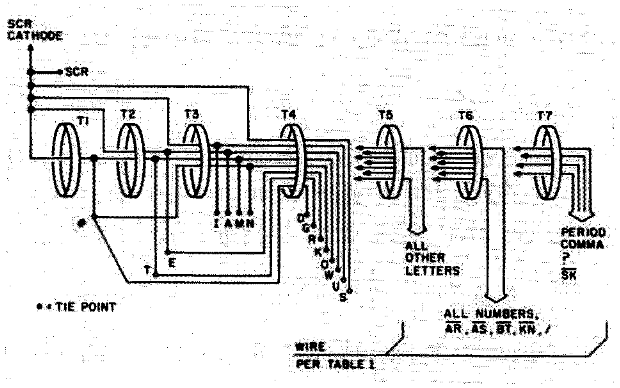

Fig. 2. Eliminate unnecessary duplicate wiring with tie-points. Follow Table 1 to complete the wiring.

So this would be the answer.

Let me point out that progress is very slow in my ham shack, and, so, the October, 1976, issue of *73 Magazine* arrived. Here was another article by WA9VGS describing a CMOS version of the Keycoder I. This one was still simpler; no power supply was needed—just a 9-volt battery. I was determined to build one!

By late 1978, I got around to it! I built not just one (with a few modifications, of course), but several more, for friends. Two other friends, AB9J and WB9ROU, also built them. We all think they are the greatest.

Since just about everyone is familiar with the aforementioned Accu-Keyer, a comparison is in order: The Accu-Keyer takes 7 ICs plus an ac power supply, miscellaneous parts, and a fairly expensive paddle; the CMOS Keycoder takes 7 ICs, miscellaneous parts, a 9-volt battery, and a keyboard. A new keyboard can be obtained for about the price of a paddle. But even surplus, used, or homemade keyboards will give excellent results. So, for less than the cost of an Accu-Keyer, you can have a code typer. Keyboards should become very popular for CW even for those who don't own computers.

Now, if I've convinced you to build a code typer, here are some ways to simplify the keyswitch wiring. Whether you build the

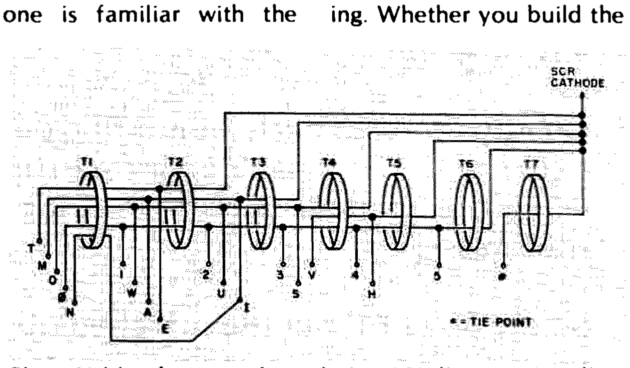

Fig. 3. Wiring for opposite polarity (SCR line at T7). Follow Table 2 to complete the wiring.

TTL or CMOS version, or any other using five to eight toroidal transformers, these principles can be applied.

First, to refresh your memory, keyboard encoding is done with the very simple but clever idea of passing wires through toroidal cores. This idea has been around so long I forget where it originated. Each core has a secondary winding of about ten turns which sets (or resets) an associated flip-flop when a wire passing through the core (the primary) is pulsed. A wire going outside the core has no effect.

Phasing Is Important

The pulses produced on the secondaries must be the correct polarity for your circuit. Phasing (or polarity) of windings can be determined experimentally during construction. Some designs may have enough "ringing" in their secondary circuit that they will work either way. My circuit boards were built with T1 on the left and T7 on the right. My SCR line was brought out just to the left of T1. Each keyswitch wire was started at the SCR line and run toward T7, passing through and outside the proper cores to encode that particular letter, and then run directly to the corresponding keyswitch. This was not difficult with #30 magnet wire, but resulted in as many as 23 wires going through some cores.

Simplification

By using tie-points for some or all of the characters, it is possible to reduce the number of wires considerably: one wire through T1, two wires through T2, four wires through T3, and eight wires through T4. If you put a connector between the circuit board and the keyboard, the connector terminals can be the tie-points. Looking at the original wiring table, or Fig. 1, it is seen that about 21 wires pass through T1. These could all be tied together between T1 and T2 with no change in operation—so replace them with just one wire! The bundle of wires passing through T2 (about 22) can be broken into two groups: One group came through T1, and the other group came around T1 from the SCR tie-point. So, only two wires are needed passing through T2. By the same logic, only 4 need pass through T3; 8 through T4. By the time you get to T5, the saving is still 4 wires.

Fig. 2 shows the pre-wiring, using tie-points for 14 characters. Notice that tie-point "#" is not a character but just a tie-point designation. This pre-wiring can be done with plastic insulated wire. That means a lot less scraping of magnet wire. Table 1 lists the routing of the remaining wires. These may go to additional tie-points or directly to the corresponding keyswitches.

I would advise you to get your complete circuit board wired and operational before starting the keyswitch wiring. Keep power on the circuit and have a sidetone oscillator connected to the output. This allows you to check each wire before soldering to be sure it produces the correct character. It also will show up any mistakes in my list as well as printer errors (such confidence!), and it gives you the last check on correct phasing.

Now, if your phasing is reversed or you wish your SCR line to enter from the T7 end, Fig. 3 shows pre-wiring for 18 characters. Route the remaining wires according to Table 2.

My hope is that this article will encourage many of you to build code machines and that my wiring will make it just a little easier. ■

Reference

1. Garrett, "The WB4VVF Accu-Keyer," *QST*, August, 1973.

Character	Through Cores:	To Tie-Point:
B	T5	#
C	T5	N
F	T5	I
H	T5	SCR
J	T5	W
L	T5	E
P	T5	A
Q	T5	G
V	T5	S
X	T5	D
Y	T5	K
Z	T5	T
1	T6, T5	W
2	T6, T5	U
3	T6, T5	S
4	T6, T5	SCR
5	T6	SCR
6	T6	#
7	T6	T
8	T6	M
9	T6,	O
0	T6, T5	O
AR	T6	R
AS	T6	E
KN	T6	K
BT	T6, T5	#
/	T6	D
PERIOD	T7, T6	R
COMMA	T7, T6, T5	T
?	T7	U
SK	T7, T6	S

Table 1. Wiring for Fig. 2 (SCR line at T1). Go from keyswitch or terminal through cores indicated from right to left.

Character	Through Cores:	To Tie-Point:
B	T1	H
C	T1, T3	H
D	T1	S
F	T3	H
G	T1, T2	S
J	T2, T3	V
K	T1	U
L	T2	H
P	T2, T3	H
Q	T1, T2	V
R	T2	S
X	T1	V
Y	T1, T3	V
Z	T1, T2	H
6	T1	5
7	T1, T2	5
8	T1, T2, T3	5
9	T1, T2, T3, T4	5
AR	T2, T4	5
AS	T2	5
BT	T1, T5	5
KN	T1, T3, T4	5
/	T1, T4	5
PERIOD	T2, T4, T6	#
COMMA	T1, T2, T5, T6	#
?	T3, T4	#
SK	T4, T6	#

Table 2. Wiring for Fig. 3 (SCR line at T7). Go from keyswitch or terminal through cores indicated from left to right.

73 Magazine *Staff*

All About Ground Rods

—getting connected to Mother Earth

Ground rods are usually used in amateur installations for grounding purposes related to lightning protection. However, they are also the only choice one may have when using a short vertical antenna which requires a good ground. The use of buried radials is certainly preferable to establish a ground screen for a vertical antenna, but an elaborate radial system may require more space than is available, or it may be impossible to lay down such a screen because of obstacles. Usually, vertical antennas are used because of space restrictions. Having the best ground for them, even if it is only a grounding rod, cannot help but improve their efficiency.

Whatever the application one may have for ground rods, it is useful to take a detailed look at how they work. The effectiveness of ground-rod usage can vary widely depending on how they are installed, and sometimes a few simple measures can vastly improve their performance.

Basic Principles

One of the basic factors affecting ground rod performance is the nature of the soil in which it is placed. The relative resistance of a ground connection using a ground rod can vary from 2 Ohms in a clay-type soil to over 2700 Ohms in a very sandy soil. As shown in Fig. 1, it is mainly the resistivity of the soil closest to the ground rod, however, that determines the overall effectiveness of the ground connection. Ninety percent of the total grounding effectiveness is determined by the soil characteristics within a radius of about 6 feet around the ground rod.

There is nothing one can do about the nature of the soil in a given location, of course, but a general awareness as to whether the soil has a high clay content, is a mixture of moist clay and sand (loam), or is mostly sand and gravel, will act as a general guide for the elaborateness needed for an effective ground rod installation.

The moisture present in a given soil can have a marked effect on its resistivity. Fig. 2 gives an illustration of this for common red clay soil. Note how sharply the resistivity increases when the moisture content of the soil falls below 20%. Again, in reality, there is not much one can do to control this factor, but it is useful to be aware of it since, depending on seasonal rainfall conditions, the effectiveness of some ground connections using ground rods can vary widely.

Temperature is another factor influencing ground rod performance. Offhand,

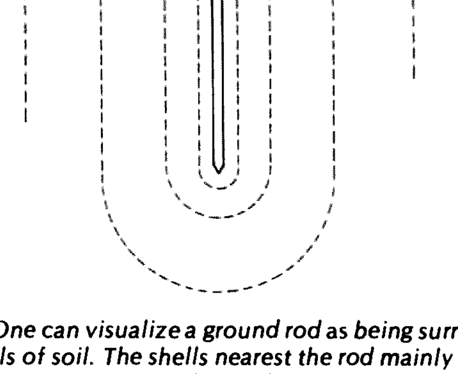

Fig. 1. One can visualize a ground rod as being surrounded by shells of soil. The shells nearest the rod mainly provide the rod's connection to the earth.

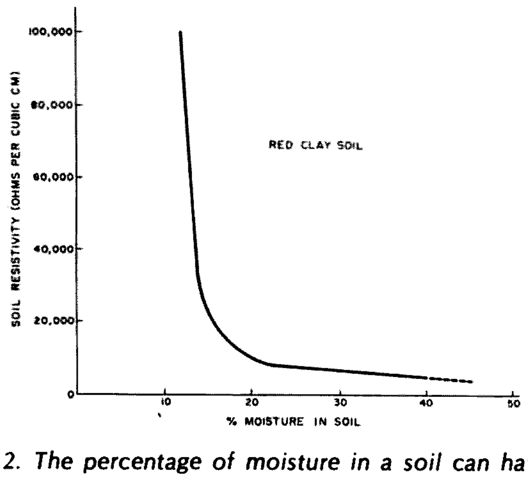

Fig. 2. The percentage of moisture in a soil can have a significant effect upon its resistivity.

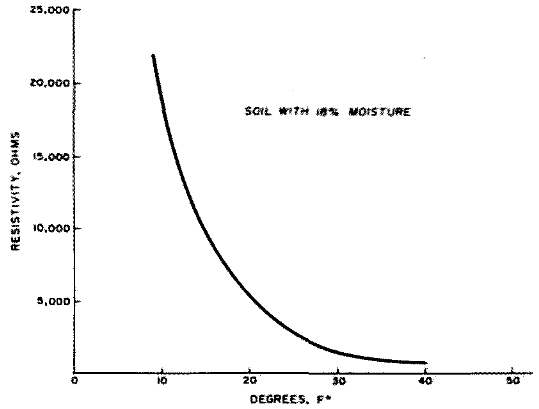

Fig. 3. Temperature also can have a sharp effect on soil resistivity.

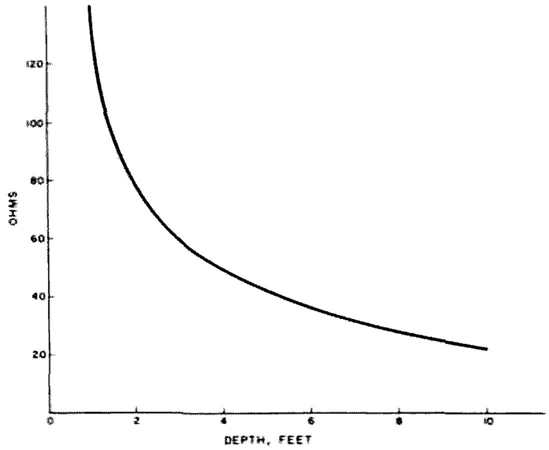

Fig. 4. Ground connection resistance for a single ground rod driven to different depths.

one might be inclined to think that the colder it gets, the better the ground rod should perform, since we associate coldness with rain or snow. The opposite is true, however, when just cold temperatures are considered. When the earth freezes to any depth, the water in the soil freezes, moisture is lost, and the resistivity of the soil increases. Fig. 3 shows the sharp effect decreasing temperature can have on soil resistivity. So, again, seasonal weather changes regarding temperature can severely affect ground rod effectiveness in some localities which suffer severe cold seasons. About the only preventive measure one can take is to drive the ground rod below the frost line whenever possible.

The depth to which a ground rod is driven also is important, as shown in Fig. 4. This illustration shows the calculated ground connection resistance with regard to the depth of a ground rod, under what might very broadly be termed "average" soil conditions. The illustration assumes uniform moisture and soil resistivity at all depths. In reality, soil resistivity usually decreases with depth since the few feet near the surface are subject to alternate wetting and drying, depending on rainfall, while the moisture content of deeper soil is more stable. For ground rods more than a few feet long, therefore, performance is usually better than that indicated by Fig. 4.

The greatest reduction in ground connection resistance is obtained by driving a ground rod to between 6 and 8 feet down. Although there may be particularly moist soil conditions in certain locations and at certain times of the year where a 3-foot rod is effective, this generally is not the case. Note also that the illustration is based on a ground rod fully driven into the ground. Many casual ground rod installations leave from ⅓ to ½ of the rod's length above the surface of the soil.

Finally, another factor that one might consider is the diameter of the ground rod used. Intuitively, one would think that the larger the diameter of the ground rod used, the better the earth connection. As it turns out, however, diameter plays a negligible role in improving the ground connection. This has been confirmed by various tests done by the former Bureau of Standards and the Underwriters Laboratories. Whether one uses a ½", 1", or even larger diameter rod can be based on mechanical strength factors, therefore—that is, a size large enough to be driven into a particular type of soil without bending.

The metal the rod is made out of is not important except for the factor of corrosion. Steel rods are commonly used, although if one can obtain Copperweld grounding rods, they are ideal for the purpose. They have a steel core for strength and an exterior of copper for corrosion resistance.

Measuring Grounding Resistance

It is not necessary usually to measure the actual grounding resistance provided by a ground rod as long as good practices are used in installation of the rod. If one is curious about the approximate grounding resistance achieved, however, it can be measured fairly easily by the three-point method shown in Fig. 5. In this illustration, A represents the actual ground rod and B and C represent two temporary ground rods of two- to three-foot lengths. The temporary rods should be placed about 6 feet from the actual ground rod and from each other. The resistances between rods are measured and used in the formula shown to obtain the grounding resistance of rod A. One can try doing the measurements with an ohmmeter, but usually bet-

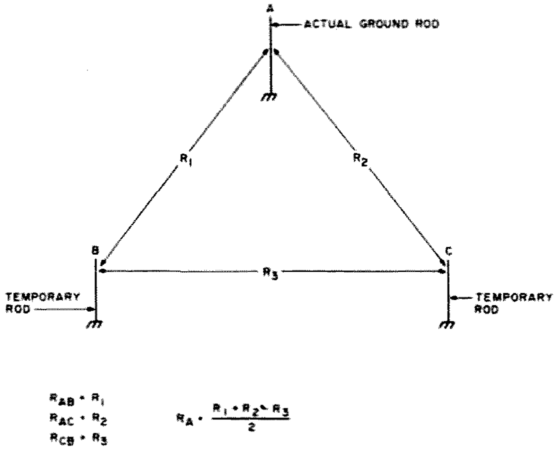

Fig. 5. By installing two temporary ground rods and taking some resistance readings, one actually can measure the ground connection resistance of a ground rod.

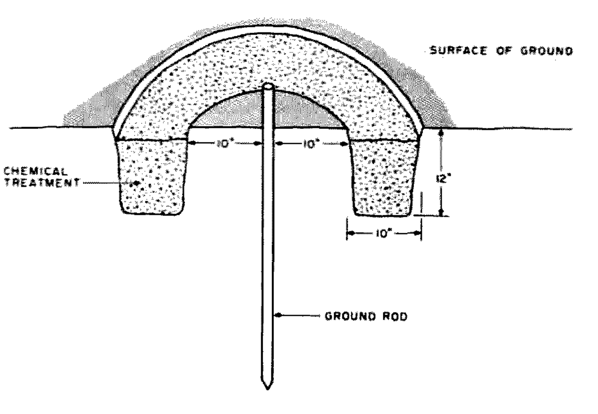

Fig. 6. Construction of a trench around a ground rod to hold a chemical treatment. The rod should be at least six feet into the ground, although the treatment will improve the performance of shorter rods also. Dimensions are not at all critical.

ter results are obtained if one goes the old-fashioned voltmeter/milliammeter route, using some low voltage ac or dc as a voltage source.

Improving Ground Rod Performance

There are several methods one can use to improve ground rod performance if it is felt that a simple ground rod installation is inadequate. One of the simplest methods is to use multiple ground rods. If the rods are spaced 6 to 10 feet apart, they act very much like resistances in parallel. So, two rods will effectively cut the ground connection resistance in half, and so on. It is very important to maintain the spacing between the rods.

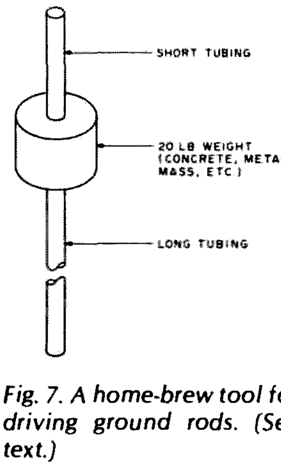

Fig. 7. A home-brew tool for driving ground rods. (See text.)

A few rods clustered closely together will be no more effective than a single rod. A practical maximum number of rods to improve a ground connection by the use of multiple ground rods probably would be 4 to 6.

The ground lead from each rod should be run directly to the base of the vertical antenna in the center of the ground rod array. There should also be one directly underneath the base of the antenna to act as a central ground rod. There might be some value also to running interconnecting wires between adjoining ground rods, but this is not as important.

Another fairly simple method to improve a single or multiple ground rod installation is to treat the area around the rod chemically, as shown in Fig. 6. This is not complicated to do since one does not have to dig a very deep trench around the rod. The treatment material can be magnesium sulphate, copper sulphate, or even ordinary rock salt. All are about equally effective; the only advantage of magnesium sulphate is that it is the least corrosive.

Note that the treatment material does not have to touch the ground rod—nor should it. With the passage of time, the treatment material will seep towards the rod and corrode it, however, and rain will wash it away. The result of all this is that within a period of perhaps 2 to 3 years both the rod and the treatment material may have to be replaced. On the other hand, one accomplishes quite a bit by using chemical treatment. Typically, a ground connection resistance of over 1000 Ohms can be lowered to less than 100 Ohms.

Another method to improve ground rod performance that is useful in some cases is to drive the rod particularly deep. This method probably doesn't have much applicability when an antenna ground is considered, since it is soil resistivity and grounding nearer the surface that mostly affects antenna performance. Also, it is naturally hard to accomplish in many soils without specialized equipment. Nonetheless, in some soils, particularly sandy ones which start to have a clay base further down, it can be very effective from the viewpoint of lowering the ground connection resistance. For example, by using a 20-foot sectionized ground rod as compared to a 6-foot one, the resistance might be reduced by a factor of 6 or more.

Installing Ground Rods

Any number of methods of installing ground rods have been devised, and this is pretty much an area where one's own ingenuity has to come into play. The sledgehammer approach will suffice in a great many cases. Another method which some amateurs have found successful with hollow tubing used as ground rods is to insert a garden hose in the tubing and let the water pressure wash away the soil slowly as the tubing is pushed into the ground.

Another approach to consider, especially if one is going to drive several rods, is to construct a simple home-brew driving tool such as is shown in Fig. 7. This tool is made around a central weight mass of about 20 pounds. A short piece of tubing is affixed on one side and a longer piece of tubing on the other side. The tubing is chosen so that it is just large enough to slip over the ground rod. The length of the two sections will depend on the length of rod—three- and one-foot sections, for instance, are used for a 6-foot ground rod. In use, the long end of the tool is slipped over the ground rod and used initially to pound the rod into the ground. As the rod gets driven further in, the short side of the tool is slipped over the rod and used to complete pounding the rod into the ground. The advantage of this tool is that the tubing over the ground rod prevents the rod from bending, and the pounding force exerted by the tool is exactly in line with the axis of the ground rod.

Ground Rod Connections

All the effort exerted in placing a ground rod can be wasted if a dependable low-resistance connection is not made to the rod. The ideal case would be to have all metals the same: a copper-plated rod using a copper clamp and copper wire. Such items and fittings can sometimes be purchased through electrical contractor supply houses. In most cases, however, one will be using dissimilar metals for the rod, clamp, and ground wire. In this case, one must be sure only that all connecting surfaces are clean and tight. Covering the clamp and rod junction with some weatherproofing compound also would be advisable. ■

OSCAR Orbits

Courtesy of AMSAT

The listed data tells you the time and place that OSCAR 7 and OSCAR 8 cross the equator in an ascending orbit for the first time each day. To calculate successive OSCAR 7 orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the day's first ascending (northbound) equatorial crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world from you, it will descend over you. To find the equatorial descending longitude, subtract 166° from the ascending longitude. To find the time OSCAR 7 passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR 7 when it is within 45 degrees of you. The easiest way to determine if OSCAR is above the horizon (and thus within range) at your location is to take a globe and draw a circle with a radius of 2450 miles (4000 kilometers) from your QTH. If OSCAR passes above that circle, you should be able to hear it. If it passes right overhead, you should hear it for about 24 minutes total. OSCAR 7 will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15° east or west of you, add another minute; at 30°, three minutes; at 45°, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

OSCAR 8 calculations are similar to those for OSCAR 7, with some important exceptions. Instead of making 13 orbits each day, OSCAR 8 makes 14 orbits during each 24-hour period. The orbital period of OSCAR 8 is therefore somewhat shorter: 103 minutes.

To calculate successive OSCAR 8 orbits, make a list of the first orbit number (from the OSCAR 8 chart) and the next thirteen orbits for that day. List the time of the first orbit. Each successive orbit is then 103 minutes later. The chart gives the longitude of the day's first ascending equatorial crossing. Add 26° for each succeeding orbit. To find the time OSCAR 8 passes the North Pole, add 26 minutes to the time it crosses the equator. OSCAR 8 will cross the imaginary San Francisco-to-Norfolk line about 11 minutes after crossing the equator. Mode A: 145.85-.95 MHz uplink, 29.4-29.50 MHz downlink, beacon at 29.40 MHz. Mode J: 145.90-146.00 MHz uplink, 435.20-435.10 MHz downlink, beacon on 435.090 MHz.

OSCAR 7 Orbital Information

Orbit	Date (Dec)	Time (GMT)	Longitude of Eq. Crossing °W
23068	1	0050:49	79.5
23081	2	0145:06	93.1
23093qrp	3	0044:26	78.0
23106	4	0138:43	91.5
23118X	5	0038:04	76.4
23131	6	0132:20	90.0
23143	7	0031:41	74.8
23156	8	0125:58	88.4
23168	9	0025:18	73.3
23181qrp	10	0119:35	86.9
23193	11	0018:55	71.7
23206X	12	0113:12	85.3
23218	13	0012:32	70.2
23231	14	0106:49	83.8
23243	15	0006:09	68.6
23256	16	0100:26	82.2
23269qrp	17	0154:43	95.8
23281	18	0054:03	80.7
23294X	19	0148:20	94.2
23306	20	0047:40	79.1
23319	21	0141:57	92.7
23331	22	0041:18	77.5
23344	23	0135:35	91.1
23356qrp	24	0034:55	76.0
23369	25	0129:12	89.6
23381X	26	0028:32	74.4
23394	27	0122:49	88.0
23406	28	0022:09	72.9
23419	29	0116:26	86.5
23431	30	0015:46	71.3
23444qrp	31	0110:03	84.9

OSCAR 8 Orbital Information

Orbit	Date (Dec)	Time (GMT)	Longitude of Eq. Crossing °W
8862Jbn	1	0008:41	49.7
8876Jbn	2	0013:49	51.0
8890Abn	3	0018:58	52.3
8904Abn	4	0024:06	53.6
8918X	5	0029:14	54.9
8932Abn	6	0034:23	56.2
8946Abn	7	0039:31	57.5
8960Jbn	8	0044:39	58.8
8974Jbn	9	0049:48	60.1
8988Abn	10	0054:56	61.4
9002Abn	11	0100:04	62.7
9016X	12	0105:12	64.0
9030Abn	13	0110:21	65.3
9044Abn	14	0115:29	66.6
9058Jbn	15	0120:37	67.9
9072Jbn	16	0125:45	69.2
9086Abn	17	0130:53	70.5
9100Abn	18	0136:02	71.8
9114X	19	0141:10	73.1
9127Abn	20	0003:04	48.6
9141Abn	21	0008:13	49.9
9155Jbn	22	0013:21	51.2
9169Jbn	23	0018:29	52.5
9183Abn	24	0023:37	53.8
9197Abn	25	0028:45	55.1
9211X	26	0033:53	56.4
9225Abn	27	0039:01	57.7
9239Abn	28	0044:09	59.0
9253Jbn	29	0049:17	60.3
9267Jbn	30	0054:25	61.6
9281Abn	31	0059:33	62.9

FCC

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Amateur Radio Service; Modifying Procedures for Notifying the Commission of Name and Mailing Address Changes; and To Give a 5-Year License Term to All Licenses Issued

AGENCY: Federal Communications Commission.

ACTION: order.

SUMMARY: The Commission amended §§ 97.13 and 97.47 to delete provisions which allowed Amateur licensees to notify the Commission of name and mailing address changes by letter. All future Amateur license modifications must be requested by filing the appropriate application form. The Commission also amended § 97.59 to provide that all Amateur licenses will be given a five-year term.

DATES: The effective date of the Order is November 12, 1979.

ADDRESSES: Federal Communications Commission, Washington, D.C. 20554.

FOR FURTHER INFORMATION CONTACT: Maurice J. DePont, Private Radio Bureau, (202) 254-6884.

SUPPLEMENTARY INFORMATION:

Order

Adopted: September 27, 1979.
Released: October 5, 1979.

By the Commission: Commissioner Lee absent.

In matter of amendment of §§ 97.13, 97.47 and 97.59 of the Commission's rules.

1. Sections 97.13 and 97.47 of the Commission's rules set forth the procedures to be followed by amateur licensees who wish to renew or modify their amateur radio license. In each instance, the request must be made by submitting an FCC Form 610 (or 610-B in the case of a club or military recreation station) to the Commission's office in Gettysburg, Pennsylvania. However, these rule sections also provide that a change in the licensee's name or mailing address may be accomplished by notifying the Commission by letter.

2. The provision concerning notification by letter has apparently led to confusion on the part of many amateur licensees and has *unnecessarily increased the* workload of the Commission's application processing staff. Most letter requests for address change fail to specify that it is only the licensee's mailing address which has changes. Therefore, the staff is required to ascertain whether or not the station location has also changed. In the majority of cases, the station location has indeed changed. In such a situation, § 97.47 requires a formal modification of the license. Therefore, it is necessary that the licensee file an application.

3. In order to eliminate the confusion among amateur licensees as to when an application need be filed, and to lessen the burden on the processing staff, the Commission is amending §§ 97.13 and 97.47 to delete the provisions concerning letter notice. Henceforth, all amateur license modifications must be requested by submission of the appropriate application form.

4. The Commission is also amending § 97.59 to provide that modified licenses will be issued for a five-year term commencing on the date of the modification. Currently, that section provides that modified licenses shall bear the same expiration date as the license being modified.

5. Since the amendments herein ordered are procedural in nature, they are excepted by Section 553(b) of the Administrative Procedure Act from the requirement of prior public notice and comment.

6. Accordingly, it is ordered, effective November 12, 1979, that Part 97 of the Commission's rules is amended as shown in the Appendix attached hereto. Authority for this action is found in Sections 4(i) and 303 of the Communications Act of 1934, as amended.

7. For further information on these rule changes, contact Maurice J. DePont, 254-6884.

(Secs. 4, 303, 48 stat., as amended, 1066, 1082 (47 U.S.C. 154, 303))

Federal Communications Commission.

William J. Tricarico,

Secretary.

Appendix

Part 97 of Chapter I of Title 47 of the Code of Federal Regulations is amended as follows:

§ 97.13 [Amended]

1. In § 97.13, paragraph (e) is deleted.

§ 97.47 [Amended]

2. In § 97.47, paragraph (c) is deleted.

3. Section 97.59 is amended to read as follows:

§ 97.59 License term.

(a) Amateur operator licenses are normally valid for a period of five years from the date of issuance of a new, modified or renewed license.

(b) Amateur station licenses are normally valid for a period of five years from the date of issuance of a new, modified or renewed license. All amateur station licenses, regardless of when issued, will expire on the same date as the licensee's amateur operator license.

(c) A duplicate license shall bear the same expiration date as the license for which it is a duplicate.

Ham Help

I would like to meet other amateurs who are avid bridge players. Perhaps we could form a net and discuss bridge hands, conventions, tournaments, and the possibilities for bridge-playing computer programs over the air. I am an experienced tournament player, but would be happy to talk to anyone interested.

Mike Marmer KB8GH
2749 Symphony Way
Dayton OH 45449

I'm a disabled amateur and could really use some help with the following:

1. I need someone to use my acetate film and their transfers, lines, etc., to make negatives from which I can expose sensitized PC boards myself. Any layout from my specs would be acceptable; their name, call, or whatever can go on the board.

2. I also need manuals for the BC-1306, RT-70, and VRC-19. I especially need a "Surplus Schematic Handbook" to copy. It is black with red letters and a white schematic on the front.

3. I am looking for a Knight-kit signal tracer (circa 1960) with an rf-af probe.

4. I also need someone to construct projects, at cost or a little over, from my diagrams and their/my parts.

John C. White WB6BLV
560 N. Indiana St.
Porterville CA 93257

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It's a Wattmeter . . . It's an Swr Bridge . . . It's Swattmeter!....................... K4LBY 42 Oct
Something New: the MVM........... Ogushwitz 74 Nov
Sound for the CMOS Logic Probe...... WB9PHM 138 Nov
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Build this $50 Mini-Counter........... McClellan 58 Dec

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Introducing the 2m/220 Connection.... WB4HXE 48 Nov
An Inflation Fighter for 220........... WA3HWG 54 Nov

Ham Help

I need a manual for a Heathkit model IM-32 VTVM. I will gladly reimburse reasonable duplicating and mailing expenses, or I will duplicate on receipt and send back by return mail. Thanks.

Lawrence Young W1YVW
54 Samuel Ave.
Pawtucket RI 02860

I have a Pride HFL-125 Bilinear Amplifier and I need a schematic and information on the finals. Specifically, what replacement numbers could I use? I will pay for the postage and copy. Thank you.

Fritz Zingel KA2FCG
341 72nd St., Apt. B
North Bergen NJ 07047

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION (Required by 39 U.S.C. 3685). 1. Title of publication, 73 Magazine. 2. Date of filing, Sept. 25, 1979. 3. Frequency of issue, Monthly. A. No. of issues published annually, 12. B. Annual subscription price, $18. 4. Location of known office of publication (Street, City, County, State and ZIP Code) (Not printers), 73 Pine Street, Peterborough, Hillsboro County, N.H. 03458. 5. Location of the headquarters or general business offices of the publishers (Not printers), 73 Pine Street, Peterborough, Hillsboro County, N.H. 03458. 6. Names and complete addresses of publisher, editor and managing editor. Publisher (Name and Address), Wayne Green, Pine Street, Peterborough, N.H. 03458. Editor (Name and Address), Wayne Green, Pine Street, Peterborough, N.H. 03458. Managing Editor (Name and Address), Jack Burnett, Pine Street, Peterborough, N.H. 03458. 7. Owner (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual, must be given.) Name, 73, Inc., Peterborough, N.H. 03458. W. Sanger Green, Rt. 3, Littleton, N.H. 03561. 8. Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgagees or other securities (If there are none, so state) Name, none. 9. For completion by nonprofit organizations authorized to mail at special rates (Section 132.122, PSM). The purpose, function, and nonprofit status of this organization and the exempt status for Federal income tax purposes (Check one) Not applicable. 10. Extent and nature of circulation. (X) Average No. copies each issue during preceding 12 months. (Y) Actual No. copies of single issue published nearest to filing date. A. Total No. copies printed (Net Press Run) (X) 87,000 (Y) 86,000. B. Paid circulation 1. Sales through dealers and carriers, street vendors and counter sales (X) 13,500 (Y) 13,450. 2. Mail subscriptions (X) 67,500 (Y) 66,750. C. Total paid circulation (Sum of 10B1 and 10B2) (X) 81,000 (Y) 80,200. D. Free distribution by mail, carrier or other means samples, complimentary, and other free copies (X) 1,200 (Y) 1,200. E. Total distribution (Sum of C and D) (X) 82,200 (Y) 81,400 F. Copies not distributed 1. Office use, left over, unaccounted, spoiled after printing (X) 4,300 (Y) 4,050. 2. Returns from news agents (X) 500 (Y) 550. G. Total (Sum of E, F1 and 2 — should equal net press run shown in A) (X) 87,000 (Y) 86,000. 11. I certify that the statements made by me above are correct and complete. Signature and title of editor, publisher, business manager, or owner. Robert R. LaPointe, Business Manager.

Social Events

Listings in this column are provided free of charge on a space-available basis. The following information should be included in every announcement: sponsor, event, date, time, place, city, state, admission charge (if any), features, talk-in frequencies, and the name of whom to contact for further information. Announcements must be received two months prior to the month in which the event takes place.

HAZEL PARK MI
DEC 2

The Hazel Park Amateur Radio Club will hold its 14th annual swap & shop on December 2, 1979, from 8:00 am to 2:00 pm, at the Hazel Park High School, Hazel Park, Michigan. Admission is $1.00 at the door, and main prize tickets are also $1.00. There will be food, plenty of free parking, and door prizes. Featured will be computer demonstrations of the Apple II, PET, TRS-80, and more. Talk-in on .52 simplex. For information, send an SASE to the Hazel Park Amateur Radio Club, Robert Numerick WB8ZPN, 23737 Couzens, Hazel Park MI 48030.

LORAIN OH
DEC 8

The Northern Ohio Amateur Radio Society will hold its annual Christmas banquet on Saturday, December 8, 1979, at Gargus Hall, Lorain, Ohio. There will be many excellent door prizes and an RCA TV, Regency scanner, and liquor prizes will be given away at a benefit raffle (tickets are $1.00). Tickets for the banquet are $9.00 and available on an advanced-sale-only basis. The deadline is December 6, 1979. Talk-in on 146.10/.70. For tickets and complete details, send check or money order to NOARS, PO Box 354, Lorain OH 44052.

SOUTH BEND IN
JAN 6

A hamfest swap & shop will be held on January 6, 1980, at New Century Center, on US 31 by the river, South Bend, Indiana. Tables are $3.00 each. Food service, automobile museum, and art center are in the same building as the hamfest. Talk-in on 146.52/.52, .13/.73, .34/.94, 147.99/.39, .87/.27, and .69/.09. For information, write the Repeater Valley Hamfest committee, Wayne Werts K9IXU, 1889 Riverside Drive, South Bend IN 46616, or phone (219)-233-5307.

RICHMOND VA
JAN 13

The Richmond Frostfest III, sponsored by the Richmond Amateur Telecommunications Society, will be held Sunday, January 13, 1980, at the Bon Air Community Center. There will be a home-brew contest with four awards: most original idea, best electrical work, best mechanical work, and most deserving work, and prizes. FCC exams start 10:00 am and completed Form 610s must be received in the Norfolk Office of the FCC at 870 North Military Highway, Bank of Virginia Bldg., Norfolk VA 23502, no later than January 9th. Admission is $3.00, indoor flea market tables are $3.00, and tailgaters are $2.00. Talk-in on .28/.88 and .34/.94. For further information, contact the Richmond Amateur Telecommunications Society, PO Box 1070, Richmond VA 23208.

SHARON PA
JAN 19

The third annual Mercer County Amateur Radio Club seminar will be held at the Holiday Inn, West Middlesex, Pennsylvania, off I-80, from 9:00 am to 5:00 pm. Come to hear speakers on your favorite amateur radio topics. Advance admission is $2.00. There will be door prizes. For further details, write K3LA, PO Box 673, Sharon PA 16146.

ARLINGTON HEIGHTS IL
JAN 27

The Wheaton Community Radio Amateur Club will hold its Wheaton Hamfest Portable Nine on Sunday, January 27, 1980, at the Arlington Park Expo Center, Arlington Heights Race Track, Arlington Heights, Illinois. Doors will open at 8:00 am sharp! 300 free flea market tables will be available, plus 100 commercial booths. There will also be hourly door prizes. Tickets are $3.00 at the door and $2.00 in advance. For information, send an SASE to WCRA, Box QSL, Wheaton IL 60187.

LIVONIA MI
FEB 17

The Livonia Amateur Radio Club will hold its 10th anniversary Swap 'n Shop on Sunday, February 17, 1980, from 8:00 am to 4:00 pm, at the Churchill High School, Livonia, Michigan. There will be plenty of tables, door prizes, refreshments, and free parking available, plus reserved table space of 12-foot minimum. Talk-in on 146.52. For further information, send an SASE to Neil Coffin WA8GWL, c/o Livonia Amateur Radio Club, PO Box 2111, Livonia MI 48150.

DAVENPORT IA
FEB 24

The Davenport Radio Amateur Club will hold its ninth annual hamfest on Sunday, February 24, 1980, from 8:00 am to 4:00 pm, at the Davenport Masonic Temple, Highway 61 (Brady Street) and 7th Street, Davenport, Iowa. Tickets are $2.00 in advance; $3.00 at the door. Tables are $3.00 each, no limit, with a $2.00 additional charge for ac electrical hookup. Talk-in on 146.28/.88 WØBXR repeater. Advance tickets can be purchased by writing to club treasurer Clarence Wilson WAØOEW, 1357 W. 36th Street, Davenport IA 52806.

LANCASTER PA
FEB 24

The Lancaster Hamfest will be held on February 24, 1980, at the Guernsey Pavilion, located at the intersection of Rtes. 30 and 896, east of Lancaster, Pennsylvania. General admission is $3.00, except children and XYLs. Doors will open at 8:00 am. All inside spaces are available by advance registration only and are $3.00 each for an 8-foot space, which includes a table. There will be free tailgating in a specified area outside, if the weather permits. There will be a two-hour Dutch Country tour by an advance registration of $4.00. Food will be served at the hamfest. Also, there are excellent restaurants and accommodations in the area. Talk-in on .01/.61. For information, write Sercom, Box 6082, Rohrerstown PA 17603.

STERLING IL
MAR 9

The Sterling-Rock Falls Amateur Radio Society will hold its 20th annual hamfest on Sunday, March 9, 1980, at the Sterling High School field house, 1608 4th Ave., Sterling, Illinois. Advance tickets are $1.50; door tickets are $2.00. Over $2,000 worth of prizes will be given away. A large indoor flea market will be restricted to radio and electronic items only. There will be plenty of free parking, lots of bargains, and plenty of good food. Talk-in on .25/.85 (WR9AER). For tickets, write Don Van Sant WA9PBS, 1104 5th Avenue, Rock Fails IL 61071.

VERO BEACH FL
MAR 15-16

The Treasure Coast Hamfest will be held on March 15-16, 1980, at the Vero Beach Community Center, Vero Beach, Florida. Featured will be prizes, drawings, and a QCWA luncheon. Admission is $3.00 per family in advance; $3.50 at the door. Talk-in on 146.13/.73, 146.04/.64, and 222.34/223.94. For information, write PO Box 3088, Vero Beach FL 32960.

FORT WALTON BEACH FL
MAR 22-23

The Playground Amateur Radio Club will hold its 10th anniversary swapfest on Saturday and Sunday, March 22-23, 1980, from 8:00 am to 4:00 pm each day, at the Okaloosa County Shrine Fairgrounds, Fort Walton Beach, Florida.

TIMONIUM MD
MAR 30

The Baltimore Amateur Radio Club will hold its greater Baltimore Hamboree and Computerfest on March 30, 1980, at the Maryland State Fairgrounds, just off I-83, 2 miles North of I-695, Timonium, Maryland. There will be plenty of space for dealers, displays, tables, and commercial exhibits. Special events, lectures, and demonstrations will be held. Food service will be provided. There will be acres of space for tailgate sales. Door prizes will be awarded throughout the day. Admission is $3.00 and tables are $5.00. Talk-in on the BARC repeaters, 146.07/.67 and 146.34/.94. For additional information, tickets, and space reservations, please write to Joseph A. Lochte, Jr., 2136 Pine Valley Drive, Timonium MD 21093, or for a recorded message, dial (301)-HAM-TALK.

ST. CLAIR SHORES MI
APR 13

The South Eastern Michigan Amateur Radio Association will hold its 22nd annual hamfest on April 13, 1980, from 8:00 am to 3:00 pm at South Lake High School, 21900 E. Nine Mile Road (at Mack Ave.), St. Clair Shores, Michigan.

ST. LOUIS MO
MAY 24-25

The ARRL Midwest and Central Divisions will hold their amateur radio and computer hobbyist convention on May 24-25, 1980, at the Cervantes Convention Center, St. Louis, Missouri. Featured will be prominent speakers, information forums, equipment displays and demonstrations, and an indoor flea-market sale. Friday night, May 23rd, will be "Amateur Radio Night" at Busch Memorial Stadium, where the St. Louis Cardinals will play the San Diego Padres. On Saturday night, May 24th, the convention banquet and dance will be held on the riverboat *Admiral*. On Memorial Day, May 26th, there will be an all-day visit to Six Flags Over Mid-America. For more information, write to Gateway Amateur Radio Association, Inc., Box 68, Marissa IL 62257.

Corrections

Several minor errors crept into my article, "Add Digital Display for $50," which appeared in the June, 1979, issue of *73*.

In column two of page 28, 5445 kHz should read 5455 kHz (twice), and 4995 kHz should be 4955 kHz.

The crystal frequency in Fig. 1 should be 5455 kHz.

The "5" or "9" switch position indications in Fig. 3 should read "9" or "4".

The reset line for the 7490 is missing in Fig. 3 and should connect to pins 2 and 3 of the 7490. Pin 3 should not be grounded.

S1 and S2 are push-button switches.

I would suggest using 74LS components in the counter since they should substantially reduce power and heat.

I have had many requests for circuit boards, but unfortunately they are not available at this time. Also, my address has changed since the article was published.

Richard C. Jaeger K4IQJ
727 McKinley Avenue
Auburn AL 36830

J. C. Pinckney WB2VNM has pointed out a mistake in my article ("Experimenter's Corner: The MM5369N") which appeared in the September issue. In the article, I stated that 3.579545 MHz divided through three MM5369Ns gives you 1 Hz every 1.88 years. Joe is correct in pointing out that 1 Hz is one cycle per second and that what you indeed get is one cycle every 1.88 years. I managed to miss that correction during my proofreading and apologize for the error.

Charles B. Patten
Andrews AFB MD

New Products

from page 34

frequencies (±75 Hz). A minor annoyance here is that these two controls do not possess a detent or click-stop to indicate when they are in the neutral position. Both controls are always active and cannot be switched off.

Instead of the usual rf gain pot, the Astro 150 has an i-f gain control. When receiving strong signals, reducing the i-f gain eliminates much of the normal background noise. The proper use of this control can substantially reduce the fatigue that sets in after several hours of listening.

The front-panel meter does double duty as a conventional S-meter and as a power output meter. In the transmit mode, it functions as a peak-reading wattmeter. It is accurately calibrated at the factory.

There are a host of other controls and adjustments which are accessed either through small holes in the transceiver's side panels or by removing the top and bottom covers. There are separate adjustments for VOX and CW delay (when semi-break-in is used), VOX gain, VOX antitrip, sidetone level, S-meter calibration, AGC threshold, and microphone scan rate.

On the Air

Getting the Astro 150 out of the box and on the air is a five-minute job. It's simply a matter of plugging in the power supply, speaker, and mic cables, attaching the antenna of your choice, and flipping on the power supply and transceiver power switches.

When you first apply power, the speaker is quiet for 10-15 seconds, while the PLLs lock on. The frequency display places a decimal point after each digit while this is going on so you'll know what's happening. When the decimal points blink off, the speaker springs to life, and you're set to go.

It took me a couple of days to evolve my own favorite technique for using the 150's tuning controls. A Swan representative told me that others have come to the same conclusions I did. I found the VRS knob best suited for fairly large excursions across a band, say 25 or more kHz. Then, when I was in the vicinity of my desired frequency, I switched to the pushbuttons atop the microphone. At first, this might sound like an unwieldy method of tuning, but it becomes quite natural once you've done it a few times. The push-buttons make it easy to tune up and down from your chosen spot while leaning back in your operating chair—a sort of remote control.

Dozens of contacts on every band produced many good comments about the audio quality of the rig. I ran most of the time without a linear amplifier and had no problem making plenty of DX contacts.

I had never used full break-in before checking out the 150. For most operation, I'll probably stick with the more familiar semi-break-in. When using QSK, one hears what's happening on the frequency between each dit and dah. Thus, it's possible to hear QRM while you are still transmitting and to cut your transmission short, in order to avoid competing with the QRM. Of course, experienced traffic handlers often find QSK a must. When both the sending and receiving stations are so equipped, the receiver can immediately interrupt the sender if he misses a portion of the message. I find QSK operation to be a little bit distracting after years of operating CW in silence. The break-in on the Astro 150 performed flawlessly.

Conclusion

The Astro 150 (and 151) carries a suggested price of $925, making it the least expensive synthesized HF rig I've seen. The PSU-5 Power Supply/Speaker is $179.95. The rig is worlds apart from the majority of transceivers available today, both on the outside and on the inside. Swan has taken a very different approach to transceiver design, starting from square one to produce a radio that takes full advantage of modern digital technology. The only allegiance to the past would seem to be the single conversion receiver, something Swan has long favored.

If you would rather operate than twiddle with a lot of knobs, and you want to go with thoroughly modern technology, the Astro 150 is an awfully attractive value. For further information, contact *Swan Electronics, 305 Airport Road, Oceanside CA 92054; (714)-757-7525.* Reader Service number S44.

Jeff DeTray WB8BTH
Assistant Publisher

THE WILSON SYSTEMS, INC., SYSTEM 33 TRIBANDER

Until now, the antenna farm at my QTH consisted of a monoband yagi for 20 meters on a Rohn BX-32 tower and a Wilson WV-1 vertical roof-mounted on the roof of the garage. Both antennas have performed well for both CW and SSB operation, but with the increase in sunspot activity, it has been my desire to replace the monobander with a good triband yagi beam. Lot size and tower limitations have precluded erection of the larger "DX" tribanders, so it was decided to investigate the three-element variety of beams.

Consulting with other amateurs who own tribanders and comparing the published swr curves of the various manufacturers, I finally opted for the Wilson Systems, Inc., System 33 (formerly System Three). After having purchased a Wilson WV-1 four-band vertical, I have come to accept that Wilson's swr curves were not only the most desirable, but also the most believable. The published curves indicate that the System 33 is a reasonable compromise for the amateur who wishes to work both the CW and phone portions of the 10-, 15-, and 20-meter bands.

Mechanical Construction and Assembly

Like the WV-1 vertical, the System 33 is well constructed mechanically. The boom is 14' 4" long, 2" in diameter, and comes in three sections which fit together and are held in place with heavy-duty zinc-plated muffler clamps. From the consumer's point of view, the three-piece boom is a blessing; it allows for a compact shipping carton which can be reasonably handled by UPS (truck shipments of other beams have cost twice as much to ship for about the same weight class).

When assembling the boom, I would advise that the simple addition of a bolt or heavy sheet-metal screw at the junction of each boom section be made. This should be done in order to keep the boom from twisting in heavy winds, as the muffler clamp U-bolts are not threaded far enough to snug the sections together adequately. The center section of the boom which clamps to the mast is double-wall aluminum tubing and a striking example of Wilson's mechanical overkill. The boom is attached to the mast (not supplied) with a ¼"-thick aluminum plate and 8 heavy muffler clamps.

Unlike other moderately-priced beams, the System 33's elements are heavy-duty, tapering from 1¼" where the elements meet the boom to ⅝" at the ends. The dual-section traps are affixed to the elements at approximately 32 inches from the ends of the elements. Despite their large size, there is very little droop to the elements. Each trap is clearly identified with a sticker which indicates director, driven element, or reflector and has an arrow to indicate the direction toward the boom (little chance for error here). The director and reflector are attached to the boom with a unique one-piece extruded aluminum clamp which fits around the boom. When the clamp is tightened, equal pressure is applied in all directions around the boom so that boom

20 Meters		15 Meters		10 Meters	
MHz	swr	MHz	swr	MHz	swr
14.025	1.3:1	21.025	1:1	28.025	1.1:1
14.100	1.1:1	21.100	1.1:1	28.500	1.9:1
14.200	1.1:1	21.275	1.3:1	28.600	2.1:1
14.250	1.3:1	21.350	1.3:1		
14.300	1.5:1	21.445	1.4:1		

Table 1. Swr readings for the System 33 adjusted for the CW portion of the bands.

Band (MHz)	14, 21, & 28
Maximum power input	legal limit
Gain (dBd)	8 dB
Vswr at resonance	1.3:1
Impedance	50 Ohms
F/B ratio	20 dB
Boom (o.d. x length)	2" x 14'4"
No. of elements	3
Longest element	27'4"
Turning radius	15'9"
Maximum mast diameter	2" o.d.
Surface area	5.7 sq. ft.
Wind loading at 80 mph	114 lbs.
Assembled weight (approx.)	37 lbs.
Shipping weight (approx.)	42 lbs.
Maximum wind survival	100 mph

Table 2. Manufacturer's specifications.

flattening does not occur. The clamp which holds the split-dipole driven element in place is similar to the clamps used on other popular beams and seems more than adequate mechanically and electrically.

Element sections are joined by one-piece aluminum clamps which provide for good electrical bonding and effective mechanical holding ability because the element sections will dimple slightly when tightened. The dimples will prevent element sections from sliding out of place.

The antenna is fed at the center of the split-dipole driven element with 50-Ohm coaxial cable such as RG-8/U, and there are no matching sections to adjust or stubs to tune. Resonance is set by adjusting the length of the driven and parasitic elements according to the dimensions given in the instruction manual. A balun (1:1 impedance ratio) may be used if one wishes, but it is not necessary.

Electrical Characteristics

A definite advantage of the System 33 over other triband beams is the broadband response of the antenna. It is possible to work almost all of the CW and phone portions of the three bands while maintaining a reasonably low standing-wave ratio. My primary interest is CW and the lower portion of the phone band for DX purposes, so the antenna was adjusted for the CW setting. Table 1 illustrates the swr response for the System 33 at 33' above ground. With regard to swr, the results obtained were better than the data published by the manufacturer. See Table 1.

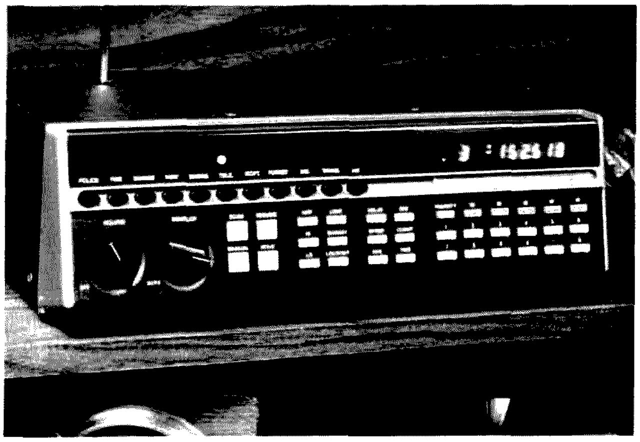
Although it has not been tried at my QTH, I believe that the response values listed in Table 1 could be improved by shortening the dimension of the adjustable part of each element by about 1 to 2 inches less than the CW setting. Despite the somewhat high swr on ten-meter phone, it appears that the beam is more broadbanded than most of the tribanders I have had the opportunity to own or work with.

Results and General Conclusions

On-the-air results have been gratifying. With regard to forward gain, results indicate that gain is at, or near, the published 8-dB value. The subjective difference between the System 33 and my three-element monobander for 20 meters is minimal. The front-to-side ratio is excellent, with a clear null heard when the antenna is positioned 90 degrees off the desired heading. The only major difference between the System 33 and the monobander is in the area of front-to-back ratio. The front-to-back ratio is at least as good as other triband beams, though.

All things being considered, I can highly recommend the Wilson System 33 for its superior mechanical construction, the ease with which it can be assembled, and its true broadband response. The System 33 is an excellent value and a wise choice. *Wilson Systems, Inc., 4286 S. Polaris Avenue, Las Vegas NV 89103, (702)-739-7401; toll-free order number is 1-(800)-634-6898.* Reader Service number W33.

Lawrence W. Stark K9ARZ
Saint Charles IL



New Bearcat® 300 Service Search.

NEW BEARCAT® SCANNER HAS OVER 2,000 FREQUENCIES IN MEMORY

The development of a new scanning monitor radio with over 2,000 pre-programmed frequencies, plus 50 user-programmable channels, has been announced by Electra Company. Named the "Bearcat® 300 Service Search," the new radio features the convenience and simplicity of advanced programmed scanner technology. By pushing a single button, the radio will search the actively assigned frequencies for the service selected. This feature completely eliminates the need to know in advance the frequencies for the most-listened-to services. The Service Search has 11 different services: police, fire, marine, "ham," mobile phone, emergency, government, forestry, business, ground transportation, and even air-to-ground aircraft channels. In all, there are 2,138 frequencies pre-programmed into the Service Search memory to ensure that the active channels for any local area are covered.

In addition to Service Search, the new Bearcat scanner also features the flexibility of a user-programmable memory. The frequencies for up to 50 channels can be stored or changed in this memory by simple keyboard entry. These frequencies can be in any mix from the 7 VHF and UHF frequency bands covered by the radio, including the AM aircraft band. Lockout, scan delay, and automatic activation of accessories (such as an alarm) can also be individually entered for each of the 50 channels. Arranged in banks, these channels can be activated or locked out in groups of 10 with a single push-button. Many other operating features are also included in this deluxe radio, including "search" between operator selected frequency limits, hold and resume controls, direct channel access without the need to "step through" channels, scan speed control, plus provisions for a priority override channel.

The clean, professional look of the new Bearcat 300 Service Search scanner features a die-cast front panel which is accented by a vacuum fluorescent digital display. The display, with bright/dim control, offers excellent readability under all lighting conditions. It not only displays the frequency being received, but also automatically shows accurate digital time when the radio is switched off. (If desired, the time can also be viewed when the radio is receiving calls by simply pushing the "time" button.) The radio measures 12¼" wide by 3⅞" high by 7" deep, permitting easy shelf or vehicle installations. Electra Company believes the radio will add a new dimension to the rapidly expanding market for scanner radios, which have already penetrated approximately 5% of US households. The radio is expected to appeal not only to sophisticated scanner users, but also to those who appreciate a unique entertainment product combining complex technology with simplicity of operation. Complete details are available from Bearcat scanner suppliers or by writing directly to *Electra Company, PO Box 29243, Cumberland IN 46229.* Reader Service number E40.

CHECKING OUT THE CLEGG AB-144 ALL-BANDER

I'm a sucker for every new transceiver add-on, accessory, and gadget. My most recent acquisition of this nature is the Clegg AB-144 All-Bander receiving upconverter, which I purchased for use with my two fixed-station 2-meter multimode transceivers.

The AB-144 is a novel frequency-range extending device that should be of interest to amateurs who would like to expand the coverage of their VHF set. The Clegg unit converts your present ham-bands-only transceiver to a continuous-coverage receiver that spans the spectrum from LF (100 kHz) to 30 MHz with no gaps. Because it works ahead of the set's rf and i-f stages, it covers this frequency range with sensitivity, selectivity, tuning rate, calibration accuracy, and mode selection (SSB, AM, CW, etc.) essentially as estab-

Band	Tuning Range
1	0.1-4 MHz
2	3.0-7 MHz
3	7.0-11 MHz
4	11.0-15 MHz
5	14.0-18 MHz
6	18.0-22 MHz
7	22.0-27 MHz
8	26.0-30 MHz

Table 1. Tuning ranges.

lished by your existing rig.

Although the unit was not yet available when the first ads appeared in early spring, it took Clegg less than one week to get the AB-144 to me by UPS when I placed my order this summer. Upon unpacking the 2-lb. unit (which came in a securely wrapped and padded box), a quick scan of the 3-page operating manual provided all the instruction needed to connect the upconverter to my Yaesu FT-221R transceiver.

A 110-volt, 100-mA, plug-in, ac-adapter-type power supply is furnished, and it's more than adequate to supply the 12 V dc @ 30 mA required by the AB-144, though you can also tap into the transceiver's dc supply if you like. I found that two additional connections, in addition to the power supply cable, had to be made. The first was the output line to the transceiver, which was made by means of a short length of RG-58 cable terminated in PL-259 connectors (user-supplied). A jack is also provided on the rear panel to connect a suitable LF/HF antenna. (A single wire will normally do fine, or if your transceiver has a separate antenna/receiver jack, you may be able to use it as a handy spot to feed in the upconverter's output.)

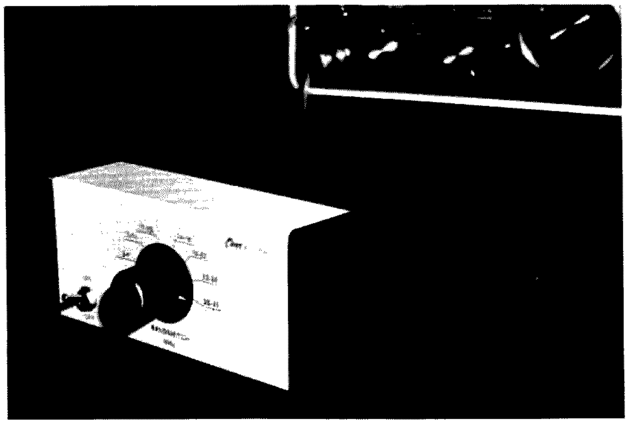
Hooking up the two rf cables and the power cord put the AB-144 in operation. There was one final step, however. I took the precaution of removing the microphone from the transceiver to prevent the accidental pumping of 2-meter rf into the AB-144—an easy thing to do if you later forget that the unit is connected. Although the upconverter is internally protected against such an unfortunate occurrence, this added measure will prevent possible damage to either piece of equipment.

I found that the Clegg unit did what the advertising literature claimed it would do. It nicely extended the range of my FT-221R down to 100 kHz, making the purchase of a high-quality all-band communications receiver of marginal value, especially considering the relatively low cost of the Clegg upconverter ($129.95) and the high cost of top-quality receivers in today's market.

Specifically, the specs call for 0.3 microvolt sensitivity (on SSB and CW) and a ±3 kHz (±1 kHz typical) frequency calibration accuracy. Selectivity is equal to that of the transceiver with which it is used. While I did not measure the sensitivity, it seemed to be at least equal to my Tempo 2020 on the ham bands and my Yaesu FRG-7 over the full range of 100 kHz to 30 MHz. Calibration accuracy was found to be close to the ±1 kHz figure. Frequency stability was excellent; no trace of drift or instability was noticed with movement of the cabinet.

Overall results you can expect to obtain with the AB-144 depend almost completely on the transceiver you feed with the upconverter's output. When using the unit with my FT-221R, which is also equipped with an outboard YC-221 digital readout display, it was a real convenience to have both analog and digital frequency display on all bands, especially the crowded AM broadcast and shortwave bands. FM and SSB reception was excellent, mainly because the Yaesu transceiver is primarily designed for these modes. CW reception was broad, as expected, due to the transceiver's i-f passband characteristics, though addition of a sharp active audio filter (such as those sold by MFJ, Autek Research, Datong, and others) would easily narrow the effective passband for better CW reception. AM reception results were marginal because the FT-221R's i-f filters are designed for SSB, having a too narrow 2.4-kHz bandwidth. The narrow AM selectivity results in some distortion, bassiness, and low audio recovery on received signals. While AM reception was usable on my transceiver, this problem might prove detrimental to avid broadcast-band and shortwave listeners. Again, this is not a problem of the converter, but of the transceiver with which it is used. If you intend to use the AB-144 with your present VHF gear, you may want to modify the set's i-f passband to broaden its AM response curve.

It also took a little "getting used to" and some rapid mental gymnastics to calculate how each of the eight band segments are upconverted to 144-148 MHz. Each band is 4 MHz wide (corresponding to the width of the 2-meter band), except the first band, which is only 3.9 MHz wide—remember, the set only goes down to 100 kHz, not 0 kHz. The bottom of each of the upconverter's eight bands is heterodyned up to 144 MHz by means of eight separate crystal oscillator circuits; the conversion process is worked upwards from there. For example, to receive a BC-band station at 1060 kHz, set the bandswitch on the AB-144 to band 1 (.1-4 MHz) and tune the transceiver



Clegg's AB-144 All-Bander.

to 145.060 MHz. Or, to receive a 3900-MHz signal, set the switch to band 2 (3-7 MHz) and dial in 144.900 MHz on the transceiver. This process *can* be confusing, with either analog or digital displays (especially the latter) until you get the hang of it. The complete tuning ranges are shown in Table 1.

I also tried out the AB-144 with my KLM 2700 transceiver, which has both a vfo (with an analog display) and a digital readout controlled by a 3-knob digital synthesizer. I found the analog display easy to work with on this set, especially since the 2-meter band was split into four 1-MHz ranges which coincided nicely with the upconverter. But the digital synthesizer—with its 3-knob tuning divided into 1-MHz, 100-kHz, and 10-kHz frequency increments and its resultant inability to directly dial in frequencies other than in 10-kHz steps—was just "too much" to get used to. However, the synthesizer was great for BC-band DXing, where most channel separations in North and South America are pegged at 10 kHz; you can set up the synthesizer and whip through the band at exact 10-kHz intervals with ease.

SSB and CW reception was good on the KLM 2700, about the same as on the FT-221R, and AM was a little better on this rig. (Some transceiver manufacturers recognize the AM reception problem and make available information on how to improve reception. KLM, for example, has issued a technical bulletin on the 2700 which shows how to broaden the AM-mode response curve for improved AM signal quality. The modification they suggest for the 2700 involves only two components, a resistor and a capacitor. I installed the modification on my set and found reception quite acceptable on the standard and shortwave broadcast bands.) Clegg mentions that the AB-144 is designed for use with the FT-225, TS-700, and IC-211, in addition to the two transceivers with which I used my unit.

What was inside the attractive 5¼" × 2½" × 6" Ten-Tec-style enclosure? The instruction manual didn't provide a clue, and no schematic diagram or servicing procedures were included (Clegg warrants the unit for 1 year and expects that you'll send the device back to them for repair). I was disappointed in not having been provided a diagram, so I peeked inside and found a small rectangular circuit board holding a 10-transistor circuit, with separate oscillators for each of the eight bands. Although it's not necessary to perform any internal adjustments or alignment unless components have been replaced and repairs made, I managed to touch up each oscillator's tuning slug to bring the frequency calibration accuracy under 1 kHz on all bands and to slightly peak up the unit's output. In examining the AB-144, I found workmanship to be good throughout.

Is it worth it? Yes, especially when compared with the alternatives of buying a separate general-coverage receiver or another of the recently-introduced upconverters designed to capture this wide-open market. I was impressed by the Clegg unit's very few birdies and images, its good calibration accuracy and resettability, and its reasonably consistent performance over each band and from band to band. You *do* have to be careful with overload, however. Cross-modulation is not as much of a problem (though there was a trace on some close-by BC stations), but overloading the transceiver on strong signals was. This is because there is no tie-in with the transceiver's agc circuit. This means that you do have to do some manual rf gain control riding, espcially on SSB and AM, for best results. Also, I

found that the external ac adapter power supply furnished with the AB-144 produced a small amount of hum on stronger signals; hooking into the transceiver's dc supply cured the problem. Too, I would recommend that Clegg add a small LED indicator to let you know that the unit is on; unless you're hooked into your set's power supply, it's easy to forget to turn off the upconverter when you turn off your rig.

Finally, you need to be careful not to zap the converter with a healthy dose of rf from your set, as I've indicated. Installing a coax switch at your transceiver's output connector will allow you to conveniently switch from converter to normal transceiver operation. A coax relay could also be used, but that would require going inside the AB-144 to arrange switching.

All in all, the Clegg people have produced a handy, useful accessory to be used with the thousands of all-mode VHF transceivers in operation today. I should also mention that Clegg has now introduced a similar upconverter, known as the MD-28-9, which transforms your ham-bands-only HF transceiver or receiver to a wide-range 100-kHz-to-18-MHz unit. With this unit, the received signals are heterodyned to the 10-meter band rather than to 2 meters.

In my opinion, the AB-144 is a real jewel that is well worth its price tag. It's an especially attractive purchase for the ham newcomer who entered the hobby from CB radio and who invested first in a 2-meter rig, rather than a shortwave set. Besides providing a good auxiliary receiver for my shack, the Clegg unit will be a welcome addition on my vacation trips to enable me to monitor HF with the 2-meter rig. *Clegg Communications Corp., 1911 Old Homestead Lane, Greenfield Industrial Park East, Lancaster PA 17601; (717)-299-7221.* Reader Service number C3.

Karl T. Thurber, Jr. W8FX/4
Ft. Walton Beach FL

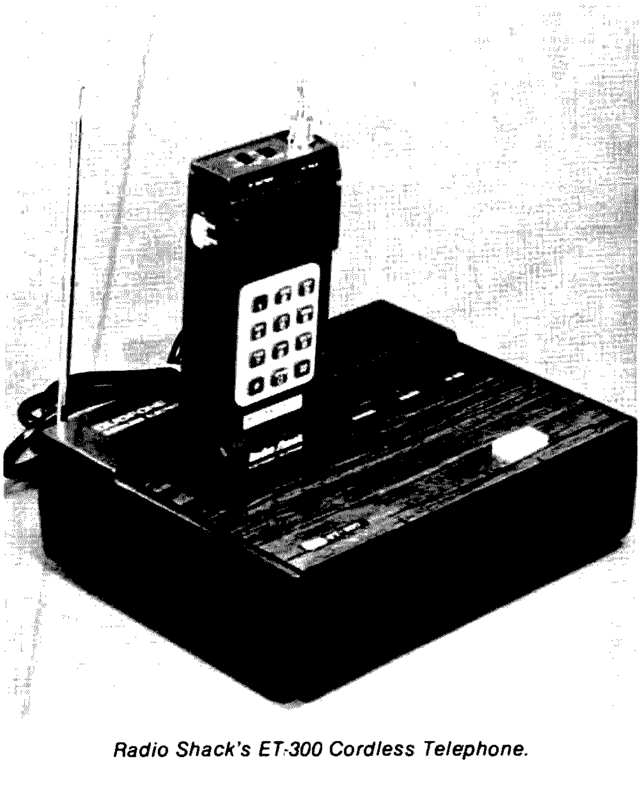
RADIO SHACK CORDLESS TELEPHONE

Now available from Radio Shack is the DuoFone ET-300 Cordless Push-button Telephone with an operating range of up to 300 feet from the base unit. It has a universal dial system for compatibility with both electronic push-button and mechanical dial telephone systems.

The ET-300 can be installed simply by plugging the base/recharger into a 120 V ac outlet and a modular phone jack—no other wiring is required.

A special feature of the phone is Auto-Redial, for one-button redialing of the last number called if it was busy or did not answer. A call push-button lets you signal the handset from the base with a tone signal.

To answer or make a call on the cordless handset, flip the talk switch and raise the antenna. To hang up, lower the antenna.



Radio Shack's ET-300 Cordless Telephone.

Trac's TE284 Deluxe Message Memory Keyer.

The base/recharger is 8⅝" x 7⅛" x 2¾" and includes a built-in modular jack for your regular phone. The handset is 2½" x 6¾" x 1¼".

For further information, contact *Radio Shack, 1300 One Tandy Center, Fort Worth TX 76102.*

TRAC DELUXE MESSAGE MEMORY KEYER

Trac Electronics, Inc., has introduced a new, completely CMOS, state-of-the-art, Deluxe Message Memory Keyer, the Model TE284. Containing all CMOS integrated circuitry, the Deluxe Message Memory Keyer contains three choices of message storage: two-message capacity (50 characters each), four-message capacity (25 characters each), or one 50-character message and two 25-character messages. The keyer can record at any speed and the message can be replayed at any speed. A memory operating LED tells when the keyer is in the memory function. The three choices of memory operation make the Model TE284 ideal for both daily QSOs and contests. In addition to the message functions, the keyer contains both dot and dash memory keying, iambic keying, 5-50 wpm, speed, volume, tune, tone, and weight controls, as well as a sidetone with speaker. The Model TE284 keys both negative- and positive-keyed rigs. *Trac Electronics, Inc., 1106 Rand Building, Buffalo NY 14203.* Reader Service number T18.

ICM INTRODUCES NEW GROUND STATION SATELLITE RECEIVER

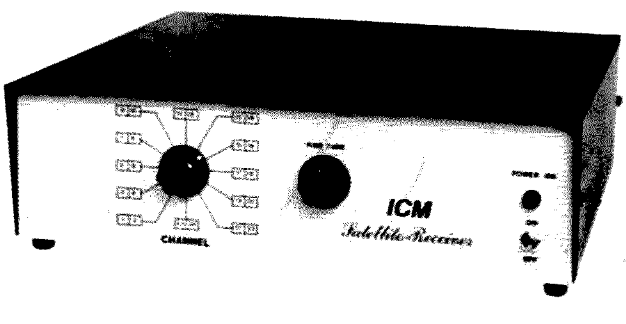
A new low-cost satellite receiver, covering all channels 3.7-4 GHz, is now being manufactured by International Crystal Mfg. Co., Inc., Oklahoma City.

The TV 4200 receiver is fully tunable and provides standard dual audio outputs of 6.2 and 6.8 MHz, with other outputs available. The receiver has a built-in LNA power supply, and output levels are compatible with video-monitor or VTR input.

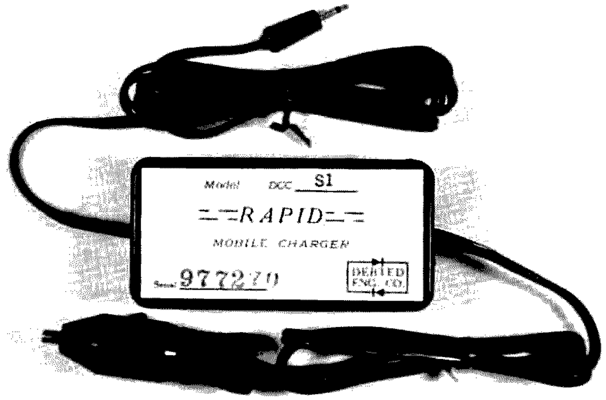
For further information, contact *International Crystal Mfg. Co., Inc., 10 North Lee, Oklahoma City OK 73102.* Reader Service number I48.

RAPID MOBILE CHARGER

With the current trend toward using hand-held transceivers for mobile operation, keeping the hand-held batteries charged has become a problem. DebTed Engineering has solved this problem with a new line of 12-volt-operated rapid chargers for amateur and commercial use. Available exclusively through Debco Electronics, the rapid charger units are equipped with a cigarette lighter plug on the in-



ICM's satellite receiver.



Debco's Rapid Mobile Charger.

The EK-480M keyer from Curtis Electro Devices.

put side and an appropriate charging plug on the output side. Models are currently available for the Tempo S-1, Wilson Mark II, and Wilson Mark IV. The charger will rapidly charge a fully discharged good battery in 4-6 hours and may be used during transmit, receive, and off periods. Furthermore, it will not damage batteries if left connected for prolonged periods of time, due to automatic shut-off circuitry. *Debco Electronics, PO Box 9169, Cincinnati OH 45209.* Reader Service number D68.

HAMTRONICS' UHF FM EXCITER KIT

Continuing in their tradition of making professional quality transmitter and receiver modules, Hamtronics, Inc., has announced a new UHF FM Exciter Kit. The model T450 is rated at 1 Watt for continuous duty, which makes it an ideal unit for repeater and control link service.

Features include low-impedance dynamic mic and receiver audio inputs; crisp, clear modulation; low spurious output; and built-in test points for easy alignment. The unit is designed on a 3" x 5¼" PC board and uses both individual coil shields and compartmental shielding. Double-tuned circuits are used for low spurious output, and decoupling uses ferrite beads and resonant bypasses for stability.

For further information, contact *Hamtronics, Inc., 65F Moul Rd., Hilton NY 14468; (716)-392-9430.* Reader Service number H16.

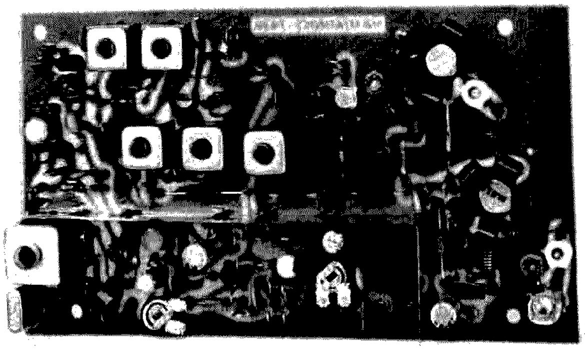
NEW KEYER USES OPTOISOLATORS

An advanced-design electronic keyer employing optoisolators for key isolation has been introduced by Curtis Electro Devices, Inc. Based on the popular 8044 single-chip circuit, the EK-480M features a direct meter readout of code speed in wpm. Measuring only 7" x 4½" x 2½", the unit features dot and dash memories, iambic or standard mode operation, internal 117 V ac or battery supply, internal sidetone and speaker, front-panel volume, pitch, weight, and speed controls, and an accessory socket for soon-to-be-announced message memory, Instructo-Keyer, and keyboard keyer add-on units. The unit will key ± 300 V dc at up to 200 mA.

For additional information, contact *Curtis Electro Devices, Inc., Box 4090, Mountain View CA 94040; (415)-494-7223.* Reader Service number C90.

THE ISOPOLE™ CONT.

We should have noted in our October issue (p. 167) that AEA's new ISOPOLE™ is indeed a VHF antenna. Versions are available for 2m and 220 MHz.



Hamtronics' UHF FM Exciter.

Ham Help

I have recently come into possession of an Elmac receiver, Model PMR-6A. I have not been able to find any info on this unit. I do not have the power supply, but I understand that it was a mobile unit.

I need a schematic for the unit and a list of the voltages needed for operation so a power supply can be assembled. I will appreciate any help and will happily reimburse copying and postage costs involved. Thank you.

Paul Uhlig K0MD
1342 Estate Ct.
Wichita KS 67208

I have an xtal XCB-4 AM CB radio and I would like to convert it to 10 meters. Has anyone made this conversion? Can anybody help?

John S. Lee KA4EPR
17401 N.W. 20th Ave.
Miami FL 33055

Carthage High School is organizing a club, and we desperately need any junk or articles collecting dust. Anything would be appreciated: books, magazines, spare parts, wire, coax, old repairable transmitters or receivers, etc. We will gladly reimburse postage or shipping.

Jerry Reeves WD5IMA
Carthage High School
PO Drawer D
Carthage TX 75633

I am in need of a circuit diagram and manual for an Allied A-2515 receiver. I would certainly pay any copying costs, and it will help a future ham get on the air.

Robert Napoli K2LGO
Box 158
Riverhead NY 11901

The Wells High School Amateur Radio Club is a new organization that needs help. We have a group of interested students, three co-advisors, and not one speck of equipment.

The group is now raising money for an equipment fund and working on a vocational education grant application, but we are wondering if someone might be willing to either donate old gear or place gear with the club on loan, until the club can afford to buy its own rig.

The club would be more than willing to pay shipping costs or, if practical, pick up equipment in the coastal Boston/Portland area.

David W. Rotthoff
Amateur Radio Club
Wells High School
Wells ME 04090

I would like to find out about the existence of any Bible study nets or round tables to help my study of the word of God. Thank you.

Gary L. Anderson WB0GWP
1528 34th St. S.E.
Cedar Rapids IA 52403

I would like to hear from someone who has successfully interfaced the IF-1 regenerative repeater (*73*, November, 1978, p. 254) to an ST-6000.

A. Ustal WB4TRJ
180 Arlington Rd.
West Palm Beach FL 33405

DX

from page 30

quency, that is, on the frequency of his last station worked. Either a remote vfo on your transceiver, RIT (receiver incremental tuning), or a separate transmitter and receiver is required. Any of these setups will accomplish the goal.

First, tune in the DX operator and listen while he works one or two stations, to establish in your mind what his operating pattern is. Books and articles have preached this simple rule for decades. When your radios are warmed up and tuned up (off the air, naturally), get ready to put your transmitter on the proper spot. When the DX turns it over to someone, find that someone and put your signal just slightly off his frequency—off a matter of Hertz, *not* kilohertz!

That's all there is to it. When you call, your signal should be right where the DX station's receiver is tuned, and he will hear you without touching his receiver tuning knob. If the DX operator is getting calls by carefully listening for "tail-enders," you have no choice but to play his game and tail-end yourself. Tail-ending means giving your call, or just your suffix, at the very end of the transmission of the station who is signing off with the DX. A very skilled operator can pick out parts of callsigns from tail-enders and can keep a string going without ever saying "QRZ?" or whatever. Mostly, however, tail-ending degenerates into a mob scene. *Never* use the technique unless the DX station encourages it, and even then only if it is working.

It's difficult to not feel smug after finding a pileup, observing the poor slobs who call and call but never figure out what is happening, then make one or two quick calls yourself, exchange reports, and tune away looking for more rare QSOs, while the same pileup goes on and on. There's something more training classes should teach: It's called using your head. Put yourself in the shoes of the DX station you want to work. Think like he does and you will invariably call at the right time on the right frequency. Otherwise, you can call all night.

160 METERS

December is the time to talk about our lowest frequency band, since the winter months are to 160 as the summer months are to sporadic "E" skip on VHF. Many modern rigs cover 1.8 MHz, and the amateur magazines have had their share of tips the last couple of years on how to put a signal on 160 when only modest real estate is available. A dipole is 270 feet long, a fact which constrains most of us. But there are ways!

Many have become interested in 160 since the hundred-country barrier was broken a couple of years ago. As we recall, W1BB actually had the magic century figure some time before, but a few of the countries were "pre-War" and didn't count when the ARRL decided to offer a 160 endorsement to DXCC. By 1979, several have made this achievement level. Now most expeditions to rare spots include 160-meter coverage, as well as 6 meters and OSCAR. When one has worked his fill of Europeans or JA stations on 80, 160 becomes the natural band to which to gravitate for more thrills.

DX on 160 is found primarily in the "window," 1825-1830. *Do not* transmit in this segment unless you are outside of the US and Canada. The DX will specify a listening frequency around the bottom edge of the band, 1800-1805. Pacific island stations such as Hawaii will transmit near the top edge of the band, as will JA stations. Send an SASE to the ARRL and ask for their special chart of 160-meter allocations, which includes information on how much power you can use at various times of day and night in different regions of the US.

Six-Band DXCC, anyone? (It's been done!)

MAILBAG

KV4FZ reminds us that he was the first operator outside the 50 states to make WAS on 160 meters; PY1RO, mentioned in this column last July, was the first station outside North America to accomplish the feat. Herb KV4FZ has also confirmed 100 countries on six different bands, 160-10 meters.

A nice letter came from Cliff Sides KX6SC, who, along with Ed Williams KX6SA, has been keeping the Kwajalein Atoll active. They have been on 6 meters, with consistent openings to Japan, Hawaii (2000 miles NE of KX6), Guam, the Solomon Islands, Papua-New Guinea, and Jordan. Some openings to Australia and New Zealand have also occurred.

Their best time on 50 MHz, where they hang out around 50.110, has been 0900 to 1200 UTC. If you can hear KH6 stations this winter, you may work a real rare one if the skip runs to KX6.

Here's how Cliff summarizes the low-band openings:

10 Meters: Open from Kwajalein sunrise to sunset (1800-0600 UTC); Europe comes in first, followed by stateside and VK, then Japan at night between 0600 and sunrise.

15 Meters: Open sunup to sundown, very similar to 10.

20 Meters: Best openings to the US occur between 0300 and 0800 and again between 1100 and 1500. Europe is very good between 0500 and 2200.

80 Meters: Propagation to the US peaks about 1400, Europe slightly later. East-coast US stations have the best shot at this part of the world at their sunrise on the east coast, about 1200 UTC in the winter.

The first expedition to VK9 (Cocos-Keeling) in some time took place September 18 and 19, 1979. VQ9s JJ, KK, and MR (yes, the same one mentioned in Novice Corner) started out by having their plane delayed 24 hours. They finally arrived on Cocos Island (about 1500 miles from their homes on Diego Garcia) and fired up at 0830 UTC on the 18th.

Their next problem was dead bands. Our active sun, responsible for the excellent propagation on the bands these days, greeted the Cocos group with the residual effects of a solar flare. The bands came back to life a little toward the end of their two-day stay, but working them from stateside, for example, was no picnic.

In 30 hours, the trio did manage some 2200 contacts, almost all on 15 and 20 meters. For those who missed this one, there's good news: VQ9JJ and VQ9TR are talking about going back early in 1980, with a beam antenna this time.

August, 1979, was a banner month for expeditions. Manihiki (Northern Cooks chain) Island was represented by no less than two different groups. KØSVW provided a report on one, which signed ZK1AM. Other operators were WØWP, KØEVE, and ZK1DR; they made 15,000 contacts on 80-10 meters. WØWP is handling QSLs, which were supplied by Collins Radio.

ZK1AM was on the air August 18-25, using a pair of IC-701s, an FTDX-400, and loaned TH3 Hy-Gain beams and DenTron amplifiers. Expenses for the operation, including a six-day boat ride each way, totaled twelve thousand dollars, which was paid by the participants. If your group is interested in seeing the slide show and talk on this interesting adventure, contact Dr. Steve Towle KØSVW, 214 N. 34th Avenue East, Duluth MN 55804.

September's Hurricane David devastated the island of Dominica in the Caribbean. David wiped out all communications there except for amateur radio. J7DAY was all alone for the first few days and provided all government-to-government communications for relief operations.

J7DAY was joined by KP2A (American Virgin Islands) and WØDX. They set up at a Red Cross headquarters first as KP2A/J7 and then as J73A. W4UY joined them later. As things got in order, J73A was able to do some casual operating; if you worked them and would like the special QSL card, send yours with an SASE to K2TJ.

As you read this, the Indian Ocean-Africa expedition by N2KK, K5CO, and N5AU should be in full swing. Their itinerary includes 3B7 and 3B9, Glorioso and Juan de Nova, and then Mayotte and 5R8 (Malagasy Republic). After that, N2KK hopes to get into Somalia (6O) solo.

Dave N2KK is a professional photographer who has traveled extensively throughout the world (to more than 100 countries). He will be taking many photos during the expedition and will undoubtedly be prepared for the "convention circuit" upon his return.

If you worked KP4AM/D (Desecheo) last spring, you might want to send your QSL now to David Novoa KP4AM, PO Box 50073, Levittown PR 00950.

VE3FXT should be operating from Thailand by now, after getting in some air time from HS4AMA while awaiting his own callsign. Also active from there, of course, is Fred Laun HS1ABD. Fred listens for stateside and Canada on 3517 at 1130 daily.

The December issue of *CQ* magazine, a publication which has been quite DX-oriented over the years, is the first under the new management of K2MGA, K2EEK, and W2LZX. Among other things, CQ has sponsored the Worldwide DX Contest, the WPX (prefix) contest, and a 160-meter contest, not to mention an awards program, including the USA-CA (US counties) award. It is expected that *CQ's* emphasis will continue mostly unchanged, at least for the time being.

With the departure of Chuck Stuart N5KC as editor of this column, new authorship begins with this issue of *73*. Please send your input c/o *73*, Peterborough NH 03458. And thanks from all DXers to Chuck Stuart for the excellent work he has done with the column during the past year!

Most of the information for this column came from *The DX Bulletin* (Vernon CT 06066). Thanks.

Looking West

from page 18

and other "radio tricks" and increased lawlessness.

Where Are We Headed?

As this lawless group becomes larger and more powerful, it will become more fearless. It will also become more sophisticated in the "art" of raising hell via radio technology.

Please realize that the driving force of this group is an ego trip based on the power they can apply to other parts of society. Also, be aware that this sort of ego trip *can never be satisfied.* That is to say, once they have their way with the ham bands, they will begin to turn their eyes (egos) to other targets.

What targets might these be? What with scanners in abundance, targets are very easy to find. What about mobile radio services, taxis, fire, police, etc.? I can imagine thinking like the following:

"Wouldn't it be a lot of fun to study the fire frequencies and learn how to get around their security systems and send half of the LA Fire Department out on a wild-goose chase? Wow! That was fun. Next week, let's fake LAPD into another Watts riot!" Or, "Let's talk to a 747 pilot coming into LAX and burn his ears!"

The technology is not too difficult for this group of lawless people. They already know how to put a synthesized 2m transceiver well outside its design band limits. They know the frequencies that many services and individual agencies use. They know a great deal more.

I don't wish to be disrespectful of the FCC and its abilities, but I feel it would take quite a while to nail someone who is doing the things I project above. Meanwhile, the FCC receives a tremendous black eye, and society will pay a large bill in monies, property, and maybe lives.

What To Do?

It seems to me there are several choices:

1. Do nothing. Result:
•Eventual anarchy within the whole radio spectrum.
•FCC in total disgrace.

2. Vigilante action. Result:
•People hospitalized.
•Houses burned.
•Innocent parties hurt.
•"Good" people (vigilantes) sued and hurt.
•FCC gets black eye.

3. FCC participation in restoring law and order to the ham bands. Result:
•Stop anarchy before it spreads further into the non-ham parts of the spectrum (where the FCC would not have a vast army of hams to help with the clean-up).
•Cooperation from those of us hams who have developed RDF skills and equipment. This will aid the FCC in its work.
•Restoration of what is probably the most effective weapon of all—peer pressure in the form of fear of exposure to the FCC.
•FCC gains respect and stature.

* * * * *

The only question left is: "When will the tide begin to change back in the direction of collective decency?" Maybe the shift has already begun.

BYE-BYE, MISS AMERICAN PIE DEPARTMENT

On September 6th, the FCC acted to suspend, pending revocation action, both the operator's and station license of Scott Lookholder WB6LHB of Los Angeles, California. Earlier this year, Lookholder had entered a guilty plea in federal court on a number of counts in an indictment charging him with the use of "foul and abusive language" while operating on the two-meter amateur band. Allegedly using the callsign W6JAM, Lookholder spent many hours making life miserable for the usership of many Los Angeles area repeaters, especially the Mt. Lee WR6ABN repeater.

Ironically, Lookholder was even a member of the DFing committee set up to catch W6JAM, and it was only due to some rather phenomenal detective work by another member of that same committee that he was caught at all. Even after they were sure that Lookholder was their man, they found it hard to believe and spent many hours trying to disprove their "find" before turning their evidence over to the authorities.

The rest you already know. Scott Lookholder was given his day in court, admitted to the charges against him, was sentenced to pay a fine, and was placed on probation. He was also ordered by the judge not to utilize his amateur equipment during the term of the probation. However, though a number of letters were sent to the Commission by area amateurs requesting that Lookholder's license be pulled, the FCC took months to act on the matter. Infuriated, many amateurs charged the FCC with running

Congressman James Corman (left) with Attorney Joe Merdler N6AHU. Both care a lot.

scared of anything that even remotely smelled of First Amendment. Letters to the Commission have gone unanswered, including my own.

In the meantime, the inaction by the Commission on this and other regulatory violations issues helped worsen an already highly volatile situation. The kooks have realized that the FCC is seemingly powerless in this type of matter and have made a field day of it. Filth, racial slurs, character assassination, and hate have replaced normal day-to-day operation on many repeaters. It's even been reported, though not confirmed, that at least one "jamming" club has been formed to further wreak havoc. Carrying their banner of "our way or no way," the kooks have been growing in number and strength. No longer would they hide behind the anonymity of their microphones. Rather, they were proud of who they were and what they were doing. They declared open war on Joe Ham, and Joe was hard put to fight back.

Not every Joe was inclined to sit still and accept the decaying situation, nor every "Jay" for that matter. In what might be considered one of the finest political moves ever initiated within the ARRL, League Southwestern Division Director Jay Holladay W6EJJ convinced the Board of Directors that a *bad* situation did exist and was able to get the Board to pass a resolution which instructed ARRL General Counsel Bob Booth to contact and develop a working guideline with the FCC in handling this type of problem. Jay's next step was to appoint Los Angeles Attorney Joseph Merdler N6AHU as a Special Assistant Director, charged with advising Jay in methods to eliminate this ever-growing maliciousness that was, by this time, threatening to destroy normal amateur operation.

Through Joe, a meeting was arranged with US Congressman James Corman, Democrat from Van Nuys, California, which Jay and Joe attended. Congressman Corman was briefed on the deteriorating situation, the problems with FCC inaction on these cases, and given a basic education about the amateur service itself. As a result of this meeting in August, Congressman Corman agreed to support the amateur community in its internal house-cleaning effort and said that he would see what could be done through Washington. About two weeks later, I personally interviewed Congressman Corman, and what follows is the text of that interview.

Q: Congressman Corman, what led to your decision to get involved in this matter?

A: All of us who have had little contact with amateur radio are still aware of its importance. I'm occasionally aware due to news items of amateurs who have performed important services during times of disaster, maybe an individual disaster or something that affects a whole community. I was not, until recently, aware that there were some problems. Those problems involve the use of false call letters, interference with the normal use of the airwaves, and some serious cases of obscenity. I have discovered that the FCC appears to be doing little to police the use of the airwaves for amateurs and is potentially diminishing this service which the amateur operator can give to his community.

Q: Congressman, now that you are involved, what direction do you intend to take?

A: Joe Merdler (N6AHU), who is a good, long-time friend of mine

and the new president of the Personal Communications Foundation, has given me tapes to show me what is happening on the airwaves, and I'm going to be sure that the FCC hears those tapes. I hope that will generate some action from them. Also, I'm going to be working with Congressman Van Deerlin, who heads the Communications Subcommittee, which has jurisdiction in this area, to see whether or not we need some statutory change, to make certain that the FCC is doing a responsible job of policing the airwaves.

Q: Do you feel that the FCC is doing its job in this matter?

A: Evidence I have at the moment would indicate that they are not! For instance, a man was convicted in a court of law of using both false call letters and obscenities, very serious ones interfering with the normal legal use of the airwaves, and yet the FCC was reluctant to take action against him. He may be punished in a civil court or criminal court, but as long as he has the *ability* to continue to interfere with the normal legal use of the airwaves, then the FCC is not doing its job and I want to find out why.

Q: I assume you are speaking of the Scott Lookholder matter?

A: Yes.

Q: Do you feel that the Commission may be running scared of First Amendment issues in this matter?

A: I'm sure that the FCC feels controlled by the First Amendment, but there are things here that go well beyond First Amendment rights, having to do primarily with interference with other people's use of the airwaves, and clearly there are obscenities that go far beyond one's constitutional right. I know Chairman Ferris and plan to contact him and ask if that's what they're (the FCC) worried about; I want to sort it out and get some legal opinions as to whether or not they can move. It may be that it's something else, and I suspect that something else may very well be that they just get bogged down in the normal bureaucracy and that nobody has paid close attention yet. Maybe I'm wrong and it is something else, but we will find out what it is and try to get to the bottom of it.

Q: Are you going to bring the Lookholder matter to their attention and try to get action on it?

A: Yes. I want to be sure that it is before the chairman of the Commission. He may have a valid reason for not proceeding. I want to know what that reason is. If it is a valid reason, I will come back and report it to the people involved. If it's not a valid reason, I'll try to see that action is taken.

Q: What if some of these alleged "bad guys" charge you with violation of their First Amendment rights? Will you still stand behind the amateur community in its housecleaning efforts?

A: The point is that the courts will protect the First Amendment. There is no First Amendment right to falsifying call letters. There's no First Amendment right to blasting obscenities on the airwaves. Admittedly, obscenity is a difficult thing to determine under the First Amendment, but aside from that, assuming that they are saying something very proper, if they're falsifying call letters and if they are intentionally interfering with the normal use of the airwaves, then it's my suggestion that it is *not* their First Amendment right. I believe very strongly in freedom of speech. Clearly, when you think about the airwaves and their importance, there is the necessity for using them in some reasonable and rational way for all. To use them irrationally, to intentionally jam them, has nothing to do with First Amendment rights in my book.

Q: I understand that you are going to be coordinating your efforts with the American Radio Relay League through its General Counsel, Bob Booth. Would you care to elaborate?

A: I asked if I could see Mr. Booth as soon as I get back to Washington. I'm hoping that Mr. Merdler will be able to come back as well. For one thing, there are 435 of us in the House of Representatives and we don't want to be running in 435 different directions. That's why it's so important that the association (ARRL) quarterback what's going on, so that we are all moving in the same direction. We need to coordinate a good reference.

• • • • •

Less than two weeks after my interview with Congressman James Corman, word reached us that the FCC had acted on the Lookholder case, and since that time, the FCC has apparently been quite busy helping us clean house, not just on two meters, either. Could it be that an overall cleanup of the amateur bands has become an FCC priority? The rumors of almost daily "busts" run rampant, but the FCC refuses to say anything. Following up on such a rumor just this week, Westlink Correspondent Alan Kaul W6RCL called FCC Field Engineer in Charge Larry Guy at the Long Beach field office. How far did he get? Read his final "air copy" here:

NEWS ITEM: THE WESTLINK AMATEUR RADIO NEWS EDITION #106

"In Los Angeles last week, another FCC raid was made on an amateur station allegedly involved in illegal transmissions. Officials from the Long Beach field office took part in the action. In a capsule, here's what happened: A signal from an amateur transmitter was jamming a two-meter repeater in the Los Angeles area. Direction-finding equipment led to the location, but no one was home. Westlink has learned that the jamming operation was done by remote control, and that the owner of the station was activating the transmitter by telephone.

"The FCC refuses to confirm or deny the report, and will say only in terse governmentese: 'An inspection was made on Monday, September 10th, but the results of that inspection are not public information.'

"So, we don't really know what happened and can't really be sure who the ham involved was, but it looks like the score from Los Angeles is FCC 2, jammers nothing."

If there is real validity to the rumors, and I have good reason to believe that such is the case, then it looks as if a cleanup of our amateur bands is our Christmas present to ourselves, with a bit of help from the FCC. The only ones who won't appreciate the gift are the foul-mouthed, the carrier-throwers, and jammers in general. Why? Because the gift they get will probably be notification that they are no longer licensed amateurs; *good riddance*. You see, the "good guys" who wear white hats and ride white horses can win a fight —even today!

Happy holidays!

Microcomputer Interfacing

from page 28

shown in Fig. 1 pressed, a negative pulse of duration 2.62 seconds will also be observed. If you fail to press the pulser, however, and thus do not apply a positive edge at GATE0, no monostable pulse is observed. On the other hand, if you repeatedly press and release the GATE0 pulse at time intervals less than 2.62 seconds, the monostable pulse can be prolonged indefinitely. In this way, a *retriggerable monostable multivibrator* output can be produced.

With a control word of 064, the behavior depicted for MODE 2 in Fig. 2 can be observed. By repeatedly generating positive edges at GATE0 at time intervals of less than 2.62 seconds, counter #0 is repeatedly reset and the appearance of the short negative clock pulses is prevented. The same purpose may be accomplished by allowing GATE0 to remain at logic 0 after a positive edge has been applied. The GATE0 input thus exhibits both gating and trigger/reset behavior.

MODE 3 behavior (control word of 066) is similar to that for MODE 2, except that a nearly symmetrical square wave is produced. Deviations from symmetry occur when the counter byte is an odd number and are most pronounced when the counter byte is very small.

In MODE 4 (control word of 070), the positive edge of the WR pulse (which is applied at pin 23 of the timer when the STA instruction at 003 014 is executed) initiates counting that culminates in the production of a negative clock pulse of pulsewidth T. The time duration between the positive edge and the pulse is 2.62 seconds. The GATE0 input acts as a gating input, with a logic 0 inhibiting the counting process.

Finally, in MODE 5 (control word of 072), a positive edge at GATE0 initiates counting. By repeatedly generating positive edges at GATE0 at time intervals of less than 2.62 seconds, counter #0 is repeatedly reset and the appearance of the single negative clock pulse is presented.

It should be noted that in all modes, counter action begins on the first negative clock transition after WR (pin 23) or GATE0 goes to logic 1, and that WR can initiate counting in all modes except MODE 1 and MODE 5.

Although in many applications of the 8253 timer the primary interest will be to generate the proper signal at OUT0, as shown in Fig. 2, you can also read the contents of the 16-bit counter *without affecting the counting operation*. By inputting a control word of 000, 100, or 200, you latch the 16-bit count of either counter #0, counter #1, or counter #2, respectively. As shown in the memory-mapped I/O example in Table 1, the two bytes can then be read into the 8080A chip, with the LO byte first and the HI byte second.

LETTERS

from page 16

sultant squeal from various troopers to your magazine. I noticed some of the biggest squeals around here came from police who have linears in their patrol cars on CB and they own amateur gear for a home CB station. One local community police department is almost entirely involved in overpower on CB. In fact, in this particular area, a county of maybe 7,000, there are 15 to 18 Yaesus and 7 Siltronix, and linears in autos and home are almost commonplace. Only one Yaesu is owned by a licensed amateur.

Then we see an article printed by a completely illegal, overpowered, out-of-band HFer (Peters) trying to convince us he is just a good ol' guy trying to do his thing, fellas, so please give us HFers some consideration and kindness as they operate like hams and are really good guys. Horse cocky! He is an illegal bootlegger using illegal equipment and should be in jail on a criminal conviction, not being published in an amateur magazine.

Then we have the article that, merely because a ham was a Conditional or Tech, says it was justifiable and cute for an Advanced-type ECM engineer to break the law in dozens of ways to "teach him a lesson." All because the so-called offender was a Conditional whose comments the hot-shot engineer didn't like. I'd rather see ads by Trigger.

In the past, your mag always had the best of amateur radio, every article seemed to be informative, and construction articles for amateurs were of the accepted *ham* type, i.e., licensed and law-abiding. Other than the abovementioned drivel, though, you still have the best mag published and someday you will get back to the average amateur and make us feel we are with you on a one-to-one basis as we read your editorials.

Joe Feagans W9HCI
Tallula IL

EGYPTIANS

Now the "other side" has had its say in the pages of *73*, with the word of Bess Nelson (September, 1979, page 156) pitted against the earlier letter of Tania Miller (August, 1978, page 8) in regard to the situation prevalent at the Egyptian Radio Club, Granite City IL. It is one of the oldest, strongest, and most prestigious clubs in the nation, whose chief accomplishment seems to have come 40 years ago, within a decade of its founding, when it won ARRL's Field Day three years in a row.

When I saw Tania's letter, I thought it a bit hasty in remonstrance against an admitted problem, but now I think she, not Bess, had the better perspective on things there.

At present, Mrs. Nelson is editor of the club's newsletter, a journal I had the honor to publish several years ago. Her latest edition, besides containing two unsigned letters—something most of the rest of us editors stopped airing quite a while back—gives the news that the club's regular membership stands at 126, with the obvious implication that the membership is *up* to this figure. The true picture is that club membership must be *down* to 126, following the mass exodus of 29 former members, according to my sources, who walked out the door, led by old-timer Harry Turner (holder of world record for sending code on a straight key—35 wpm—see *73 Magazine*, Jan., 1976, page 5), who turned his back in disgust and dropped not only his membership, but also his position as club treasurer, a post he had held for more than a quarter century.

Up until early this summer, I had felt sure that "our" problems would soon be resolved and we would all be back in the same boat again. But I now no longer think this is possible. The arrogant and supercilious behavior of a small knot of hierarchical dictators within the club has made any broadly-based "aura of good feeling" an impossibility. Oh, not that disagreements are ever expected to end, but they need not break up the party. To be sure, old traditions and ideas must and will be changed, and I never particularly agreed with the notion that women should not be members of the club. But it was not this issue that was at the heart of the troubles—rather like the issue of slavery, destined to be the most memorable point of the American Civil War, but which was not really the cause of it all. The more likely situs of the ERC problem is exactly what Bess points to: feelings of power on the part of a chiefly self-appointed elite within the club.

Oddly enough, my strongest disagreements have been with Harry Turner himself, who once walked out of a board of directors meeting because I was there although not a member, but at the invitation of that body. But Mr. Turner and I can stick to our positions responsibly and still keep our composure and our friendship—as we have continued to do. With the 27 others, I must agree, there's little point in continuing the animosity; I just walked away from it, too. But I don't like to see in print an appearance that the "good guys" won, when they didn't.

Harry Church W0KXP/9
Lebanon IL

ATV

On the night of September 4, 1979, all hell broke loose on ATV. At eight thirty pm, VE3IWP, who lives in Toronto, informed me via two meters that W9ZIH from Chicago was coming in on his screen. I fired up my TV station, and sure enough, there he was. I just couldn't believe that I was receiving an ATV picture all the way from Chicago (Hickory Hills) IL about four hundred twenty miles away, while my normal range is about seventy to eighty miles. He was working VE3EYR in Brantford, Ontario.

After that contact, he worked W3POS in Erie PA, approximately four hundred miles between the two stations. At ten pm, I got ahold of W9ZIH myself; we worked both ways, live on camera as well as sound. He received me P4, and I received him P5 (broadcast quality). I nervously took some pictures and made a video recording for future reference. W9ZIH was on for several hours, not just a few minutes as might be expected. VE3EYR, VE3IWP, and myself were in contact with each other on two meters. There were times when I would almost lose W9ZIH, and VE3IWP, who is fifty miles from me, would see him P5, and sometimes conditions would be reversed.

After I finished my ATV QSO with W9ZIH, I picked up N9AB from Mundelein IL, which is four hundred forty-one miles from me. We only flashed our logos at each other for a while; he came in P2 at times. We also saw K9KLM from Oak Creek WI once; he was P3 on my screen and is four hundred eight miles away. Later on that night, W2RPO in Lockport NY and VE3AHS in Weliand, Ontario, also saw W9ZIH. Needless to say, I had a sleepless night after all this. I don't know who holds the world record for DX on fast scan, but we might be close to it. Ron W9ZIH was running five hundred Watts out on 439.25 MHz video, and one hundred fifty Watts on 443.75 MHz sound; his antenna on video had one hundred seven elements up sixty-five feet. I was putting out forty Watts on video and ten Watts on sound with a forty-eight element antenna on video and twenty elements on sound. My converter and preamps are home brew as well as my transmitting equipment. I am not trying to take any credit; we were all active in this and were very enthusiastic. We all hope that what has happened to us might spark some interest in others. I have been a ham since 1959, but after the initial excitement of the first several years wore off, I lost interest in the hobby. After getting involved in amateur fast scan TV, I got my old spirit back again. There is no better way that I can think of for old-timers who are getting stale to rejuvenate the interest in our wonderful hobby. ATV has got all the excitement of the early days of radio, with lots of room for experimentation.

John Vander Ryd VE3CYC
Hamilton, Ontario

EUREKA!

Re: 890-960 MHz Machine-to-Machine CB

Eureka!

It now looks fairly definite that the new proposed amateur band in the 890-960 MHz band will not remain vacant due to the lack of equipment.

Our Canadian Department of Communications, through its Director General of Regulations, is proposing a 5-MHz portion be set aside for CB operation. They are proposing a wide-open mode of operation including man-to-machine and machine-to-machine. Comments on band plan, modulation schemes for voice and data, and, most important, eligibility requirements are being requested from the public.

My opinion is that the DOC feels that the big boys, G.E., Motorola, etc., are not being aggressive enough in their development in this area for the private commercial user. The commercial manufacturers keep screaming for more spectrum rather than developing improved technology to communicate within the spectrum they now have.

Motorola has developed a DVP Digital Voice Privacy System along with Harris and pos-

sibly others. This appears to have been developed only for the purpose of privacy. I feel the big "M" and others are going to be left out in the cold unless they and other *domestic* manufacturers join in on the development of this proposed new band, if it is approved.

Of course I am excited because this brings new and inexpensive technology to the amateur portion of the band.

Paul Cassel VE3AVY
Kitchener, Ontario

Well, unless we somehow manage to get a lot more licensed amateurs than we have now, I'm not sure that we will have enough people to do much pioneering on a new band. Of course, the availability of relatively inexpensive equipment would help a lot and might take some of the pressures off 450 MHz as a repeater control band. But remember that we have a 1215-1300 MHz band which is virtually unused... primarily because it is so difficult to make the necessary equipment.

The 900-MHz band might be one where amateur TV fanatics could set up a series of repeaters and make it possible for that mode to cover more ground. — Wayne.

THINK TANK

I'm not writing to bitch or complain about anything. As a matter of fact, I'm writing to obtain my copy of "How to Write for *73*." Hopefully, we can strike up a mutual agreement whereby I give you excellent articles for publication and you give me money!

I also want to comment on *73 Magazine* in general. I've been a reader of *73* since I was first licensed in 1963. I've followed your magazine's growth from "just another ham rag" to the best ham magazine currently being published. *73* gets in my mailbox first (most of the time) and gets read the longest. The articles are, by far, the most practical and fairly easy to duplicate. The articles also provide an excellent base for "think-tanking" my own projects.

I was delighted with the letter from K8DNV about "Wayne Green's Lair" in the July, '79, issue. Doug DeMaw W1FB has long been one of my favorite authors. Unfortunately, the rest of the senior ARRL staff don't share his opinion.

Several hams here in England are in the process of forming a G5 Amateur Radio Club for all licensed G5 operators. The unofficial G5 calling frequency is S19 (no relation to the CB counterpart) or 145.475 (simplex) MHz. No HF net has been set up as yet. *So far, we have* about 10 interested hams. Once we get a few more together, we'll have election of officers, formation of a G5 awards program, and all the other things that go into the makings of a ham club. So, any G5 licensed ham who would like to get in on the ground floor of the G5 ARC, please contact G5CSU at 10 Apple Close, Lord's Walk Estate, RAF Lakenheath Camp, Brandon, Suffolk, IP 279 PJ (my British mailing address), or come up on S19 to get full details.

One more item: 29.6 MHz FM is alive and well. G5BRB has a rig on 29.6 FM and I'll have an old Motorola L41 on as soon as the crystals come in, so look for some G5 activity on 10 FM from Jolly Old England.

That's about it for now. Once the G5 ARC is formed and the awards program is adopted, I'll provide you with the details. Keep up the good work in *73* and *Kilobaud MICROCOMPUTING*.

Richard H. Arland G5CSU
APO New York NY

THANKS, HARRY

I would like to comment on the article, "The 80 Meter Coax L," by Harry Pardue in your August, '79, issue.

Even though Fig. 1 is in error to the extent that the feedline braid is not connected to the ground rod as it should be (and as it is described in the text), the article is a fine contribution to our hobby and I wish to thank Harry and *73* for its publication.

My version of it, which *runs* 20 feet on the vertical to a chimney bracket and then slopes down about 5° to anchor to a nearby tree, shows an swr of about 1.2 and required no trimming whatsoever! First contact was Oklahoma City to St. Louis, which approaches 600 miles; at 3:00 pm, that's not bad (80m Novice CW).

Clarence H. Dollmeyer KA5EKM
Edmond OK

VINTAGE QSLS

I purchased the following QSLs at a local stamp and coin dealer. He had purchased them at an estate sale and was selling them to stamp and postcard collectors. If any of the following hams are still active and would like to have the QSL, send me your name and QTH and I'll send you the card.

W1BYF—'33; W1BFP—'31; NU1VT—'28; NU1WV—'28; W2AMM—'29; 2AON—'27; 2BBC—'26; U3BNU—'25; 3LB—'28; U3QW—'25; U3VF—'26; 4AG—'23; 4EE—'25; 5PE—'22; 5WK—'25; 6ACH—'26; W6AIF—'32; W6AIY—'31; 6ARW—'25; 6ASL—'28; 6AZZ—'26; 6BDW—'28; W6BMH—'31; 6CZU—'26; 6DAQ—'25; 6DOG—'28; 6DTP—'28; W6EBV—'29; W6FOC—'34; W6QY—'29; 6RJ—'25; 8AIB—'21; 8AVZ—Sept., '26, "Been on air week hr"; 8CTD—'24; W8ESG—'55, "ex-W8AKV"; 9AIG—'21; 9ASK—'22; 9ASN—'21; 9BEW—'24; 9BHB—'24; 9BOB—'24, "ex-9BDQ"; 9BQZ—'25; 9BVK—'24; 9DAE—'27; 9DHJ—'24; 9DMX—'24; W9FTR—'31; 9HO—'22; W9LAY—'33; U9WK—'27.

Is there a radio museum which would be interested in a donation of unclaimed cards from the above?

Gary Payne WD6BJK
1347 E. Dakota
Fresno CA 93704

SHINGLE POWER

Without a doubt, WB6AAM (September Letters) is right in urging hams to get busy and power their rigs with solar and alternative forms of energy. Considering the momentum that Jane Fonda and the "hate nukes" society is gaining, blackouts are coming. If you like the gasoline shortages of the '70s, you will love the electric power shortages of the '80s and '90s. (For more information, write to Department E, National Rural Electric Association, 1800 Massachusetts Avenue N.W., Washington DC 20036.)

If anyone can come up with a solar cell that can be used instead of shingles for a roof, it will be welcomed across the nation (even by power companies). Power companies need some support.

TMI was the worst nuclear disaster in history—yet no one was hurt. Oh, yes, it is claimed that there may be one to ten more cases of cancer in the next decade, but peddlers of hysteria fail to mention that over 325,000 cases are expected anyway. Yes, TMI was a tragedy. It set back nuclear power 20 years. Yes, there are risks involved with nuclear power, but these are small compared to others that we take.

For more eloquent thoughts on the subject, readers are referred to A. Hailey's new book, *Overload*. It provides sober food for thought.

Russell C. W. Crom AG9N
Mt. Prospect IL

MALICIOUS FOOLS

This will no doubt be one of many letters to you highly commending the fantastic job done by the hurricane watch during the recent hurricanes, David and Frederic.

I cannot commend too highly the excellent work done by all those running the net and most particularly by Ellie K4RHL and Lynne WA1KKP. So many people who benefited from information received by their tireless efforts will hold them in warm regard, and for those of us who sat on the sidelines during the long hours, their patience and fortitude under difficult conditions was more than admirable.

The difficult conditions were unfortunately made doubly so by some sick pranksters or malicious fools who persisted in heckling and attempting to block vital transmissions with all manner of QRM. It is hoped that the FCC is in a position to take positive action. I think that every ham who heard the QRM deplored it and would love to have been in a position to throttle the bastards.

George Benson GY5GB
Kingston, Jamaica

Ham Help

The Cincinnati Area UFO Net has been active Thursday evenings on 28.8 MHz (alternate frequency 28.795 MHz) at 0100 UTC. A Saturday afternoon section will be inaugurated beginning January 5, 1980, at 2000 UTC. Stations in the western, southwestern, and southern states with UFO traffic or interest are cordially invited to check in on or about 28.8 MHz at that time. Net control will be KA8BVO, with K8NQN providing assistance and liaison with the Mutual UFO Network nets which meet in the morning on 40 and 75 meters.

Information relating to UFO movies shown to radar specialists in the military service during the 1950s is of particular importance. If you or someone you know has seen such movies, please contact Mick Georgin KA8BVO, 8788 Mockingbird Lane, Cincinnati OH 45231, in confidence. His landline is (513)-729-3430. Thank you.

David L. Dobbs K8NQN
6612 Pleasant Street
Cincinnati OH 45227

If anyone has any information on any organized net of Masons *on the amateur* bands, please drop a line to Bill Williams, Box 419, Philmont NY 12565. Thank you.

Arthur Roraback III
RD 1, Box 87
Chatham NY 12037

Awards

from page 22.

of the amateur receiving this award.

WORKED ALL SM
WASM I

This award is offered by the Swedish Amateur Radio Society as tangible evidence of the proficiency of foreign amateurs in making contacts with the various call areas of Sweden.

The award may be claimed by any amateur in the world who has fulfilled the following qualifications. Swedish amateurs will not be eligible.

European amateurs must work two stations in each of the eight Swedish call areas. These areas are SM1 to SM7 inclusive and SMØ. The contacts may be made with SM, SK, and SL stations, and all stations have to be land-based. All contacts must be made after World War II. Non-Europeans need only contact one Swedish station in each of the required call areas.

The contacts may be made using any authorized amateur band and any type of emission. No endorsements for work on any certain band or for phone work will be given.

The applicant must submit a list of claimed contacts which may be verified by two amateurs, a local radio club secretary, or a notary public.

To cover expenses for this award, which is cloth and beautifully designed, there is a fee of 11 IRCs. Applicants are to send this fee and list of contacts to: SSA Diploma Manager, Ostmarksgatan 43, S-123 42 Farsta, Sweden.

Join us again next month as we span the globe looking for additional incentives to make those new contacts worthwhile. Continue to forward award information as it becomes available. Perhaps your own radio club sponsors an awards program. Why not share it with our readers worldwide?

Contests

from page 35

GARDEN CITY CONTEST
Starts: 1200 GMT December 8
Ends: 1159 GMT December 9

The Visvesvaraya Industrial and Technological Museum, Bangalore, and the Bangalore Amateur Radio Club cordially invite all amateurs to participate in the VU2DX Contest. There will be two groups of operation, with one group operating both 20 and 40 meters and the other group operating only 40 meters. Log sheets regardless of score will be of definite interest to all concerned along with any photographs of the shack and contestants. The contest is open to all amateurs but restricted to CW only and single operators. The station must be manned by the individual amateur contesting without receiving any assistance from any other persons for log-keeping or spotting, etc., during the entire period of the contest. Stations may be worked once per band and valid points can be scored by contacting stations not in the contest provided complete RST exchanges are made and logged.

EXCHANGE:

RST and serial QSO number in three digits or more.

SCORING:

Each completed QSO counts 1 point with the following multipliers: VU station contacting Asia = multiplier of 1, contacting Europe, Africa, and Australia = multiplier of 2, and contacting North and South America = multiplier of 3.

ENTRIES AND AWARDS:

All entries to the contest must be postmarked no later than December 31st and sent to: The Convenor, Garden City Contest 1979, Visvesvaraya Industrial and Technological Museum, Kasurba Road, Bangalore 560 001, India. There is no entry fee and the entries must be a true copy of the actual log for the contest period. All DX stations who contact 20 or more VU2 stations will be issued a "Garden City Certificate."

TEENAGE RADIO SPRINT
Starts: 0000 GMT December 22
Ends: 2400 GMT December 23

Sponsored by the Twin City Teenage DX Club, the contest's purpose is to promote teenage amateur operators and to help friendship with other teenagers. All hams over 21 years of age must work only stations under 21 years of age. Stations under 21 may work all stations. To show under 21, put "/T" after your callsign. General call will be "CQ TNGE TEST."

EXCHANGE:

RS(T) and age; if over 21 and you don't want to send your age, simply send xx in place of the age.

SCORING:

Score 2 points per QSO in one's own country, 4 points for all DX QSOs. Double QSO points (4 and 8 points) for QSOs on 160, 80, or 40 meters. Multiplier is number of different prefixes worked on each band and mode. No crossband contacts except via OSCAR.

FREQUENCIES:

CW—40 to 60 kHz up from bottom of band, 10 kHz up for Novice.

SSB—near or around 3975, 7275, 14275, 21375, 28575.

6 and 2 meters may also be used.

ENTRIES AND AWARDS:

Awards will be given depending on the activity! Entry classes include single-operator, all band; multi-operator, single transmitter; and multi-multi. Also, special classes for CW only, SSB only, or mixed. A summary sheet is requested and a sheet with scoring and contact totals along with the usual contest information signed by the operator is requested. All logs must be sent to Greg Deuhs KBØCV, 1945 Ashland Avenue, St. Paul MN 55104.

12TH AUSTRALIAN JAMBOREE
December 29, 1979—
January 7, 1980

The vast distances and small potential of people power do not deter Western Australians from thinking big. Although covering one third of the Australian continent, making it the biggest state in the world, the West has only 8% of its population at about 1.2 million people.

1979 is the state sesquicentenary (150th anniversary) year, so many years ago the W. A. Scout Branch applied for the regular three yearly Australian Jamborees always previously held in the populous eastern seaboard states. This was agreed and the Jamboree becomes the final event in a year-long birthday party embracing the whole population from all towns, utilizing all activities which could be imagined.

World Scout Bureau gave it regional status as the 4th Asia-Pacific Jamboree. Subsequently, with the postponement of the 1979 World Jamboree in Teheran, Iran, it became one of the 1979 World Jamboree Year Camps. About 8000 scouts from eastern states and over 1000 from 30 overseas countries will mix with 2000 locals for eight days of camping, activities, sight-seeing, shopping, trying new skills, fraternization, and fun.

Because amateur radio amplifies many of these Jamboree concepts, e.g., new skills, fraternization, and fun, local amateurs are preparing one of the biggest VK6 stations ever mounted. Facilities will include:

- a high-frequency station on 20 or 15 meters operating round the clock beaming the world, including eastern states;
- a high-frequency station on 15 or 10 meters operating all day beaming eastern capitals;
- a high-frequency station on 40 or 80 meters operating as required with dipole aerials favoring north/south;

Results

RESULTS OF 1978 TOPS CONTEST

Winner was HA5NP—Robert Soket of Budapest, Hungary
No. of contacts—549 Number of points—1014
No. of prefixes—115 Total score—116,610
FT-250 at 200 Watts

Second was HA9RU—Janos Pokker of Miskde, Hungary
No. of contacts—480 Number of points—851
No. of prefixes—130 Total score—110,630
FT-250 at 200 Watts

Third was YU1OCV—Vojislav Kapun of Kikinda, Yugoslavia
No. of contacts—386 Number of points—810
No. of prefixes—118 Total score—95,580
FT-200 and amplifier at 500 Watts

•a RTTY station operating most of the time as signals are available;
•amateur TV F/S on UHF with special receivers located in subcamp fraternity areas;
•three or more VHF stations on 2 meters and 6 meters and perhaps other bands; and
•a workshop where, under the supervision of amateurs, the scouts will be able to build a simple electronic working project.

In addition, a broadcast band radio station on 1610 kHz is in preparation so that items of news, happenings, instruction, and music can be conveyed quickly to all scouts for their entertainment.

It is expected that the stations will be busy with amateurs in contact and that the special Jamboree Badge QSL Card will be in demand. It is hoped also that scout groups and units with radio amateur capabilities or friends will make a special time to get together during the Jamboree to make contact. Further, it is expected that many groups around the world will want to make contact to find out how the Jamboree and their particular people are progressing. To assist these contacts, skeds will be accepted for a particular frequency, date, and time. Mail to: Scout Amateur Radio VK6SH, 12th Australian Jamboree, Box 467 P.O., West Perth, Western Australia 6005.

To test propagation conditions as far as it is possible, all skeds will be acknowledged by trying all contacts with one of the VK6 amateurs on the organizing team exactly four weeks to the day and hour on which the contact is asked for. If that sked does not work, another will be tried a week later—three weeks from the Jamboree. The sooner that skeds are requested, the better can the arrangements be.

The Jamboree is being held at Perry Lakes Stadium and associated grasslands—an international track and field site established for the Empire Games in Perth in 1962. The radio station is to be sited on the top floor of the stadium building using most of an area 250 feet long by 11 feet wide.

For further information, contact: (Jamboree) Mr. Alex Shaw, The Scout Association of Australia (W. A. Branch), Box 467 P.O., West Perth, W. A. 6005, phone 321-7217 (Mr. Doug Napier); or (Radio) Mr. Peter Hughes, Asst. Branch Commissioner, 58 Preston Street, Como, W. A. 6152, phone 367-1740 (mornings 364-7588).

CANADIAN CHRISTMAS QSO PARTY

Starts: 0001 GMT Saturday, December 30
Ends: 2359 GMT Saturday, December 30

This contest is sponsored by the Canadian Amateur Radio Federation and is open to all amateurs. Everybody may work everybody on all bands, 160-2 meters, CW and phone combined. Entry classes are single-operator allband and single-operator single band.

EXCHANGE:

Exchange signal reports and consecutive serial numbers, e.g., 599001. VE1 stations also send province.

SCORING:

Stations may be worked twice on each band, once on CW and once on phone. Score 10 points for each contact with Canada, 1 point for contacts with others. Multipliers are the number of Canadian provinces and territories worked on each band and mode (12 provinces/territories times 8 bands times 2 modes for a maximum of 192).

FREQUENCIES:

CW—1810, 3525, 7025, 14025, 21025, 50100, 144100 kHz.

Phone—1810, 3770, 3900, 7090, 7230, 14150, 14300, 21200, 21400, 28400, 28600, 50100, 146520 kHz. Suggest phone on the even hours GMT, CW on the odd hours.

ENTRIES:

Entries, with dupe sheets and summary sheet, must be mailed by January 31, 1980, to CARF, Box 76752, Vancouver BC, Canada V5R 5S7.

OOPS

Hope we didn't cause any problems, but there was a slight typo error in the September contest calendar write-up on the 89'ers Run. Certificate applications should go to WB5YKD and not WB5TKD as listed.

W2NSD/1
NEVER SAY DIE
editorial by Wayne Green

from page 6

emissaries a few minutes before a net is scheduled to open. They can get on, check around, and, if the net frequency is in use, find a spot for the users to move, if they can be coaxed into it. Most hams are like me, they will do almost anything for you if you ask nicely . . . and will fight to the death if told what to do.

If the chaps are obstinate . . . or if one of the net people trying to get a clear channel is less than diplomatic, there should be an understanding that the net can move up or down a few kilohertz to keep peace in the family. Blessed are the peacemakers for they are the first to get killed when war starts.

FINDING THE JAMMERS

Little has been written or even done about trying to find the jammers. We are a whole generation behind in working on the problem. The FCC and other agencies have gone years beyond us in the design of sophisticated equipment for searching out jammers . . . while we are still out waving loop antennas around, chasing off in the opposite direction at top speed.

I've heard that the FCC is able to get a fix on a jammer within one or two seconds . . . or is it milliseconds? As I've mentioned before, I'd sure like to have some articles in *73* on how to build some modern DF equipment. The Happy Flyers in California have run up an impressive record of tracking down repeater kerchunkers and jammers by plane, but I should think that we might be able to go beyond that before long.

We could use articles on techniques for identifying stations by looking at their keying patterns. This means freezing the leading edge of a kerchunk and looking at it on a scope. I understand that every rig may have its own identifiable pattern. We want to know more about triangulation via receiving both the signal on the repeater input frequency and the repeater output. If pairs, or more, of operators could get a net going to do instant triangulation, that might be worthwhile. Let's start tackling this.

AFTER YOU FIND 'EM

In most cases, a ham will shut up once he knows he's been discovered. In those cases where the ham is blatant about it, stronger measures are needed. I've heard that massive visits from concerned local amateurs can have a settling effect on strong-willed jammers. It is impressive when a hundred hams drive up and come to your door to reason with you . . . particularly if they have sticks in their hands.

There are a lot more articles needed on ways which have worked to calm down hard-core jammer cases. I doubt if broken arms are necessary—just some powerful reasoning.

THE WORST WAY

Amateur radio has a reputation of being self-regulating. We try, as much as the FCC will permit, to generate our own rules and we have an enviable record of sticking to them. I can't think of a case yet where FCC-generated rules have been nearly as well suited to our work as our own rules. Amateurs are very considerate of each other, most of the time, and tend to go overboard in the protection of special interests more than in putting them down.

So, in view of this image of self-regulation, every time we turn crying to the FCC over some interference problem, we are hurting our image with the outfit where our image is the most important. We should move heaven and Earth to handle our own problems and not keep calling up the FCC every time some idiot lets loose.

WHAT'S NEXT?

Until we get a lot more information on direction-finding and have a few dozen stations set up for instant fixes, there isn't much we can do. Swinging a three-element 20m beam is hardly the way to try to locate some idiot in Nebraska who is raising hell with hurricane communications. We need to be able to pinpoint the trouble quickly and have things organized enough so we can get in touch with a net in the specific area which can get action.

Clubs which get set up to participate in direction-finding can let me know and I'll try to run a list so other groups will know whom to contact when a problem arises. I should get contact call letters and phone numbers, together with some idea of the bands which can be DFed, etc.

Let's get going on this . . . with articles and organization.

COOL THE HAMFESTS

The *QST* editorial suggesting that hamfests be cut back sure wasn't given much thought before being put to paper. Sure, there are major problems for some of the ARRL conventions . . . there have been real bummers. But this doesn't mean there is anything wrong with hamfests. The Milwaukee Central Division Convention, after two solid years of planning and work, featuring Harry Dannals as speaker, brought in eight exhibitors and a crushing

400 in attendance. The National, in Baton Rouge, also featuring Harry, was another disaster.

Let's compare that with the first-time hamfest in St. Louis (boycotted by the ARRL) which drew about 2,500. There were over 1,500 put to sleep by my talk alone. This year, the St. Louis crowd is loaded for bear . . . they've rented the largest riverboat on the Mississippi for the banquet . . . seven decks and a capacity of 3,500 . . . two orchestras . . . and some entertainment by Wayne Green. I understand that there is a possibility that Arthur Godfrey may be able to make it . . . he's been sick lately, so we don't know yet. And there will be a lot more entertainment.

You may be sure that every exhibitor from last year will be back . . . they cleaned up from the money-waving crowds. I predict there will be many more ham and computer dealers and manufacturers exhibiting this time.

The fellows down in Maryland are cooking up a big event for the spring . . . again featuring me. Why do I draw crowds? Well, I say exactly what I think about things . . . and I'm able to say a lot at talks like this that I would never be able to print. Perhaps I go too far sometimes and say things, which, though true, shouldn't be let out of the bag.

A lot of people come to see what Wayne Green is really like . . . since I aggravate the hell out of them in my editorials . . . and they usually find that after 40 years around this hobby and 27 years of publishing, I really do know what I'm talking about.

No, there's nothing wrong with hamfests except the stifling effect of the League trying to keep the truth from getting out. Boy, do those fellows remind me of the Kremlin!

WHAT'S DOING AT 73?

With the ham field in the doldrums, we're not indulging in many expansion plans for *73*. It is doing well, obviously, but the growth is mainly in the microcomputing end of things. *Kilobaud MICROCOMPUTING* has been growing steadily. We have a new magazine, *80-MICROCOMPUTING*, for the TRS-80 owners, starting in January (out before then). The *Industry Newsletter* has grown into a magazine of its own . . . now pushing 60 pages a month, and with no end in sight. The Instant Software publishing is now perking along, with over 100 program packages already in publication and a couple thousand in various stages of production. Since this division has only been in serious production since the first of the year . . . and since it takes about six months to process and publish a program, the project is doing surprisingly well.

Instant Software is now being distributed all through Europe, in several hundred outlets in the US, in South Africa . . . and will soon be distributed in Asia. It's going in Australia and is getting started in South and Central America. Programs are being produced in German, Italian, French, Spanish, and even English.

A headquarters building and the seed staff for still another magazine has been organized in Boston. This will be a magazine devoted to leisure in that area. If it works well, it might expand to similar magazines for other cities, just as the New York, Philadelphia, and Boston magazines have proliferated. This is scheduled to kick off early next spring.

Having had dozens of hobbies and interests, the leisure magazine idea seemed a natural to me. I've been heavily into horseback riding and horse training, flying, skin diving, skiing, gourmet cooking, sports car rallies and gymkhanas, boating, water skiing, mountain climbing, hamming, hobby computers, car racing, spelunking, restauranting, and more things which don't come to mind immediately, so what better than to do a magazine about all of the activities which are possible in and around greater Boston? It will be fun.

DECEPTIVE ADVERTISING?

Every time I see an ad for the Little Giant antenna in *Ham Radio Magazine*, I laugh. From my viewpoint, this piece of garbage is a pure rip-off and I feel that no reputable publisher should accept an ad for it.

In addition to knowing enough antenna theory to recognize that the contraption is useless, I've also tested the silly thing. It first popped up around 1958 when I published an ad for it. I got in touch with the "inventor," a very nice chap, Stan Byquist . . . K0AST, I think was his call. I looked over his literature and tried to figure out some way . . . any way . . . that it could be more effective than a piece of window screen. I failed, so I got Stan to send me one.

Sure, I could tune it up . . . heck, you can make almost anything load . . . but it was no more effective than an old window screen. Stan said he was getting good results . . . but when he said he had to keep the feedline away from his tower to get good reports, I knew what was happening . . . it was the feedline which was radiating and the intricate (and expensive) lump on top was a weird loading coil, in effect.

I talked it over with Sam Harris W1FZJ and he agreed. But, just to make sure, he borrowed the kludge and tried it every way possible . . . he felt that it was *inferior* to a window screen. I passed the bad news along to Stan and told him we would accept no more advertising. A short while later, I noticed an order from Stan for an 8JK antenna handbook coming in to Radio Bookshop. I hope Stan read the book . . . but I somehow doubt it.

By 1960, Stan had moved to Ohio as K8VRM and had put aside his Little Giant antenna (oh, I forgot to mention . . . that was my idea for the name of the dumb thing). He took on *73 Magazine* as a rep for the Ohio area and did a bang-up job of getting sales with electronics stores. Stan is a very nice guy and did a great job as a rep.

In the 60s, he got involved with hardware for CBers . . . switches, power meters, etc. Then, for some reason, the Little Giant got going again and I see ads for it in *Ham Radio* every now and then. I've talked with 'em at *HR*, so they know the antenna doesn't work. Perhaps they feel that the ad, which says that the antenna "may not outperform a full-sized beam," is warning enough to the wise. That is a true statement. I would not expect the antenna to outperform a full-sized beam, even if it were lying broken on the ground.

Shouldn't there be some responsibility on the part of publishers to protect the unwise from being sucked in on bummers? I have a whole list of firms which I won't permit to advertise in *73* . . . though most of them have gone back into the woodwork. I haven't seen a Dycomm ad in a while. And we shut down ads for EBC, Ebka, Processor Tech, Swivitek, Valpey Fisher, SAROC, etc.

The ARRL makes a stab at trying to protect the *QST* readers, but they permit rip-off advertisers that I would never let run. I do enjoy their bragging about what few they do avoid.

Let me repeat something I keep repeating: If you feel ripped off over any ham gear, please let me know the details. I prefer you write a letter to the perpetrator with all details and send a copy to me.

1980 ASPEN CONFERENCE

Ham manufacturers are always looking for some new concept which might permit them to bring out ham equipment which would make all past rigs obsolete, thereby triggering a massive buying of new equipment. Since we're talking about something on the order of $1 billion or more in sales, this is not to be treated lightly.

Oddly enough, hams, too, are looking for exactly the same thing . . . something new. It is fun to buy a new rig, but the expense is a major one and not to be made unless there is a darned good reason.

I think I have two breakthrough ideas which together could make all existing rigs completely obsolete . . . and that includes both low-band gear and FM equipment! It will be possible to use these new modes of operating with add-on units for starters, but I suspect that most amateurs will want to opt for equipment with these new modes built right in. These concepts will, I think, make it possible for us to see profound changes in amateur radio over the next few years.

The first public unveiling of these ideas will be at the Aspen Ham Industry Conference, January 12-19th. The admission fee will be a signed non-disclosure contract for one percent of the wholesale price of any equipment sold using the concepts I shall divulge.

It is too late now for us to make reservations for you, so if you are going to attend the conference (which includes a lot of skiing), you'll have to handle the reservations yourself. Please do let Sherry know if you are going to be there so we can include you in the activities and workshop session (Sherry Smythe, *73 Magazine*, Peterborough NH 03458). The main group will be staying at the Limelight, in downtown Aspen.

AUGUST WINNER

Amassing the largest total vote ever recorded in our Most Popular Article contest, "You Can Watch Those Secret TV Channels" walked away with August's award. Authors Jim Barber K0JB and Jevon Lieberg K0FQA will be splitting the $100 prize. If you have a favorite article in this issue, be sure to use the Reader Service card ballot to let us know what it is.

Ham Help

I need a schematic, manual, or data sheet on an Instrument Corporation of Florida very low frequency receiver, model R-500. This fixed-tuned 5-channel receiver was part of a Cubic Timing Systems network.

Harry A. Weber
2605 West 82nd Place
Chicago IL 60652

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	14	14A	21A	21
ARGENTINA	14	7A	7	7	7	7	14	21	21A	21A	21A	21
AUSTRALIA	21	14	7B	7B	7	7	7B	14	21	21	21	21A
CANAL ZONE	14	14	7	7	7	7	14	21	21A	21A	21A	21
ENGLAND	7	7	7	7	7	7B	14	21A	21A	21	14B	7
HAWAII	21	14	7B	7	7	7	7	7	14	21	21A	21A
INDIA	7	7	7B	7B	7B	7B	14	14A	14	7B	7B	7
JAPAN	14A	14	7B	7B	7	7	7	7B	7B	7B	7B	14
MEXICO	14	14	7	7	7	7	7	14	21A	21A	21A	21
PHILIPPINES	14A	14B	7B	7B	7B	7B	7	7	7B	7B	7B	14
PUERTO RICO	14	7	7	7	7	7	14	21	21A	21A	21	14
SOUTH AFRICA	14	7B	7	7	7B	14	21	21A	21A	21A	21	21
U.S.S.R.	7	7	7	7	7	7B	14	21A	14	7B	7B	7
WEST COAST	21	14	7	7	7	7	7	14	21A	21A	21A	21A

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	7	7	7	7	7	7	14	21	21	21A
ARGENTINA	21	14	7A	7	7	7	14	21	21	21A	21A	21A
AUSTRALIA	21A	14	14B	7B	7	7	7B	7B	14	21	21	21A
CANAL ZONE	21	14	7A	7	7	7	14	21	21A	21A	21A	21A
ENGLAND	7	7	7	7	7	7B	7B	14	21A	21	14B	7B
HAWAII	21A	14	14B	7	7	7	7	7	14	21	21A	21A
INDIA	7	7	7B	7B	7B	7B	7B	14	14	7B	7B	7B
JAPAN	21	14	7B	7B	7	7	7	7	7B	7B	7B	14A
MEXICO	14	14	7	7	7	7	7	14	21	21A	21A	21
PHILIPPINES	21	14	7B	7B	7B	7B	7	7	7	7B	7B	14
PUERTO RICO	14	14	7	7	7	7	14	21	21A	21A	21A	21
SOUTH AFRICA	14	7B	7	7	7B	7B	14	21	21A	21A	21	21
U.S.S.R.	7	7	7	7	7	7B	7A	14A	14	7B	7B	7B

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	7	7	7	7	7	7	7	14	21	21A
ARGENTINA	21	14	14	7A	7	7	7B	14	21	21A	21A	21A
AUSTRALIA	21A	21	14A	7B	7	7	7B	7B	14	21	21	21A
CANAL ZONE	21	14	7A	7	7	7	7	14	21A	21A	21A	21A
ENGLAND	7B	7	7	7	7	7B	7B	14B	21A	21	14B	7B
HAWAII	21A	21	14	7A	7	7	7	7	14	21	21A	21A
INDIA	14	14	14B	7B	7B	7B	7B	7	7	7B	7B	7B
JAPAN	21A	14A	14B	7B	7	7	7	7	7	7B	14	21A
MEXICO	21	14	7	7	7	7	7	14	21	21A	21A	21
PHILIPPINES	21A	21	14B	7B	7B	7B	7B	7	7	14B	14B	21
PUERTO RICO	21	14	7	7	7	7	7	14	21A	21A	21A	21
SOUTH AFRICA	21	14B	7	7	7B	7B	7B	14	21	21A	21	21
U.S.S.R.	7B	7	7	7	7	7B	7B	7B	14	7B	7B	7B
EAST COAST	21	14	7	7	7	7	7	14	21A	21A	21A	21A

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor
SF = Chance of solar flares

december

sun	mon	tue	wed	thu	fri	sat
						1 F
2 G	3 G	4 G	5 G	6 G	7 G	8 G
9 F	10 F	11 G	12 G/SF	13 F/SF	14 P/SF	15 F
16 G	17 G	18 F	19 G	20 G	21 G	22 G
23 30 G/G	24 31 G/G	25 G	26 G	27 F/SF	28 P/SF	29 G